MINISTRY OF DEFENCE

REVIEW OF UNITED KINGDOM MILITARY HELICOPTER LOW FLYING IN RESPONSE TO A RULE 43 LETTER FROM THE LOUTH AND SPILSBY CORONER

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EXECUTIVE SUMMARY

This review has been conducted by the Directorate of Air Staff (DAS) in response to a Rule 43 letter that made nine Recommendations about helicopter low flying training. The review considers the need for military helicopter low flying, and quantifies the scale and scope of training requirements for each helicopter type. Accurate patterns of helicopter activity are identified. Current and future levels of simulations are considered together with other means of mitigating the effects of helicopter low flying.

The need for tactical training is not in doubt and has been proved conclusively during recent conflicts. The activity with the most potential to cause disturbance to the public is tactical helicopter training that covers a variety of activities and is conducted by Battlefield, Naval, Search and Rescue and Training helicopters. A thorough examination of the various training syllabi has quantified the minimum levels of training necessary for operational readiness, and these levels cannot be reduced further without detriment to operational readiness. Much tactical training is conducted within existing Dedicated User Areas (DUA), but already high usage rates mean that these areas are at saturation level, and some training must be conducted in other parts of the UK Low Flying System (UKLFS). Because of the limited range and performance associated with helicopters, to maintain a high level of training efficiency, as much of the necessary training as possible is conducted close to main operating bases, and therefore a regular pattern of activity can be identified within low flying areas adjacent or close to DUAs. Patterns of activity within these routine training areas are well established, and the public is accustomed to the activity. Consequently, training that is likely to cause most disruption to the public is the small amount of tactical training that is conducted outside DUAs and routine training areas.

To ensure the minimum effects of this training on the public, there must be tight control of both supervision and authorization of flying, and procedures have been put in place to ensure that a fully auditable trail of the conduct and justification of these activities is available. To mitigate the effects of this training, more information must be given to the public as a matter of routine, and specifically when 'unusual activity' is planned. It is therefore proposed that routinely-used training areas are designated as Helicopter Training Areas (HTAs), to define the limited geographic area in which routine training occurs, thereby enabling better information to be made available to the public. Outside DUAs and the newly created HTAs, two measures are suggested to increase the accuracy of information available to the public. Firstly, a requirement for all exercises, both fixed and rotary wing, will be the production of a Public Relations plan to cover the intended activities that will be approved by the Ministry of Defence (MOD) Press Office before authority to use the required airspace is given. Secondly, it is proposed that for helicopter tactical low flying training outside DUAs and HTAs, information about routes or areas of activity is made a mandatory part of low level booking procedures. This latter proposal will only affect approximately 5-10% of all tactical flying and therefore is not onerous. However, it will ensure that the least frequent training activities that

have the greatest potential for intrusion are properly publicised to enable more informed decisions to be made by members of the public.

A detailed examination of existing simulation shows that a high level of use is made of the synthetic environment, and available training is under constant development, not only to improve the quality of existing synthetic training, but also to introduce new synthetic training activities that will further reduce the need for live flying. Exporting helicopter low level training as a measure to reduce the impact of low flying is carefully considered, and it is evident that where possible, helicopters participate in training exercises overseas. However, increasing the amount of overseas training brings considerable cost implications if air transportation is necessary, and sea transportation, whilst less expensive, generates significant issues of aircraft availability and therefore the ability of MOD to meet National contingency commitments.

Trial BRIGHT EYES was conducted by the Rotary Wing Operational Evaluation and Training Unit (RWOETU) to investigate measures to increase visual detection of horse riders, as technical solutions using either Radio Frequency or Infra-Red devices do not offer a workable solution. The largest single factor that offers an improvement to rider safety would be the increased use of high visibility clothing that enables visual identification from the air at significantly improved ranges. This positive safety message will be taken into the riding community in a joint MOD and British Horse Society (BHS) safety initiative following release of this Review.

A number of recommendations were made to improve the ease of investigation of any incident that a future Inquest may have to consider. Procedures used by the Defence Flying Complaints Investigation Team have been thoroughly revised and new protocols introduced. The data-recording capability of all military aircraft has been established in conjunction with QinetiQ, Boscombe Down. Consideration will be given to introducing extended voice recording capability on new helicopter designs, or for upgrades to existing helicopters, but where currently fitted, voice recording capability meets Civilian Aviation Authority (CAA) standards. It is not considered practical or necessary to introduce cockpit video recorders as more accurate information for investigative purposes is already available from aircraft data recorders. Finally, there is no operational requirement to change the existing arrangement for Chinook radio altimeter warnings.

The avoidance area afforded to Middle Rasen will be retained as a mark of respect for the Bell family for helicopters only, and will be reviewed in 2009.

The major area in which improvement can be made is in communication with the public. The measures outlined above will enable MOD to provide far more accurate information on the pattern of helicopter training activity, and will ensure that unusual activity that takes place outside routine training areas is properly communicated to the public. This will significantly increase the utility of the free-phone advisory service and enable the public to make better informed decisions on any intended riding activity. A number of local initiatives are already in progress, and ‘best practice’ has been shared with all helicopter units. The reception of local initiatives is often initially hostile, but perseverance has demonstrated categorically that a very positive outcome can be achieved with local authorities and groups representing country activities. A very positive relationship between MOD and the BHS has been established to take joint safety initiatives forward, and following publication of this Review of helicopter low flying training, joint public relations action will ensure the widest publicity is given to this issue.

INTRODUCTION

1. This Review of United Kingdom military helicopter low flying has been conducted by DAS in response to a Rule 43 letter[1] sent to the Assistant Chief of the Air Staff (ACAS) by the Louth and Spilsby Coroner following the death of Mrs Heather Bell in a horse-riding accident in 2003. A low flying Chinook helicopter conducting tactical low flying training was deemed to have caused Mrs Bell's horse to spook, causing a subsequent accident that inflicted fatal head injuries. The Louth and Spilsby Coroner made nine Recommendations to ACAS, and the purpose of this report is to provide a comprehensive response to these Recommendations.

2. This report is laid out in a format where each of the Coroner's Recommendations is dealt with in turn. Each recommendation is listed in full, and subsequently discussed in detail. Conclusions are drawn where appropriate in the text. Finally, a summary of future military helicopter tactical low level training is given. The report contains a considerable level of detail to support the arguments and conclusions, and provides a robust and enduring case to support helicopter low level training activities. Data used within the report represents a 'snapshot' at the time of compilation, and these data will invariably vary over time due to changes in training syllabi, operational deployments, aircraft availability and other similar factors.

TERMS OF REFERENCE

3. The Terms of Reference tasked the review group to address five main areas of helicopter training as follows:

- To consider the need for military helicopter low flying set against Defence Strategic Guidance.

- In consultation with primary responsible Commanders, to quantify in detail the scale, scope and future training requirements for each helicopter type.

- In consultation with primary responsible Commanders, to conduct data gathering using a Helicopter Low Level Record of Flight to identify accurate patterns of helicopter activity outside Helicopter Dedicated User Areas.

- In consultation with primary responsible Commanders, to identify the level of simulator use within current annual operational training, operational conversion and helicopter flying training syllabi; to identify the limitations of existing simulation, and to identify the potential for increased future usage.

- In consultation with primary responsible Commanders, to consider mitigation measures to limit the impact of military helicopter low flying on the public whilst retaining a sustainable operational training regime.

[1] SPGF/PD/BELL dated 4 November 2004.

SCOPE

4. The purpose of this Review is to examine the current pattern of helicopter low level training to assess whether the Recommendations made by the Coroner can be implemented, or to provide a full and robust justification for the continuation of training activities as they are currently conducted. The scope of the Review is therefore wide-ranging, and has been conducted by a stakeholder group representing all United Kingdom (UK) military helicopter operators under the chairmanship of DAS Lower Airspace.

DEFINITION OF TERMS

5. There are a wide variety of helicopters in current use, and they conduct a range of operational and training activities. The following terms have been used throughout the report for consistency:

- Operational Helicopters. Operational helicopters are those helicopters that are or can be tasked with the conduct of operational missions and can be divided into maritime and battlefield helicopters.

  -- Maritime Helicopters. Maritime Helicopters (MH) are those helicopters that are operated primarily from the sea in support of maritime operations. However, they may also be used in support of the land battle[2].

  -- Battlefield Helicopters. Battlefield Helicopters (BH) are those helicopters that are operated in either direct or indirect support of the land battle. They may also be operated from the sea when embarked on major surface vessels.

- Search and Rescue Helicopters. Search and Rescue Helicopters (SARH) are those helicopters that conduct Search and rescue duties within the United Kingdom (UK).

- Training Helicopters. Training Helicopters (TH) are those helicopters dedicated to training duties that do not have an operational role.

- Helicopter Low Flying. The definition of helicopter ***low flying*** used throughout this report is flight by helicopters between 100 and 500 ft Above Ground Level (AGL).

- Helicopter Tactical Low Flying. The definition of helicopter ***tactical low flying*** used throughout this report is flight by helicopters between the surface and 100 ft AGL.

[2] During Op TELIC the Sea King Mk7 ASaC was utilised during the assault of the Al Faw peninsular.

RECOMMENDATION ONE: REDUCTION OF THE AREA IN WHICH LOW FLYING HELICOPTER TRAINING TAKES PLACE WITHIN THE UNITED KINGDOM

Currently, the whole of the UK open air space is available for "Low Flying Training in Helicopters" (hereafter referred to as "LFTH").

Prior to 1979, only forty percent of the UK air space was available for LFTH. As I understand the position, pre 1979 the majority of LFTH took place in sparsely populated rural areas.

I believe that there is an immediate need for you to revert to the Policy which existed pre-1979.

If LFTH is concentrated in restricted, sparsely populated areas of the UK then I believe that the general risk to the public will reduce accordingly. Both livestock and humans should become familiar with the impact of LFTH (similar to those living in the flight path of major airports) which should also ameliorate the risk to the public.

It is accepted that helicopter crews will have to train in a more restricted air space and will inevitably become familiar with the terrain in the UK. This, I am afraid, is the price that has to be paid for reducing the risk to the public.

If this recommendation were to be implemented then the loss of air space available for LFTH in the UK could, in part, be made up by exporting a significant proportion of the LFTH overseas.

I was informed by a representative of the Health and Safety Executive that there is already a ministerial edict that sixty percent of fast jet operational training (between 250 feet and 100 feet) is undertaken overseas – much of it in remote areas of Canada.

When Air Commodore Garwood gave evidence he objected to the suggestion that LFTH should be exported. He stated that to do so would be both costly and time consuming. It seems to me that if you have succeeded in exporting low fly jet training then surely it has to be possible to export, at least, a proportion of LFTH.

There must be a vast number of sparsely populated areas in Scandinavia, USA, Canada, Australia etc. where LFTH could take place without any UK resident being at risk of death.

I was also informed that a great deal of current LFTH occurs in Dedicated User Areas. The capacity for increasing LFTH in such areas needs to be explored.

6. In response to this Recommendation, a full and very detailed examination of helicopter low-level training has been conducted to establish the requirement for helicopter low-level training together with the type, nature and conduct of this required training. In addition, helicopter low-level training sorties over a three month period have been analyzed to determine patterns of activity and airspace requirements necessary to support the required training profiles. This data will be discussed during consideration of low flying training area requirements. The guidance for this review is MOD's continuing policy that operational efficiency must be maintained, whilst achieving a proper balance in conducting the minimum training necessary to achieve the required level of efficiency.

THE OPERATIONAL IMPERATIVE FOR LOW LEVEL HELICOPTER MISSIONS

7. All operational helicopters share a common mission profile: they will depart from an operating base (whether this is on land or at sea), navigate to an objective area, deliver the required effect (whether this is direct fire, fire support, surveillance or support to ground or other forces), and then return to their operating base. To conduct this mission profile, four primary factors must be considered: the threat faced by the helicopter; the requirement for tactical surprise; the requirement for safe separation from other air platforms (both piloted and remotely piloted vehicles) and fire missions from both artillery and other aircraft, and the prevailing weather.

a. The Threat. Helicopters are comparatively slow and generally not armoured. Consequently, these aircraft are vulnerable to all types of hostile fire. Recent conflicts on land in Afghanistan and Iraq have perhaps seen a reduction in the threat from integrated air-defence systems operating comprehensive layers of sophisticated Surface to Air Missiles (SAM) and fighter aircraft. However, small arms, rocket-propelled grenades, anti-aircraft artillery and man-portable shoulder-mounted SAMs are available to irregular or insurgent forces in considerable quantities and these simple weapons are highly effective against helicopters. With the increasing move into the littoral, MH are faced with a similarly diverse threat. Consequently, all operational helicopters must minimize their exposure to weapons systems of every type by either concealing the aircraft as much as possible using either terrain or man-made features when operating over-land, and if engaged over-land or over-sea, being able to manoeuvre rapidly and with agility to defeat simpler unguided weapons, and to maximise the protection of on-board defensive systems against more sophisticated SAMs. The potency of these threats is clearly indicated by the loss of 15 United States Army helicopters during Operation Iraqi Freedom[3].

b. The Requirement for Tactical Surprise. Threats to helicopters operating over-land exist from opportunity encounters en-route to their objective area, and the high level of threat in the objective area itself. Tactical surprise is therefore of considerable importance as this will reduce the opportunity for engagement by hostile forces, and low-level profiles may be used throughout the duration of the mission.

c. Separation from Air Platforms and Fire Missions. To maximise the use of airspace to conduct effective operations, different users of the airspace are generally assigned differing height levels to ensure deconfliction. The nature of helicopter operations and their differing performance characteristics compared to fast-jet aircraft and Unmanned Air Vehicles (UAVs) invariably results in helicopters being assigned the lowest levels available when airspace controls are implemented.

d. Weather. Poor weather can provide some benefit to helicopter operations as reduced visibility and precipitation from low cloud will decrease the acquisition ranges for both visual and infra-red weapons systems, delaying detection and limiting the time available for engagement. Nonetheless, unlike fast-jet aircraft that may be

[3] Aviation Today: available from www.aviationtoday.com accessed 24 May 05.

equipped with terrain-following radar or other devices to enable 'all-weather' operations, BH are primarily designed to operate in an environment where they have visual contact with the ground, and this requirement also increases the necessity to be able to operate at very low altitudes. Additionally, many helicopters only have limited protection against in-flight icing conditions, and when these conditions are encountered, must reduce height to maintain visual flight conditions clear of precipitation[4].

Conclusion One: The Operational Imperative. The threat faced by helicopters, their vulnerability due to speed and manoeuvre limitations, the need for surprise, the requirement for separation from other air platforms and the requirement to operate in marginal weather conditions all strongly support the imperative for helicopters to operate at very low altitudes. Typically therefore, in an operational theatre, helicopters will operate overland as close to the ground as possible depending on the task and the prevailing conditions.

HELICOPTER LOW LEVEL TRAINING REQUIREMENTS

8. The Helicopter Training Imperative. The above factors imply that a set of competencies are required by aircrews to operate effectively over-land and over-sea, by both day and by night. These competencies comprise the skill sets that are necessary to ensure that helicopters are able to operate at relatively high speeds down to ground level, whilst being able to navigate accurately and retain situational awareness; assess the terrain and the optimum height to fly to neutralise the threat; and avoid collision with physical hazards or other aircraft in a formation. The low level environment is most demanding, requiring unique skills that are complex and highly perishable. The acquisition of these competencies is demanding, requiring significant training and constant maintenance. The challenge faced is to find a balance that ensures crews conduct sufficient realistic training to maintain the necessary proficiency to allow deployment to an operational theatre without significant delay to conduct additional training, whilst minimizing the impact of this training on the general public. UK military helicopters are held at varying states of readiness to meet National responses to crises both in the UK and overseas.

9. Helicopter Training. Operational helicopters are operated by all three services, but are functionally grouped under the Royal Navy (RN) and Joint Helicopter Command (JHC) that includes the Commando Helicopter Force (CHF). Both the RN and the Royal Air Force (RAF) operate search and rescue helicopters, and initial and advanced helicopter training is undertaken by the Defence Helicopter Flying School (DHFS) and the Army Air Corps (AAC), with conversion to type being conducted by Operational Conversion Units (OCUs). There are therefore a wide variety of training requirements, dependant on the role of the helicopter. These roles and requirements are discussed below. Prior to the start of this review, much BH training was conducted at tactical heights currently used during operations in Iraq and Afghanistan, and there is a clear supporting logic for this concept. However, this training can cause increased disturbance to the public. Following on from earlier MOD work that

[4] These restrictions are not unique to military helicopters, and civilian helicopters operating between the mainland and North Sea oil and gas rigs are often forced down to low altitudes due to icing conditions.

continuously assesses the balance between training requirements and operational readiness, and in response to the Recommendations made following the Bell Inquest, Commander JHC redefined how BH low level and tactical training should be conducted. JHC policy directs that BH low flying training is to be conducted at a minimum of 100 ft AGL, with tactical low flying training below 100 ft AGL being restricted to specific training requirements for clearly defined operational tasks[5]. This division between *low flying training* and *tactical low flying training* is an important for two reasons:

a. Reduction of Potential for Disturbance. The majority of helicopter *low flying training* has now been restricted to a minimum of 100 ft AGL. This height is an absolute minimum and not a target height to achieve, and therefore in practical terms, the helicopter will be flown above this height with a comfortable margin to ensure the minimum height is not breached. Whilst some disturbance will inevitably occur through low flying training at these heights, the level of intrusion of this activity on the public is lower than the potential impact of *tactical low flying training* that can be authorized down to 50 ft AGL, and for certain specific tasks such as the insertion of troops or the pick-up of under-slung loads, down to Ground Level.

b. Quantification of Training Requirements. By restricting *tactical low flying training* conducted below 100 ft AGL to training activities linked to operational tasks or specific training objectives, it has been possible to reduce, re-define and quantify the necessary level of these activities, further mitigating the overall effect of helicopter low flying.

10. The Current Use of Lower Airspace. Outside Controlled Airspace[6], lower airspace in the UK (Denoted Class G by the Civil Aviation Authority (CAA)) is available to both military and civilian aviation. The basic principle used within this airspace to prevent collision is 'see and be seen' however, height separation is also used to further separate traffic. The lowest level of this airspace is reserved for military helicopters, which are considered to be low flying when operating below 500 ft AGL. However, most military helicopter operations take place below 200 ft AGL. Military fast-jets are considered to be low flying when operating below 2000 ft AGL, with a minimum height of 250 ft AGL. Routinely, military fast-jets operate at low level between 250 - 500 ft AGL. Civilian aircraft and helicopters can operate down to 500 ft AGL away from any habitation, but most civilian light aviation operates at 1000 ft AGL and above. Therefore, whilst both military and civilian aircraft can operate at similar heights, in routine operations there is a degree of height separation, particularly separating military helicopters and military fast-jets. This review carefully considered the potential for raising the operating height for low flying military helicopters as a measure to reduce the potential impact of this activity. However, raising the height of low flying training for military helicopters above 200 ft AGL significantly reduces the training benefit as many of the techniques necessary for low level flying cannot be satisfactorily practiced at this height. Furthermore, raising the height at which military helicopters conduct low flying training would place them at increased risk of collision because of the conflict with military fast-jet low flying training. In addition, whilst it may be possible for the minimum heights for

[5] Cdr JHC Low Flying Policy Statement Feb 05.

[6] Controlled Airspace is dedicated airspace including airfield control zones and airways, where air traffic is strictly regulated by Air Traffic Control.

all users to be raised, in certain areas this could cause air traffic to be compressed, again increasing the risk of mid-air collision. Following a similar argument, in 2005 the CAA lowered the height at which civilian aircraft are permitted to operate over congested areas, noting that a 'powerful safety argument has been identified that, by increasing the depth of the layer of airspace available...the traffic density can be reduced and with it the risk of a mid-air collision over a residential area[7]'. Finally, the current use of the lower airspace has been established and refined over many years, and is safe, efficient, practical and fully understood by both civilian and military users. Attempting to change the pattern of current use could have considerable impact, potentially requiring a complete revision of the regulation of UK airspace in order to mitigate the increased risk of mid-air collision. Therefore, any potential benefit to be gained from increasing helicopter operating heights must be balanced against the detrimental effect on other lower airspace users, and therefore this option does not seem to be a viable proposition. Consequently, this review will not consider routine helicopter low level training in further detail, but rather will **focus on tactical low level training conducted below 100 ft AGL** as this is the training activity most likely to be intrusive to the public.

11. Dedicated User Areas (DUAs). Approximately half of all helicopter low level training is conducted within helicopter Dedicated User Areas (DUAs) that are set-aside for this purpose, with highly restricted access for other traffic. The available training area within the DUAs is 12,359 km^2 or 6.45% of the total UKLFS[8]. DUAs were first set up in 1979, with the aim of providing an area where helicopters can train close to their home bases, and offering two main advantages:

- the need to transit to more distant training areas is reduced, thereby increasing the proportion of airborne time available for effective training rather than transit flying to a more remote training area.

- the reduction in the requirement for transit flying reduces the impact of training on the public.

Within DUAs, the patterns and levels of activity have become established over 26 years, and the population within each DUA is accustomed to these training activities. Currently, **DUAs support 68% of all helicopter tactical training**. Unless the existing basing arrangements for helicopters are changed, these patterns and levels of activity should be retained as removing the facilities provided by DUAs would result in an increase in the number of flying hours required to achieve the same level of training; would increase the requirement for transit flying, and would increase the potential for disturbance to the public. Consequently, **this review will further refine its focus to tactical training outside DUAs**.

Conclusion 2: The existing geographical size and location of DUAs must be retained to ensure training efficiency, and maintaining the current level of helicopter training within these areas minimizes the potential for wider intrusion of these activities.

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[7] CAA Safety Regulation Group Ref 9/99/11/02/01 dated 19 May 2004.
[8] The available area of the entire UKLFS is 191 618 km^2.

12. Helicopter Tactical Training Requirements outside DUAs. The next two paragraphs identify the specific tactical training activities conducted by each helicopter type, and for each helicopter type, tactical training outside DUAs is indicated as a percentage of the total monthly training requirement. A more detailed breakdown of helicopter tactical training requirements outside DUAs showing the overall annual requirement is at Annex A.

13. Royal Navy (RN) Helicopter Tactical Training Requirements outside DUAs. The RN operates three types of helicopter: the Lynx, Merlin, and Sea King. In general, naval low flying is conducted at 200 feet AGL, with an absolute minimum of 100 ft AGL unless authorised by the appropriate Helicopter Force Commander[9]. This enables the force to maintain capabilities in Troop Insertion, Naval Fire Support, Search and Rescue, Casualty Evacuation, Lift and Maritime Counter-Terrorism. Apart from specific activities such as Confined Area Landings and Mountain/Cliff Winching, there is no routine requirement for RN helicopters to operate below 100 ft AGL. Given that such evolutions require a reconnaissance of the area before they are conducted, RN Tactical Training Requirements should have no adverse impact on either public or livestock.

14. Joint Helicopter Command Tactical Training Requirements outside DUAs. Joint Helicopter Command (JHC) is the operational helicopter command responsible for BH that provide support to Land Forces. Within JHC, the Commando Helicopter Force (CHF) operates Sea King and Lynx helicopters; the Army Air Corps operate Apache, Gazelle and Lynx helicopters, and the RAF operates Chinook, Merlin and Puma helicopters.

a. Apache AH Mk 1. Designed to hunt and destroy tanks and other difficult and important targets, the Apache AH Mk 1 provides a major enhancement to the Army's operational capability. The aircraft can operate in all weathers, day or night, and can carry 16 Hell-fire 'fire-and-forget' anti-armour missiles, 76 2.75in rockets and a 30mm chain gun. The typical Apache mission profile is to transit from its operating base, usually at between 150 – 200 ft AGL, before entering a target area to perform direct fire or fire support. During this phase of the mission, the helicopter will operate down to very low altitudes to take advantage of concealment using terrain or other features.

- Apache monthly requirement for tactical training outside DUAs: 38% of training hours[10].

b. Gazelle AH1. The primary role of Gazelle is observation and reconnaissance. It is a vital component of anti-tank helicopter operations and is also used in a wide variety of supporting roles - Air Observation Post to direct Artillery fire, Airborne Forward Air Controller to direct ground-attack aircraft, casualty evacuation, liaison, and command and control, and communications relay. The Gazelle is therefore operated in close proximity to hostile forces, using very low altitude and terrain features to conceal the aircraft.

[9] To be incorporated in BR 767 – Naval Aviation Orders, Order N 330.110.1 at next change.
[10] This high percentage is generated because 9 Regiment Army Air Corps based at Dishforth with Apache do not have a DUA available for their training.

- Gazelle monthly requirement for tactical training outside DUAS: 18% of training hours.

c. Lynx AH7 and AH9. The Lynx is the Army's primary battlefield utility helicopter and can undertake a variety of roles. Lynx can be equipped with eight anti-armour missiles for use in the anti-armour role. The Lynx is therefore also operated in close proximity to hostile forces, again relying on very low altitude and terrain features to conceal the aircraft.

- Lynx monthly requirement for tactical training outside DUAS: 18% of training hours.

d. Chinook HC2/2a/3. The primary role of the Chinook is to provide support to the Army that includes the tactical manoeuvre of troops, weapons, ammunition and supplies to the battlefield either on-board the helicopter, or as under-slung loads, and to provide a casualty evacuation (casevac) capability. The Chinook is extremely versatile and also has a number of secondary roles that include support of amphibious support operations, ship to shore transfers and re-supply and support to dispersed combat aircraft. The varied roles of the Chinook require crews to be trained in the low-level environment to navigate effectively in a battlefield environment to conduct Concealed Approaches and Departures (CAD), operations into Confined Areas (CA), the insertion and extraction of ground forces and pick-up, and transportation and delivery of under-slung loads.

- Chinook[11] monthly requirement for tactical training: 12.5% of training hours.

e. Merlin HC3. Merlin HC3 (EH101) medium support helicopter used for the movement of troops, weapons, ammunition and support stores in and around the battlefield. Merlin also has an additional role of Casualty Evacuation. The low level skills required are similar to those for the Chinook.

- Merlin (RAF) monthly requirement for tactical training: 9% of training hours.

f. Puma HC Mk 1. The Puma HC1 is used for tactical troop and load (internal/underslung) movement by day or night. The aircraft can accommodate 16 equipped troops or up to 2 tonnes of freight. Another major role is casualty evacuation where 6 stretchers can be fitted. The versatility of the Puma allows operations in a variety of terrain, and crews are trained to operate at low-level in both desert and mountain/deep snow conditions.

- Puma monthly requirement for tactical training outside DUAs: 8% of training hours.

[11] Does not include Chinook/Lynx Joint Special Forces Air Wing requirements.

g. The Commando Helicopter Force. Commando Helicopter Force (CHF) is a group of 4 squadrons and supporting elements, integrated under the command of an HQ, established to operate helicopters in support of the UK armed forces. It is a combined Royal Navy/Royal Marine force flying Sea King Mk 4 and Lynx Mk 7 helicopters and specializes in amphibious warfare. The Force operates world wide from its base at Royal Naval Air Station (RNAS) Yeovilton in Somerset. The Sea King Mk 4 is able to carry up to 27 troops and can also carry a variety of underslung loads and has a low level training requirement that includes Concealed Approaches and Departures, trooping and lifting under-slung loads. The Lynx Mk 7 performs a similar attack role to the JHC Lynx AH 7/9. The CHF has a reduced requirement for tactical over-land flying because much of its operational work is embarked operations on-board ship.

- CHF monthly requirement for tactical training outside DUAs: 4.5% of training hours.

15. Search and Rescue Tactical Training Requirements outside DUAs. Both the RN and RAF operate Sea King helicopters in the Search and Rescue (SAR) role. The minimum transit height for SARH is 100 ft AGL for all training activity, and low level transit flying below this height is only conducted during live search and rescue operations if weather conditions reduce the available operating altitude. Apart from specific activities such as Confined Area Landings and Mountain/Cliff Winching, there is no routine requirement for SARH helicopters to operate below 100 ft AGL. Specific training activities require a reconnaissance of the area before they are conducted and consequently, SARH Tactical Training Requirements should have no adverse impact on either public or livestock.

16. DFHS Training Requirements outside DUAs. The DHFS has its main base at RAF Shawbury in Shropshire, with an additional Search and Rescue Training Unit (SARTU) based at RAF Valley in Anglesey. To prepare crews for the front-line helicopter operations, the complete range of front-line helicopter tactical activities described above is taught. However, helicopter flying training differs from operational flying training as sorties are of shorter duration to enable sufficient teaching to be completed for a specific exercise without overloading the student. Consequently, the majority of training sorties are of relatively short duration. Equally, SAR training at RAF Valley is largely conducted inside the Military Air Traffic Control Zone and the Holyhead Range Danger Area that is set aside for this activity. The patterns and levels of training activity are therefore well established with the local population.

- DFHS monthly requirement for tactical training outside DUAs: 5% of training hours.

17. AAC Middle Wallop. Training conducted at AAC Middle Wallop utilises its own DUA and there is no requirement for tactical training outside the DUA.

Conclusion 3: Low Level Training Requirements outside DUAs. The amount of low level training conducted is closely matched to the operational role of each helicopter type and, providing a DUA is available for that helicopter type, only a small proportion of this

training is conducted outside the DUA. Low level training requirements are retained at a minimum level to ensure operational proficiency is maintained. Any reduction in the current allocation of low level training hours would cause a loss of operational proficiency.

18. Areas in Which Low Level Helicopter Training is Conducted. Having determined the requirement for helicopter low level training, the areas in which this training is conducted now must be considered.

a. Use of the Defence Training Estate. Ideally, from the public's perspective, all BH tactical low flying should be limited to the UK Defence Training Estate. However, these areas are small and over-congested, and BH activity is frequently incompatible with the requirements of other users (e.g. live firing in danger areas). Furthermore, whilst relatively slow compared to fixed wing fast jet traffic, BHs cover ground quickly and, particularly when operating in formations, rapidly exhaust the scope of the UK training estate to conduct realistic tactical training. Therefore, it is not possible to confine BH low level training to the Defence Estate without a significant degradation in operational readiness.

b. Dedicated User Areas (DUAs). As indicated at Para 11, 68% of helicopter tactical low level training is conducted within DUAs for training efficiency, and to minimize the potential for disturbance to the wider public. The patterns and levels of activity are well established, and it is not practical to change the geographical location of existing DUAs unless the existing basing arrangements for helicopters are changed (***see Conclusion 2***).

c. The Pre-1979 Solution. Until 1979, military low flying was permitted only in certain designated areas of the UK that had relatively low population densities. A map showing the pre-1979 low flying areas is at Annex B. These areas covered about 40% of the total UK lower airspace and were joined by low flying routes and link routes. Disturbance was therefore concentrated on the population within these designated areas and routes. This review of helicopter low flying was generated by a horse riding accident, and it is significant that in the pre-1979 solution, the accident location was in a 'sparsely populated area' at the junction of a designated low flying route with a link route, and would have been subject to considerably more low level traffic than is experienced under the current UKLFS. For helicopter low level training, the major problem in reverting to these pre-1979 areas is an issue of range: for BH based in the south of the UK, only two of the 16 pre-1979 areas fall within current operating areas. Imposing use of the pre-1979 areas would therefore bring a requirement for helicopters to conduct considerably extended transits to get to the pre-1979 low flying areas, and with this would also be a requirement to refuel away from their main operating bases. The net effect therefore would be to considerably increase the number of flying hours necessary to achieve the same level of training, and therefore potentially increase low level transit requirements due to weather or airspace considerations, thereby increasing the risk of disturbance to the public with the exact opposite effect to that desired. In addition, it may also be necessary to move ground forces to these pre-1979 low flying areas to support helicopter tactical training, further increasing the potential for disturbance to the public[12]. Therefore, without considering the additional limitations on effective training due to crews becoming over-familiar with small low flying areas, reversion to the pre-1979 low flying system is not a practical option.

d. The Current Pattern of Helicopter Activity. The current pattern of helicopter low level training activity has been identified by a three-month research programme that recorded details of routes and activities conducted by all UK military helicopters. Perhaps unsurprisingly, helicopter activity is largely predictable, and the areas in which this activity takes place on a routine basis can be clearly identified. Whilst the whole of the UKLFS is available for helicopter training, in reality a much smaller proportion is used on a regular basis, and these ‘routine’ operating areas are a reflection of the limited speed and endurance of most BH that combine to restrict their operating range. It is clear from the data that approximately 80-85% of all helicopter activity follows the pattern of departing from home base to conduct the necessary training before returning to home base. Furthermore, it also reflects the conditions necessary for productive training where in many situations, BH need to work closely with ground forces. Much of this activity takes place within DUAs, but it is evident that this 80-85% level of activity also uses additional low flying areas, but these additional ‘routine’ training areas border either existing DUAs, or established helicopter operating bases. For example, BH from RAF Odiham and Benson conduct much of their training within their DUA, but also routinely train in parts of low flying areas No 2, 4, 6 and 7 that border their DUA. Equally, some established helicopter bases do not have DUAs[13] and therefore routinely use the wider UKLFS for their training, significantly increasing the apparent level of activity outside DUAs. Current statistics on the pattern of low flying also present a distorted picture of activity outside DUAs, as any booking outside a DUA is recorded as a booking for the entire low flying area, rather than the more limited area actually used for helicopter training. The research into patterns of helicopter training activity has addressed this issue, and a map showing the areas routinely used for helicopter training activity is at Annex C.

e. Tactical Low Flying Activity Outside DUAs and Routinely Used Training Areas. As discussed above, the majority of low flying outside DUAs takes place in routinely used areas, close to DUAs or helicopter operating bases. The table below shows the total amount of low level helicopter training conducted between April 2004 and March 2005, with further subdivisions to show the amount of tactical low flying below 100 ft AGL outside DUAs. However, what is of considerable significance is the limited amount of tactical low flying that is conducted outside the routinely used training areas defined above.

[12] For further discussion of the requirement for ground forces, see paragraph 20b below.
[13] For example, 9 Regiment Army Air Corps based at Dishforth with Apache currently do not have a DUA established for their use (see Para 14 a).

Proportion of Tactical Low Flying within DUAs (%) (a)	**Proportion of Tactical Low Flying inside DUAs and routinely used operating areas** (%) (b)	**Tactical Low Flying outside DUAs and routinely used operating areas** (%) (c)
68%	**95%**	**5%**

Table 1: The proportion of tactical helicopter training conducted outside DUAs and routine operating areas.

f. Low Flying Areas Necessary to Support Helicopter Training Activities. As shown above, helicopter training activity can be divided into 3 areas: the DUAs, the routinely used areas close to DUAs or operating bases, and the remainder of the UKLFS.

(1) DUAs. It has been suggested that greater use should be made of the existing DUAs[14]. In 1995, the first year that data was collected, a total of 25,834 hours helicopter low-level training was conducted within the DUAs. Towards the end of the 1990s, following the draw-down of UK forces in Germany, the UKLFS was required to absorb the additional training requirements of returning Army Air Corps and RAF helicopter squadrons, and by 2002/2003, training activity within DUAs had risen to 28,109 hours, an increase of approximately 9.4%. However, since 2002/3 this figure has remained relatively constant with 28,217 hours training activity in 2004/5. The available training area within the DUAs is 12,359 km^2 or 6.45% of the total UKLFS[15], but this limited area already supports 54% of all helicopter low level training, and 68% of tactical low level training. Maximum possible use is already made of the existing DUAs, and any attempt to increase the levels of activity would have significant flight safety implications.

(2) Routinely-used Training Areas. Because of the already very high levels of activity within the DUAs, additional low flying areas bordering DUAs are also routinely and frequently used for helicopter training. The Rule 43 Recommendation One employed a logical argument that both humans and livestock should become familiar with the impact of helicopter training in frequently used areas (similar to those living in the flight path of major airports) and it is this familiarity that can ameliorate the risk to the public. The pattern of low level training activity in these routinely-used areas is also well established, and it can therefore be assumed that the population in these areas are already far more accustomed to these activities than in other, less well-used areas. Consequently, the options for these routinely-used areas must be explored.

[14] Coroner's Rule 43 Letter, Recommendation One.
[15] The available area of the entire UKLFS is 191 618 km^2.

(3) Expanded DUAs. It could be possible to expand existing helicopter DUAs to subsume these additional, routinely used areas. However, these routine helicopter training areas are also used by fast-jet traffic and extending the existing DUAs would impose a restriction on fast-jet training activities, thereby concentrating increased fast-jet activity on a smaller proportion of the UKLFS. This is likely to meet considerable resistance from the population that inherits the increased fast-jet traffic.

(4) Designated Helicopter Training Areas. It could be possible to formally designate these routinely-used areas as Helicopter Training Areas (HTA), to signify to the public that these are areas where helicopter training is routinely conducted. This would have no impact on the conduct of fast-jet training that takes place above helicopter low level operating heights, and therefore would not increase the 'weighting' of fast-jet traffic on some parts of the population. What it would do is to reflect the existing pattern of helicopter low level training, and would enable much more accurate information to be given to the public on helicopter activity within these more limited areas. This approach has already been used to establish the Stafford Rotary Wing Training Area as an adjunct to LFA9, the DUA for RAF Shawbury, and presents an attractive way forward that meets one of the fundamental aims of the Rule 43 letter.

(5) Use of the UKLFS Outside DUAs and Routinely Used Areas. It may be perceived to be desirable to restrict **all** helicopter activity to either DUAs or HTAs discussed above, using a similar philosophy to the pre-1979 low flying system. However, some of the most important tactical training is conducted during major and minor exercises, where the exercise scenario will require helicopter deployments away from home bases to conduct realistic and extended tactical training usually in conjunction with the deployment of ground forces. This exercise activity often reflects the culmination of a period of tactical training, and it is the closest training experience to operational flying that crews can undertake. Consequently, it is imperative for the adequate preparation of helicopter forces for operational readiness that the ability to conduct this vital form of training is not restricted. It is evident from Table 1 above that the amount of tactical low level training conducted outside the DUAs and routinely used areas (HTAs) is a relatively small amount, representing approximately 5% of all tactical training, but this training has the potential to cause the most intrusion because the population is not used to the activity on a routine basis. Consequently, it is vital that measures are put in place so that when this training is conducted, more accurate information about the time and location of the training can be given to the public. Measures are being put in place to ensure that formalised exercises are properly publicised (See Para 29 below), but for other tactical training outside DUAs and HTAs there will in future be a requirement for the following information to be given as part of the low level booking so that the public may be better informed:

- for a pre-planned tactical transit: broad route and time information

- for pre-planned tactical operations (CAD, CA, observation, fire support, winching, under-slung loads etc): a position centred on a 10nm radius of the location of the activity.

- for tactical training during exercises, some tasking may be at short-notice and in response to the exercise scenario. However, the location and planned conduct of the exercise will be publicized widely in advance of the event, providing an increased level of public information on the activity.

Conclusion 4: the area in which helicopter tactical low level training takes place. Most helicopter tactical low level training takes place in DUAs, or close to DUAs in 'routine' operating areas, with only a small proportion of activity being conducted at longer ranges throughout the UKLFS. Nonetheless, this smaller level of activity provides a high proportion of the most realistic training and therefore the ability to conduct such training must be retained to ensure operational readiness. Reversion to the pre-1979 low flying system would result in an increase in helicopter activity because of the need for longer transits, and is therefore counterproductive to the aim of this recommendation. Routinely used training areas should be re-designated as Helicopter Training Areas (HTAs) to indicate to the public the routine use of these areas for helicopter tactical training activities, and to provide a much better forecast of training activity. To mitigate the effects of tactical training outside HTAs, detailed information on the conduct (location and routes) of training activities will be made available to the public to enable more informed decisions about outdoor pursuits to be made.

19. The Supervision and Control of Low Level Tactical Training. Having been able to define the training requirement and the airspace necessary to support that requirement, it is essential that low level tactical training is tightly controlled and fully supervised at every level, to ensure that only essential training is conducted, and that 'where' and 'how' that training is conducted can be fully justified. All military flying is subject to stringent authorization procedures that are stipulated in Regulation 301 of Joint Service Publication (JSP) 550: Military Aviation Policy, Regulations and Directives issued by Command of the Defence Council. The policy directive is that every flight made by a UK military aircraft is to be authorized, where authorization is the authority given to an aircraft commander to fly a particular aircraft on a specified mission or duty.

a. Delegation of the Authority to Authorize Military Flying. The power to authorize military flying is delegated through Command Headquarters to Commanding Officers of aviation capable ships, flying stations and units. Each Commanding Officer will appoint officers of suitable experience to conduct authorization duties on a day-to-day basis for the control and supervision of flying, and will detail the specific powers of authorization granted to each of these named officers.

b. The Responsibility of the Authorizing Officer. The Authorizing Officer is responsible for ensuring that the Aircraft Commander understands the aims of the tasked mission or duty, and is capable of carrying out his responsibilities. Equally, the Authorizing Officer will ensure that the Aircraft Commander or Formation Leader has thoroughly planned their mission, alternate mission or duty, and that the crew are qualified and capable of executing the tasked mission as planned, without undue hazard. Except when embarked, in operational conditions or for Search and Rescue Operations, UK Military Aircraft must not be flown unless the flight has been authorized in writing and the Aircraft Commander has signified that he understands the mission or duty by initialling the appropriate authorization sheets. Exceptionally an Aircraft Commander or Formation Leader may undertake a mission or duty not included in the pre-flight authorization. However, the deviation must be within the constraints of JSP 550 regulations, and the Aircraft Commander/Formation Leader must be satisfied that the deviation from the authorized mission is on the grounds of aircraft safety, or in the UK national or Service interest.

c. The Record of Authorization. Completed Authorization Sheets contain all relevant details relating to the flight, and specifically all of the activities that are to be undertaken on that flight, together with the heights at which those activities are authorized to take place and the LF area/booking number. On completion of the sortie, the Aircraft Commander enters details of the sortie, including any deviations from the initial authorization that were necessary, and again enters his/her signature. Completed Authorization Sheets therefore provide a means of tracking what training activities have been conducted, and provide a fully auditable trail of the conduct and justification for those activities. Authorization therefore provides a powerful method of control that the supervisory chain of command can use to ensure that only those training activities that are necessary for the maintenance of operational readiness are conducted, and that those training activities are conducted in accordance with all relevant regulations, and in an appropriate area for the planned activity.

d. Authorization of Helicopter Tactical Low Level Training. The way in which tactical low level training is supervised and authorized has been closely examined. Commanding Officers at all helicopter units frequently review the powers of authorization granted to those officers who are charged with the day-to-day supervision and control of flying, and the number of authorizing officers is strictly limited to the number necessary to enable flying operations to be conducted. The necessity to conduct the minimum amount of tactical training necessary to maintain operational readiness has been re-emphasized and the duration of that training is strictly limited. The theme strongly running through the conduct of authorization of helicopter activities within all three Services is ***accountability***, and individual authorizing officers are in no doubt of the potential for tactical low level training activities to cause disturbance, and therefore conduct their duties accordingly. For exercises and deployments away from home operating bases, directives are routinely issued to specify the intended conduct of the training, and to address the authorization of tactical training activities.

(1) Chinook Authorization. The Chinook is the largest of MOD’s BH and therefore has the greatest potential to cause disturbance. Consequently, measures have been put in place to ensure that Chinook training activities receive the highest possible level of supervision. Each Chinook Squadron’s training programme is managed by the Deputy Squadron Commander, and a

weekly planning meeting is held to determine how Joint Helicopter Command tasking and local training requirements will be met using available resources. The planning meeting is attended by an Authorizing Officer who will be responsible for the direct supervision and control of flying throughout this weekly period to ensure that the tasking and training programmes are translated into coherent and prioritized activity. Every sortie that will undertake tactical low level training below 100 ft AGL will be scrutinized by the Authorizing Officer to ensure that tactical low level training is conducted in suitable areas, and for the minimum duration necessary to achieve the task or training objective. Before authorization is given, the aircraft captain is given a comprehensive briefing to ensure compliance with this policy. On completion of the sortie, maps and bookings are collated to complete the audit trail and to confirm the need for accountability by the crews. Any complaints, or comments about areas of sensitivity are collated and brought to the attention of the Force Commander. These stringent measures ensure that the training activities of the largest BH are very tightly controlled, with complete visibility and accountability at every stage.

Conclusion 5: the supervision and control of low level tactical training. Authorization of military low level training activities is tightly controlled at every level, and the authorization process provides a fully auditable trail of the conduct and justification for these activities.

EXPORTING HELICOPTER LOW LEVEL TRAINING

20. It is highly desirable to undertake tactical flying training in a representative environment where potential combat or peace support operations may take place, and UK military helicopters routinely take part in exercises around the world designed to give experience in operating in differing terrain and with other military forces. Because of the complexity and

Exercise Name	Dates	Location	Aircraft Numbers and Types
AURORA	May – Jul 04	USA	7 x Sea King 3 x Lynx 3 x Gazelle 2 x Chinook
WESTERN RHUMBA	Aug – Oct 04	Ghana	3 x Sea King
JEBEL SAHARA	Sep – Oct 04	Morocco	2 x Chinook 2 x Puma
GRAND PRIX	Sep – Oct 04	Kenya	2 x Lynx
MOUNTAIN LION	Nov 04	Switzerland	3 x Puma
CLOCKWORK	Jan – Mar 05	Norway	4 x Lynx 2 x Sea King 2 x Chinook 2 x Merlin 2 xPuma
TROPICAL STORM	Feb – May 05	Belize	2 x Puma

Table 2: Overseas Helicopter Exercises May 04 to May 05.

considerable demands of tactical training overseas, deployment on overseas exercises is normally only conducted by operational squadrons, and helicopters from the Defence Helicopter Flying School (DHFS) and Operational Conversion Units (OCU) generally conduct their training exclusively within the United Kingdom Low Flying System (UKLFS). Over the last year, UK military helicopters have taken part in a variety of overseas exercises to conduct low flying and tactical training. These are detailed in Table 2 above.

21. Exporting helicopter low flying training to sparsely populated locations overseas may initially appear to offer a solution that reduces the impact of helicopter low flying training within the UK. However, there are a number of issues that affect the potential benefit of this proposed solution.

a. Environmental and Territorial Issues. Whilst there are a number of very sparsely populated areas of the world that would appear to offer suitable airspace for low flying, many of these areas are the subject of environmental concerns or territorial claims, often from indigenous peoples. As a result, pressure on low flying, even in these sparsely populated areas is mounting. For example, although there is currently 130 000 km^2 available for low flying at Goose Bay in Labrador, 142 450 km^2 territory in Labrador is the subject of the Labrador Inuit Land Claim, and a final agreement with the Canadian Government is expected later this year. Other sparsely populated areas around the world may become subject to similar claims. In addition, global environmental pressure continues to affect the availability of appropriate flying training areas.

b. Effective Training. Some training areas offer large areas of terrain to practice low flying operations, and Canada has long been utilised by UK fast-jet aircraft for this purpose. However, fast-jet and helicopter operations are very different. Fast-jet low level training is extremely effective providing the range area offers simulated targets, and a range of ground-based threats. There are few other requirements apart from the participation of other aircraft. The primary role of all BH is to support the army, and to be effective almost every aspect of helicopter tactical training requires the participation of ground forces. It is wholly impractical to attempt to separate low-level flying per se from other aspects of helicopter training if the training is to be effective. As BH activity is inextricably linked to support of ground forces, ground forces are often an intrinsic part of helicopter training, both in providing the environment for effective helicopter training and also to ensure that troops are themselves trained to operate with helicopters. Therefore, whenever training is planned, it often includes ground forces. For example, Exercise EAGLE’S STRIKE, conducted in the UK towards the end of 2004, involved approximately 40 helicopters operating from West Freugh airfield in Scotland. To provide an appropriate ground scenario for effective training, 4,000 ground troops and 1,500 vehicles were also involved. Although these ground forces also received valuable training, without their presence effective helicopter training would not have been achieved. Consequently, if helicopter low level training is to be exported, ground forces to support and participate in that training must also be exported, considerably increasing the scale and cost of the overall deployment.

c. Reciprocal Arrangements. The potential effect of reciprocal agreements as a by-product of exporting more low flying training must also be considered. Within the

UKLFS, foreign aircrew are not generally permitted to low fly unless reciprocal arrangements have been established and UK aircrew can low fly in their country. However, the reverse is also true, and those countries that permit the UK to export low flying training are normally granted permission to low fly in the UK. Therefore, whilst some UK military low flying is already exported, increasing the amount could also bring a corresponding increase in foreign use of the UKLFS.

d. Maintenance of Low Flying Facilities. Globally, the total amount of fast-jet low flying is decreasing because aircraft numbers are reducing as individual aircraft become more capable and because of an increased use of 'smart' munitions that do not require low-level delivery. To support the export of low flying from the UK the RAF has previously maintained a permanent facility at Goose Bay, however the reducing requirement together with budgetary constraints have caused this facility to close. Defence across most western nations is under similar budgetary pressure, and facilities are now only bought in when necessary.

e. Transportation Issues. Deploying fast-jet aircraft overseas for training is relatively straightforward, as fast-jet aircraft can self-ferry over long distances, and this range can be extended by the use of air-to-air refuelling. Consequently, fast-jet deployment to European destinations is achieved in a single day without additional support, or to destinations in Canada or the USA in two days utilising air-to-air refuelling. Recovery of fast-jet aircraft from deployed locations is also equally rapid, maintaining the National capability to respond to unforeseen operational requirements. Deploying helicopters over similar distances is considerably more problematic. For mid-Europe destinations, self-ferry is possible but limited range and relatively low speeds increase transit time: for example, three days is required to deploy a Puma helicopter to training areas in Northern Norway, a regular mountain flying low level training area. Deployment of helicopters to more distant destinations can only realistically be achieved by sending the helicopter as either air or sea freight.

(1) Air Freight. Transporting helicopters as air freight generally requires a certain amount of dismantling of the helicopter to be completed prior to freighting. For example, for transportation in an RAF C17 transport aircraft, a Chinook helicopter requires one day's preparation followed by three days assembly and testing when the aircraft is delivered. The C17 is the largest UK Military transport aircraft (four aircraft available), and each can carry one Chinook at an operating cost of £49,745.06 per flying hour[16]. Therefore, deployment of a single Chinook helicopter to Goose Bay, Canada would take five days and cost approximately £1 Million, based on 10 hours flying time for the return journey to deploy the helicopter, and the same return journey to recover the helicopter, although this amount would be subsumed within the overall defence budget providing that it was planned expenditure. The major difficulty in using the RAF C17 is that due to current and foreseeable operational tasking, all aircraft are wholly committed and already over-fly their

[16] Aircraft Capitation Rates 2005/2006 available from http://www.defence.mod.uk/dgfm/fmgtdocs/caprates/AirCap.pdf accessed 27 Apr 05.

planned annual flying-hours allocation. An alternative to the RAF C17 is the civilian Antonov 124 that could be hired under commercial arrangements. The Antonov 124 is less expensive to operate than the RAF C17 but nonetheless, delivering and recovering a single Chinook helicopter to Goose Bay Canada would attract a hire charge of $500,000 or approximately £300,000 depending on exchange rates. However, as the Antonov 124 is civilian registered, there can be additional and sometimes protracted difficulties with Diplomatic Clearances and Customs Regulations depending on the destination.

(2) Sea Freight. Sea freight attracts lower charges than air freight however, the time necessary to transport the helicopter to its destination is significantly increased, and there are therefore serious implications for aircraft availability. The normal method of sea transport is to use Roll-on, Roll-off (RoRo) vessels, designed to carry four Chinooks or an equivalent combination of helicopter types. The cost of hiring a RoRo vessel to transport four Chinooks to Canada is £388,000 for a one-way ferry, giving a total of £776,000 for both the deployment and recovery. Whilst the helicopters are on board the RoRo vessels, they are unavailable for other tasks, and when the vessel is at sea, the helicopters cannot be recovered to operational status to reduce this period of unavailability. It takes eight days to deploy a RoRo vessel to Canada, and the same time to recover, and an additional day is required to load and unload in port. Consequently, for a low flying training deployment to Canada, each aircraft is unavailable for a minimum of 20 days. Deployment to more distant destinations attracts proportionately increased charges, for example, to deploy and recover four Chinooks from Australia would attract a total hire cost of £1.8M, with a minimum of 54 days for a deployment to Darwin, or 62 days for a deployment to Sidney.

f. Aircraft Availability Issues. Aircraft availability is a significant issue as within any aircraft fleet, the total number of in-use aircraft is calculated by a complex formula that is driven by the operational task and the associated training requirements, based on expected aircraft availability, rates of aircraft use, servicing requirements, and the planned overall life of the aircraft. Any reduction in planned aircraft availability has significant knock-on effects. Reducing the number of aircraft available may limit the National ability to respond to an urgent operational task. Equally, if the number of aircraft available is reduced but training levels are to be maintained to ensure operational readiness, there will be an increased demand placed on remaining aircraft, thereby increasing the frequency of servicing, with an associated increase in cost to establish additional maintenance facilities. Currently, the operational tempo for helicopter forces is extremely high, and it has been high for some considerable time: there is a significant and constantly high level of tasking to support ground forces in several concurrent operational theatres, and with the current global terrorist situation, there is also a very high level of standby requirements for National contingencies. Consequently, not only are helicopter crews themselves under considerable pressure from the operational task, but there is continuous demand for a very high level of helicopter availability to meet the overall task. This appears likely to continue for the foreseeable future. Consequently, the only potential solution to increase aircraft availability without severely damaging our National capability is to procure additional aircraft so that training levels can be maintained whilst aircraft are unavailable. However this would be very expensive and would impose considerable additional and unplanned costs option on an already tight defence budget. Funding for this option appears extremely unlikely.

Conclusion 6: Exporting helicopter low level flying training. Military helicopters already participate in a variety of exercises outside the UK, thereby reducing the impact of low flying training to the public. To gain sufficient effective training during overseas low flying exercises, ground forces must be involved, thereby considerably increasing the cost and complexity of any deployment. Issues of transportation add significant costs, and aircraft availability issues also considerably detract from this option if the National capability to meet operational tasking and to respond to crises is to be maintained. The overall effect of adopting this measure would be to impose an unrealistic demand on the Defence Budget, and therefore this option is neither practical nor affordable.

RECOMMENDATION 2: INCREASED USE OF SIMULATORS

> I am aware that the Royal Air Force have and use sophisticated flight simulators to assist with crew training.
>
> I am also aware and, in part, accept that simulators have certain limitations, eg. they lack fidelity and do not replicate real flying either physiologically or psychologically. I was nevertheless impressed by the evidence given to the Inquest by Stephen Jowett. He felt that the Royal Air Force could and should rely much more heavily upon LFTH in simulators. He spoke of the role of the simulator in the civilian context and indicated that more than ninety percent of training takes place in simulators. He accepted that training in the civilian world was less demanding than in the military context. He nevertheless felt that with "the collective will of the MoD" significantly increased use could be made of simulators. If this could be achieved then, once again, it could result in the current risk to the public being commensurately reduced.
>
> I would strongly recommend that the current use of simulators is significantly increased.

22. Currently, the Gazelle and Squirrel helicopters do not have a flight simulator, and there are no plans to procure flight simulators for either of these aircraft types. The Merlin HM Mk1 simulator at Royal Naval Air Station (RNAS) Culdrose is designed to support the maritime patrol role, and has a limited overland database that cannot support low level navigation training techniques below 500 feet. In addition, the Lynx AH7 simulator at Army Air Corps Wattisham is equipped with a dusk/night database only and has no terrain detail outside the airfield boundary, preventing practical use for low level training. For all other military helicopters, simulation is used to varying degrees to conduct low flying training.

23. Limitations on the Use of Simulation. The major limitation to low flying training in simulators is insufficient terrain detail and poor surface texturing on the visual models. These limitations make depth perception difficult, encouraging pilots to form the dangerous habit of over-reliance on the radar altimeter for accurate height judgement at low heights, rather than using the normal visual cues. Obstruction avoidance techniques are therefore difficult to practice, as are approaches and departures from confined areas. On many simulators, the database does not contain realistic hazards, particularly wires to which helicopters are vulnerable. Crew lookout techniques are vital to protect the helicopter from these hazards and obstructions and also hostile action, but are limited within the flight simulator to the boundaries of the visual screens. Simulator models use a system of terrain smoothing and global weather patterns (for example a constant wind speed and direction) however, localized weather and turbulence effects at low altitudes cannot be accurately reproduced, again limiting training value.

24. Consequently, whilst military simulators are used to teach some basic low flying techniques, there remain significant limitations in the fidelity of simulator visual systems to accurately replicate ultra-low level (below 100ft) flying where more advanced and applied low flying techniques are required. This is of considerable significance as the majority of operational military helicopter tasks require low flying at or below 100 feet, in complete

contrast to civilian helicopter operations where the only time routinely spent at this low altitude is during the take-off and landing phase of flight[17].

25. An additional restriction to the successful simulation of low flying operations below 100 feet is that all simulators are designed around the handling crew, and whilst some limited interaction is possible outside the cockpit door, many military helicopter tasks cannot be rehearsed successfully. In particular, there is no capability to operate the simulator as a full crew and therefore the vital and integral role of the crewman or crewmen cannot be rehearsed. Furthermore, working with under-slung loads is a major part of the support helicopter role, and again cannot be adequately simulated. Finally, the synthetic environment cannot simulate interaction with ground troops when loading and unloading the aircraft, conversely nor can it provide these 'customers' with effective training to operate with helicopters.

26. Current and Future Use of Simulation. Despite the limitations of simulation outlined above, a considerable amount of effective training is currently undertaken within existing flight simulators, and new training programmes are being introduced to reduce the requirement for live flying exercises. Detailed below are the planned improvements to existing simulator capability:

a. Squirrel. Whilst there are no plans to introduce a Squirrel simulator, a PC-based navigation trainer is currently under trial at the Defence Helicopter Flying School. This trainer does not replace low flying, but is designed to make live low flying more effective and efficient, and has already been shown to improve crew's lookout, and consequently their ability to take effective avoiding action. The first production unit is scheduled to enter service this year.

b. Sea King Mk 3/3a. The course design teams for the Sea King Mk 3/3a are in the process of introducing Night Vision Goggle (NVG) training into the simulator syllabus. As part of the Operational Conversion course, low level NVG training will be included as an addition to the basic flying procedures. In addition, a NVG mountain flying phase will also be introduced into a scenario-based captaincy package. Both of these initiatives reduce the requirement for live low level flying training.

c. Lynx Mk 8. The Royal Navy Lynx Mk 8 simulator syllabus is being reviewed to include more captaincy and tactical exercise events, and is increasing its use of low level flying in the Full Mission Simulator, thereby increasing the proportion of low flying synthetic training available. The principles of low flying, navigation and the use of NVG are taught in the simulator, and more advanced training now includes formation low level training using NVG.

d. Lynx Mk 3 Full Mission Simulator. As with the Lynx Mk 8 simulator, more captaincy and tactical exercise events are being planned, and there will be an expansion towards more low level flying in the Full Mission Simulator, thereby increasing the proportion of low flying synthetic training available.

[17] Civilian helicopter operations are conducted at a minimum of 500 feet above ground or water unless an exemption to the Air Navigation Order has been granted by the Civilian Aviation Authority.

e. Sea King Mk 4,5,6,7. An enhanced database is being introduced that will permit more effective simulation of overland day and night low level training, including the use of NVG. Again, this measure will improve the potential contribution of the synthetic environment to low level training.

f. Chinook HC2,2a,HC3, Merlin and Puma. Simulation for the Chinook, Merlin and Puma helicopters is provided by a state-of-the-art Medium Support Helicopter Aircrew Training Facility (MSHATF) at RAF Benson under a Private Finance Initiative contract. This contract provides the most comprehensive synthetic training environment currently available, and comprises 6 Dynamic Mission Simulators, a Tactical Control Centre and Computer-Based Training classrooms together with full planning and briefing facilities. The recently introduced Tactical Control Centre will allow the synthetic environment to more realistically represent tactical low level formation flying. This initiative will result in a 10% increase in the amount of low flying conducted in the simulator.

g. Apache AH1. Simulation capability for the Apache is provided by state-of-the-art Full Mission Simulators (FMS) supported by mobile Field Deployable Simulators (FDS) that are currently deployed to Dishforth and Wattisham, the two Apache airbases. An additional FDS is currently in St Louis, USA, being utilized for future development work by Boeing. The simulation capability permits a wide range of training missions to be accomplished, from initial conversion to type, through conversion to role to advanced continuation training.

27. Proportion of Flying Conducted in Flight Simulators. The amount of flying currently conducted in simulators does vary between aircraft types, however as a general rule, modern flight simulators are more capable of replicating the real environment and providing high quality training for aircrews. The most recent flight simulators are the MSHATF facility at RAF Benson, and the Apache simulators at Army Air Corps Wattisham and Dishforth, and a brief examination of the proportion of flying conducted in these simulators will provide an indication of the levels of training currently undertaken.

a. MSHATF Usage. The usage rates of the MSHATF complex are determined by limitations in the visual system as detailed above and availability of aircrew due to the heavy impact caused by the demands of current operations on helicopter forces. Nonetheless, the simulator complex is very well used, and provides both conversion training and continuation training for aircrews. The simulator complex is configured to provide one Puma, 2 Merlin and 3 Chinook simulators, supporting a total of 38 Puma[18], 18 Merlin and 31 Chinook helicopters in operational service. An examination of the hourly use of the complex produces the following statistics:

[18] Whilst these figures perhaps suggest a second Puma simulator is necessary, the basing of 18 Puma helicopters at RAF Aldergrove in Northern Ireland has to be taken into consideration.

Aircraft Type	Live Conversion Training (% of total hours)	Synthetic Conversion Training (% of total hours)	Live Continuation Training (% of total hours)	Synthetic Continuation Training (% of total Hours)
Puma	52%	48%	75%	25%
Chinook	60%	40%	58%	42%
Merlin	38%	62%	44%	56%
Totals	50%	50%	62%	38%

Table 3: MSHATF Usage.

Aircraft Type	Live Conversion to Type Training (% of total hours)	Synthetic Conversion to Type Training (% of total hours)	Live Conversion to Role Training (% of total hours)	Synthetic Conversion to Role Training (% of total Hours)
Apache	42%	58%	55%	45%

Table 4: Apache Simulator Usage.

b. Apache Simulator Usage. Because the Apache has only recently been introduced into service, it is too early to present detailed statistics for continuation training, and the statistics presented below represent the initial training and conversion of crews as the Apache-equipped Army Air Corps regiments work-up to operational status. Nonetheless, the statistics for conversion to type and conversion to role indicate the high level of use and the potential for simulator use during future continuation training. An advanced weapons phase of simulation training is currently being introduced.

Conclusion 7: Increased Use of Simulation. Maximum possible use is currently made of available simulation capability within the limitations of existing technology. A number of initiatives are being introduced to increase the use of the synthetic environment and further reduce live flying requirements. As more modern helicopters are introduced, the requirement for live flying training decreases. However, unlike civilian helicopter aviation where a high level of simulation can be used due to the comparative simplicity of the simulation requirement, there will always be a limitation on the overall use of military simulation because the operational imperative to train as a full crew in a realistic environment with external agencies remains outside the capability of existing and near future simulation.

RECOMMENDATION 3: BETTER COMMUNICATION WITH THE PUBLIC

It became evident at the Inquest that many low fly training sorties are arranged at very short notice and no notification is given to the public.

I accept that on occasions security issues may prevent publication of proposed sorties. I suspect, however, that this would not apply to the great majority of training flights.

It seems to me that if communication with the public was significantly improved that it would, at least, enable the public to make informed choices. For example, if a horse rider knew that a Chinook was going to be low fly training over Market Rasen between 10.00am and 11.00am then the rider could choose not to ride. The current position is a completely lottery – you ride at your peril and **hope** that LFTH will not be taking place.

Air Commodore Garwood indicated that in 2005 an internet based booking system was due to be introduced, primarily to facilitate air crew in booking in to "low fly" areas. He indicated that at some future date aspects of this system could be used by the Royal Air Force to advertise low flying training regionally. This information could be made available to the public via the internet.

I would recommend that urgent steps be taken to ensure that this facility is made available to the public as soon as ever possible.

In the meantime, I would recommend that the Royal Air Force inform the public of proposed LFTH by notifying local newspapers/local radio stations on a regular basis.

I would also recommend that in each low fly area a telephone helpline should be established by the Royal Air Force. Members of the public could telephone this number to obtain information regarding proposed LFTH.

29. Free-phone Telephone Advisory Service. An early response to this recommendation saw the introduction of a free-phone telephone advisory service to give information to the public on helicopter activity. The helpline was introduced on 1 Mar 05 and was designed to be able to give information on helicopter activities booked into the UKLFS outside the DUAs. DUAs were specifically excluded from the service because of the very high levels of activity (see 17f(1) above) and their constant use. Since its introduction, the service has seen steady but relatively light use, despite considerable publicity announcing the service by both the MOD and the British Horse Society, who strongly support the initiative. The major limitation with the service as it currently provided is the limitation on the detail of helicopter activity that can be given to the public. The current system of booking low flying requires aircrew to book into each specific low flying area, giving their entry and exit times together with the intended operating height. However, as discussed at Para 17f above, this provides a booking for the whole of a low flying area, and it is rare that helicopter activity will encompass such a large area. Therefore, for example, if a helicopter wishes to transit to Sennybridge Range in mid-Wales to conduct training activity, it must currently book into Low Flying Area (LFA) 7 (Wales). Although the activity is confined to a small area of mid-Wales, the booking currently can only show that there is planned helicopter activity for the whole of the LFA. Consequently, the utility of the information given to the general public is reduced. As

discussed at Para 13f above, the utility of this service could be significantly enhanced by the introduction of HTAs. These areas would supplement DUAs and, together with DUAs would contain 90-95% of all planned helicopter activity. Consequently, warnings of booked activity could be far more easily focussed on the actual area of activity, rather than a more general warning that may have little utility. Furthermore, because of the small amount of helicopter activity that takes place outside existing DUAs and the proposed HTAs, more detailed information on broad routes and areas of operation together with planned timing of activity could be given. These improvements to the existing helpline service would offer considerably increased utility to the public to enable them to make informed decisions.

30. Exercise Planning. The largest potential for disturbance to the public is generated by unusual activity outside routinely-used operating areas. Exercises in particular can have considerable impact if the public are not adequately informed of the planned activity. Whilst there are not a large number of major helicopter exercises, these activities are the culmination of tactical training and are of significant importance to the maintenance of operational readiness, as they offer the opportunity for both air and ground forces to conduct manoeuvre warfare over extended distances. It is therefore vital that the public are fully informed of these activities. Consequently, exercise planning guidelines have been comprehensively reviewed and a significant change introduced. As part of the planning and authorisation procedure for exercises, the MOD has introduced a requirement for a comprehensive communication plan to be approved by the MOD Press Office before authority will be given for the exercise to be conducted. This mechanism will ensure that exercise planners have to carefully consider the potential impact of the exercise on the public, and how the public might best be informed of the activity, using all media together with the world-wide-web. In addition, exercise planners will have to inform interested organisations (National Farmers Union, Landowners Associations etc) as part of the communication plan. This regulation introduces a formalised system of ensuring that MOD fully informs the public of intended exercise activity, and represents a further step forward in the provision of appropriate information on which informed decisions can be made.

31. Local Initiatives. Helicopter operating bases are very aware of the potential for disturbance to the public through their activities, and there are a variety of initiatives currently in progress that are aimed to improve the co-existence of helicopter training and country activities:

a. Discussion Forums[19]. Discussion forums bring together senior station executives and representatives from the community, usually drawn from riding organisations, carriage driving organisations, landowners and Rights of Access and Council Planning Officers. Very successful forums have been run by RAF Shawbury to address issues in the Shropshire area, and one of the key themes is mutual understanding. From the work that has been undertaken thus far, it is very evident that much difficulty stems from a lack of understanding where there is limited knowledge on the military side of the needs and requirements of the local public, but equally the local public also have a very limited knowledge of the military requirements to train and to be ready for

[19] *Note: this paragraph was amended in December 2006 following updated information from Shropshire County Council.*

operations. These discussion forums have been instrumental in addressing this issue of mutual understanding, and have enabled positive relations to be established that allow beneficial schemes to be introduced. For example, personnel from RAF Shawbury have recently consulted Shropshire County Council Rights of Way staff over existing helicopter landing sites to ascertain how many have bridleways in close proximity. They have also agreed to consult the Rights of Way staff if any new sites are offered in the future to avoid any possible conflict or danger wherever possible. High profile routes such as the Jack Mytton Way long distance bridleway and the newly promoted RIDE UK routes were also highlighted, in addition to well-used and widely-promoted routes which bring many tourists to the County. The Council has agreed to inform RAF Shawbury of future plans to promote circular or linear bridleway routes in Shropshire. Furthermore, around the UK, representatives from stations are now being invited to sit in on local meetings to hear concerns raised, and to provide accurate advice on possible solutions. The work that is being conducted in these discussion forums is therefore of considerable value, and is already making significant inroads into addressing needs for the co-existence of what has previously been seen to be mutually exclusive activities.

b. Open House Schemes. Many helicopter units have adopted ‘open house’ schemes, where local landowners and representatives from groups representing country activities are invited to helicopter bases to be briefed on training activities, to see helicopters at first hand, and to meet the crews. These schemes are fundamental in building and maintaining confidence and good relationships. It is apparent from many of these meetings that initial mistrust can quickly be replaced when members of the public can see at first hand the very considerable lengths that military aircrew take to avoid the possibility of any disturbance. In particular, increasing awareness of the complex planning process necessary for each helicopter training mission does much to reassure members of the public that all possible steps are taken to avoid unnecessary disturbance. Indeed, it has often been found that the simple act of allowing visitors to sit in a military helicopter to obtain a pilot’s eye view dramatically increases their understanding of the difficulties in seeing and avoiding horse riders in a cluttered military helicopter cockpit.

32. British Horse Society Safety Conference and Future Safety Initiatives. As a result of the work undertaken in this review of helicopter low flying, excellent working relationships have been established between MOD and the British Horse Society (BHS), to take forward safety issues to the horse riding community. As part of this initiative, MOD will participate in the annual BHS Safety Conference to be held on 17 Sep 05, where comprehensive briefings will be given on the content of this Review, and on the many safety initiatives that are being conducted locally. A joint MOD and BHS leaflet and posters have been produced to give safety guidance for riders. The leaflet will be distributed to all 62000 BHS members, with posters and leaflets distributed to the 720 BHS Approved Riding Centres, and both posters and leaflets will be available to members of the public on request. An updated version of the existing Low Flying Video will be produced towards the end of 2005, and will specifically include information about helicopter operations for the rural community in general and riders in particular.

Conclusion 8: better communication with the public. There are a number of measures that can be taken to considerably improve the utility of the telephone helpline that will enable

horse riders to make better informed decisions. Measures have been taken to ensure that major exercises will be fully publicised to the public and to interested organisations. Equally, there are a considerable number of local initiatives that are being conducted to reduce the impact of helicopter low flying, and the MOD is working with a variety of organisations to explore potential ways ahead. The excellent working relationships established between the MOD and the BHS will be continued, and joint safety initiatives will be pursued, commencing with the publication of a 'Safety Guide for Riders' following the release of this Review.

RECOMMENDATION 4: IMPROVED TECHNOLOGY TO ASSIST AIR CREW IN LOCATING HORSE RIDERS

It was evident at the Inquest that helicopter pilots are over-reliant upon visually identifying horse riders to enable them to take evasive action. If the crews line of sight is blocked, eg. by a hedge, then the rider of the horse is potentially endangered.

At the Inquest, Counsel for the family suggested that the public could be better protected if a "tracker" type device was used by horse riders. This would emit a signal which could be detected by a device fitted to military helicopters. The type of device considered was likened to a gadget used by off-piste skiers to reduce the risk of being lost in avalanches. This idea was greeted with great enthusiasm by both military and civilian witnesses at the Inquest. Indeed, Air Commodore Garwood said that he thought that it was a "very very good idea" and indicated that if it proved viable it could constitute one positive benefit to be derived from the tragic death of Heather Bell.

I would strongly recommend that immediate steps be taken to investigate this proposal. It appears to have the potential of being a relatively simple device without involving high expenditure.

Considerable evidence was heard regarding the potential use by aircrew of infra red forward looking devices to locate horse riders. In general, military witnesses suggested that the use of such equipment could result in an over load of information for the crew. I would recommend that the use of infra red equipment should be carefully and objectively evaluated. It is accepted that the pilot and co-pilot have a heavy work load. Perhaps the task of monitoring such equipment could be delegated to a member of the crew who is not flying the helicopter. It is understood that the Police have infra red equipment fitted to their helicopters which may be more sophisticated than that used by the military.

33. Tracker Devices. There are a variety of 'tracker' devices currently available but these can be categorised into avalanche transceivers, personal locator beacons and man-overboard beacons. All are small enough to be carried by an individual, and fulfil the purpose for which they were designed. However, but there are a number of issues associated with adapting the use of these devices into the dynamic airborne environment that make them unlikely to be suitable for use in locating and avoiding horse-riders from a low flying helicopter. A full technical appraisal of avalanche transceivers, personal locator beacons and man-overboard beacons is at Annex D.

a. Avalanche and Man-overboard Transceivers. Both types of device are designed for local area search, and therefore devices are limited in range to offer prolonged battery life, and to prevent triggering of global search and rescue systems using satellite detection. The maximum range for detection by a low flying helicopter is in the order of one nautical mile, or approximately 30 seconds flying time. At this detection range, it is possible to get an indication of the presence of a beacon, however accurate positioning of the location of the beacon is unlikely due to broad angle of arrival and range determination requirements. Search and rescue helicopters utilise a pre-determined search pattern to address this problem, but flying a search pattern is not possible for a low flying helicopter. In addition, most systems are designed to detect and locate single beacons, and multiple beacons may cause interference and false positioning. Consequently, these types of beacons do not appear to offer the utility necessary to locate horse riders from low flying helicopters.

b. Personal Locator Beacons (PLB). PLB are used for the accurate positioning of a survivor following a distress situation, and utilise the global Cospas-Sarsat satellite system that provides detection and relay to ground-based SAR Mission Control Centres (MCC). In the UK, the ground-based MCC is at the Air Rescue Co-ordination Centre at RAF Kinloss in Scotland. Within the UK, PLBs are licensed for maritime and air distress situations only, as once a signal has been received, a National SAR operation is put into place to search for the beacon. The accuracy of the Cospas-Sarsat satellite system is designed to position local SAR forces within sufficient range of the beacon to conduct local search operations, and depending on which satellite system is used, there can be a delay of up to three hours before an accurate position is known. PLBs therefore are an invaluable survival and location aid, but are unsuitable for locating horse riders in a dynamic environment.

34. Infra-Red Devices. Some military fast-jet aircraft are currently fitted with forward-looking infra red (IR) devices and therefore considerable experience of the performance of these devices is available. During day low-level operations, a variety of heat sources can be detected by these devices, and all livestock, humans, vehicles and the like will provide an IR source that the system can 'see'. The major drawback experienced in aircraft fitted with these systems is that it is not possible to discriminate between specific sources of IR: for example, the IR signature of a horse and rider is indistinguishable from any other livestock. Consequently, the IR picture presented at low level has considerable 'clutter' due to multiple IR signatures, and the majority of fast-jet aircrew turn off IR cueing devices during the day as there is little or no usable information available. More accurate IR tracking is possible using devices similar to those fitted to police helicopters. However, use of these devices requires time to acquire the specific 'target' usually from a ground position report or from television optics that can search a larger area before pinpointing the 'target'. In addition, this type of device is most effective when used in the hover, or when stabilised and tracking the intended 'target', and acquisition at low level in a dynamic situation appears highly unlikely. Even if this type of device could be fitted to military helicopters it would, as in police helicopter operations, require a dedicated operator for the system, and therefore a complete redesign of the helicopter and its mode of operation. For military helicopters designed for combat operations this is not a feasible option, and therefore this type of IR tracker is also impracticable.

35. With neither radio-frequency nor IR devices appearing to offer a technical solution to locating and avoiding horse riders, a considerable amount of effort has been put into the investigation of more straightforward measures that may offer an affordable way forward. The key element is to improve the range at which aircrew can detect, and therefore avoid horse riders, and this requirement has many similarities with another major issue that affects all horse riders, namely safety on the roads. The British Horse Society has for many years run safety campaigns to improve rider safety on the roads, and the slogan used is 'Be Seen, Be Safe'. Intuitively, it appeared that this simple message may also be highly applicable to

assisting helicopter crews see and avoid horse riders, and consequently the Rotary Wing Evaluation and Trials Organisation based at RAF Benson
in Oxfordshire conducted Trial BRIGHT EYES to investigate the utility of this safety campaign for use with helicopters.

36. Trial BRIGHT EYES. Trial BRIGHT EYES was carried out to determine the effect on visual acquisition by helicopter crews of horse riders wearing High Visibility Clothing (HVC) and high visibility personal strobe lights. The Trial was conducted in three stages: Stage One involved cycle riders (simulating horse riders) on the airfield at RAF Benson, with visual assessment made from the ATC tower; Stage Two involved cycle riders (simulating horse riders) in the local fields system, with visual assessment made taken from a Puma helicopter flying from different directions at 50 and 100 feet AGL and finally, following consultation with the BHS, Stage Three involved horses and riders, and a Puma helicopter taking video footage whilst flying from different directions at 50 and 100 feet AGL. The use of flashing and steady strobe lights was assessed during Stages One and Two; following this stage, their use was discounted due to poor visual conspicuity from the air. Results from the use of HVC were encouraging. During Stage Two, the rider without HVC was not seen on several occasions, whereas the rider with HVC was seen on every occasion, and in enough time to effectively avoid over-flight. Flight at 100 feet AGL usually led to visual acquisition of the rider between 0.1 and 0.2 NM sooner than at 50 feet AGL. During Stage Three, the riders were not seen on two runs out of 10 when not wearing HVC; this was partially due to them being out of the field of view of the aircraft (to the left) and on a downslope. Of the seven runs when wearing HVC, the riders were seen on every occasion. A subjective assessment by the aircrew flying the Trial indicated that in most situations, horse riders wearing HVC would be visually acquired considerably sooner than if they were not wearing HVC[20]. The Trial concludes that a horse and rider wearing HVC (Day-Glo yellow) in most situations facilitates visual acquisition by a low flying military helicopter in sufficient time to effectively avoid over-flight, provided the horse and rider are in line of sight of the aircraft. Flight at 50 feet AGL will reduce the visual acquisition range, but still allow sufficient time to avoid overflight (0.3NM)[21]. The full Trial Report is at Annex E.

37. The results from this Trial reinforce the safety advice given by the BHS as a measure to reduce the frequency of road traffic accidents, and show clearly that the use of HVC significantly improves visual detection range providing horse and rider are in line of sight of the helicopter, and not obscured by terrain or other features. HVC is a low-cost safety measure[22] that provides an enhanced measure of safety, both on the roads and also for visual detection from the air, and is a measure that could be easily adopted by all riders in areas of helicopter activity. The results of this Trial together with advice for riders will be publicized as part of a joint safety campaign between MOD and the British Horse Society.

[20] For example, the riders in HVC stood out more clearly at distance than a parked Land Rover and 2 military personnel dressed in Combat Clothing. All Trial results are a subjective rather than scientific assessment.
[21] Provided within line of sight.
[22] In this Trial, the Hi Viz Jacket was purchased for £15, the Helmet Cover for £5, and the Exercise Sheet for £10.

Figure 2: Trial BRIGHT EYES - riders in normal (low visibility) and high visibility clothing.

Conclusion 9: the use of tracker devices to locate horse riders. Although radio frequency and infra red devices could indicate the presence of horse riders, they are not suitable for use on BHs in a dynamic environment as they cannot provide precision location at sufficient range to effect avoidance. Individual strobe lights, whilst effective at night, also do not offer sufficient range detection for daylight use. The use of high visibility clothing however offers a significant increase in visual detection range, and whilst high visibility clothing can never provide a total solution because of masking by terrain or vegetation, it is a simple and cost-effective option for horse riders to employ, and has a dual benefit of not only increasing visibility from the air, but also increasing visibility on the roads, where the majority of riding accidents occur.

<u>RECOMMENDATION 5: COCKPIT VOICE RECORDER</u>

> You will no doubt be aware that this device is fitted to the Chinook, however, it only records one hour of cockpit conversation before it is then overwritten.
>
> My task at the Inquest would have been made very much easier if the cockpit voice recorder had been operational throughout the whole of the sortie on 10th June 2003. I would recommend that, in future, this device should be operational throughout a sortie. If the HUMS equipment can record data for eight hours then surely it must be possible to record conversations on board a helicopter for a similar period of time. I understand that this is the norm with civilian aircraft in any event.

38. Where fitted, voice recorders fitted to military helicopters meet CAA mandated standards[23] for civilian helicopter accident recorders. This specification requires 8 hours of data supplemented by one hour of voice data with the aim of providing sufficient voice recording of any events leading up to an aircraft accident, rather than being a permanent record of the entire flight. The recorders serve to assist post accident investigations rather than post incident investigations. For future military helicopters, and when upgrades to in-service helicopters are planned, MOD Equipment Capability staff will carefully consider the requirement to fit accident data recorders that can provide an increased level of voice recording.

Conclusion 10: where fitted, current helicopter data recorders meet CAA requirements for accident recorders, but consideration will be given to fitting enhanced recording systems in future helicopters or during upgrade programmes.

<u>RECOMMENDATION 6: VIDEO MISSION TAPES</u>

> I was informed at the Inquest that sorties undertaken by fast jets are normally video taped. Is there any reason why helicopters involved in low fly training could not be fitted with similar equipment enabling the whole of the sortie to be video taped. If helicopter crews were aware that their flight was being video taped then it would encourage strict compliance with Flying Regulations. Further, it would provide evidence which would be immediately available in the event of a similar occurrence. It would also obviate the need for "flight reconstruction" in the future.

39. The fitting of cockpit video recorders does not present an insurmountable technical problem and a number of helicopters are capable of having this type of device fitted to assist in data gathering during both Developmental and Operational Evaluation trials. However, these devices are generally designed and fitted to record specific areas of interest within the cockpit and are installed for a short period of time, and therefore do not require permanent integration into the aircraft's electrical system. For trials purposes, one of the crew members can operate the camera when required, to record the item of interest, as these stand-alone

[23] CAA Specification No 18: Flight Data Recorder for Helicopter Accidents Investigation 1 June 1990, available from http://www.caa.co.uk/docs/33/CASPEC18.PDF accessed 27 Apr 05.

systems use their own battery power and have a limited duration tape length[24]. Using this type of recorder to capture sufficient cockpit information to allow effective reproduction for evidential purposes would require a multiple camera fit within the aircraft cockpit, as at an absolute minimum, data from both altimeters would have to be captured as well as the full picture looking through the cockpit windscreens, suggesting at least a four-camera fit is necessary. A multiple camera fit, whilst technically feasible, is a much more difficult problem likely to require extensive modification to the helicopter cockpit to accommodate the necessary recorders and mounting brackets. In addition, it would not be practical to expect a crewman to monitor the operation of multiple cameras in addition to the safe conduct of his/her normal duties in the low level environment, and it would therefore appear necessary to install a fully integrated control system to provide an automatic capability.

40. Fast-jet aircraft are commonly fitted with a video recording system that is designed to record head-up display (HUD) information for post mission analysis. These recorders are built into the aircraft but still only offer limited tape duration, and are consequently only operated for specific parts of any sortie. The latest helicopter, the Apache AH1, is also fitted with a head-up display system and therefore video recordings from this system are available for post-flight analysis following serious incident. The UKLFS regulations mandate that HUD tapes are retained for a period of two weeks after every sortie in case they are needed as part of accident or incident investigation, and this regulation remains in force for appropriately equipped aircraft and helicopters.

41. The alternative to using commercially available recorders for helicopters is therefore to design a video system that could be built in to the helicopter at manufacture or for retro-fitting, replicating the capability that is available on fast-jet aircraft and the Apache AH1 to record the head-up display for battle damage assessment. However, this would be an extremely expensive option that could not be justified solely in terms of gathering ‘evidence’, particularly when much of the data that could be provided by a video recorder is already available from post-flight analysis of cockpit data recorders. A database showing the availability of helicopter data recorders is at Annex F, and it can be seen that many helicopters are already fitted with data recorders, and those with earlier recording systems are scheduled for retro-fitting of the Generic Health & Usage Monitoring System (GHUMS) that provides comprehensive data that can enable accurate reconstruction of a sortie. Nonetheless, even if a video recording system was fitted, it would only show what may or may not have been seen from the cockpit, and microscopic examination of a video recording in slow time in an unchallenging environment could not take into account any of the multiple factors associated with the dynamic low level environment. Furthermore, low flying helicopters are already subject to covert monitoring to ensure compliance with low flying regulations. Monitoring is conducted without notice to aircrews by the Defence Complaints Flying Investigation Team using Skyguard radar, and is located in areas of high density traffic, complaint locations and other sensitive areas. Over the last 12 months, monitoring has revealed no breaches of low flying height regulations, showing that crews already demonstrate a high level of compliance with flying regulations.

[24] These video systems use the commercially available MiniDV format to ensure small size and portability, with a tape duration of one hour at normal levels of fidelity. Slightly longer recording is possible, but with a corresponding reduction in quality.

Conclusion 11: video recording. Using an off-the-shelf video system to record both cockpit data and the external scene would require multiple recorders and does not provide a permanent and robust solution for safe operation in he low level environment. The alternative is to build-in video recording capability with a fully automatic control system at manufacture, or as a retro-fitted modification. This option would incur considerable expense, and there is no evidence that this would produce more accurate evidence than that already available and where fitted, aircraft data recorders already provide sufficient data to enable highly accurate post-incident reconstruction. The Puma, which currently does not have a data recording facility is scheduled to be retro-fitted with the GHUMS system, and only the Gazelle will have no data recording facility. Aircraft data recording should therefore be sufficient for all evidential purposes.

RECOMMENDATION 7: SECURING EVIDENCE

In the event of future similar fatalities, clear procedures need to be established to immediately secure available evidence. Such procedures would need to incorporate the following :-

(a) All flight crew should immediately be the subject of alcohol and drug testing.

(b) The issue of whether or not the helicopter should be impounded needs to be considered at a high level.

(c) No further sorties should be undertaken following such an incident until arrangements have been made to download HUMS data from the relevant helicopter.

(d) The downloading of HUMS data should be regarded as a matter of the very highest priority. The data needs to be downloaded by a member of the Royal Air Force who has considerable experience in such matters. The download should take place in the presence of an RAF Police Officer. The downloaded data should be stored in a tamper-proof bag which should be properly labelled. The data should then immediately be placed in a secure place and kept under lock and key with limited access.

You should be aware that Sergeant Newton (Royal Air Force Police) investigated this matter. He was not aware that Chinook helicopters had HUMS equipment fitted. He indicated that he had received no training about which aircraft had such equipment and relied upon picking up such information by word of mouth.

I would recommend that immediate steps be taken to improve the training of RAF Investigators particularly in the field of securing evidence after an incident such as this.

You should be aware that the flight which resulted in Heather Bell's tragic death occurred on 10th June 2003. The HUMS data was downloaded from the helicopter some 28 hours after the crews return to RAF Odiham. You should also note that the aircraft had flown a further three sorties in the intervening period. Had the relevant data been erased from the HUMS system the Juries findings could have been radically different. Preservation of evidence in incidents such as this is of critical importance.

42. Availability of Aircraft Data.

The major user of aircraft data for investigative purposes is the Defence Aviation Safety Centre (DASC) at RAF Bentley Priory, where a permanent Boards of Inquiry Advisor is established to assist any Board of Inquiry with the investigation of an aircraft accident or incident. The DASC is supported by Military Accident Data Recorder Services that is part of QinetiQ Ltd, based at MOD Boscombe Down, under a long-term partnering arrangement. DFCIT personnel have obtained advice from QinetiQ specialists, and in conjunction with the DASC, have produced a comprehensive listing of all data sources available on current military aircraft. This list of data sources now forms part of the standard operating procedures for the DFCIT investigation of significant aircraft-related incidents, and will ensure the prompt recovery of all available aircraft data following an accident or incident. The database of available flight data recorder equipment is at Annex F.

43. Production of Standard Operating Procedures for the Investigation of Significant Aircraft-Related Incidents.

Detailed instructions for the handling and investigation of flying complaints from members of the public in the UK are contained within Defence Council Instruction 225 (2004). As a result of this recommendation, a revised protocol for the investigation of significant aircraft-related incidents has been produced by DFCIT personnel, and will be included in the next version of this instruction. A significant aircraft-related incident that will require DFCIT investigation is defined as:

a. Complaints where there has been alleged military aircraft involvement in an incident that has resulted in a fatality, life threatening or serious injuries that have required hospital admission. In the event of fatality, civilian police will have sole jurisdiction, but nonetheless DFCIT investigators will be required to advise the civilian police on securing the relevant aircraft and data.

b. Complaints where it is alleged that military ac activity has caused an incident that is likely to result in the submission of an extensive compensation claim.

c. Any incident in which a breach of flying discipline is alleged to have occurred. This would include a deliberate breach of flying discipline and/or neglect of a serious nature.

The revised protocol for the investigation of a significant aircraft-related incident breaks down the necessary action into four separate phases:

a. Confirmation of details of the reported incident with the Unit concerned and/or civilian police.

b. Aircraft log and trace through the Low Flying Booking Cell at RAF Wittering or through the Dedicated User Area operations organisations.

c. Identification of the aircraft, followed by recovery to a main operating base if airborne. With the assistance of the local Scene of Crimes Officer (Provost and Security Services), aircraft is to be sanitized for evidential purposes and guarded.

d. Recovery of aircraft data and impounding of all available evidence. Until this stage has been completed, the aircraft will remain grounded under guard.

44. Drug and Alcohol Testing. The Railways and Transport Safety Act 2003 (RTSA) imposes a criminal law regime for the testing of personnel in aviation safety critical posts for alcohol and drugs. Section 101 of the Act however exempts members of the armed forces

from the provisions of the Act, in this respect, when they are acting in the course of their military duties. The Ministry of Defence are now in contact with the Department of Transport with a view to removing the statutory exemption and applying the Act, with any additional legislative provisions that will be required, to all Service personnel in relevant military aviation posts.

a. Joint Service Publication 550. The Services have always recognised the requirement that aircrews be medically fit for their duties as well as not drinking in advance of flying duties. In particular, regulations relating to medical and alcohol limitations are contained within Joint Service Publication (JSP) 550: Military Aviation Policy, Regulations and Directives issued by the Defence Council. The relevant regulations comprise Directive D135 that states that 'all aircrew are to be physically and mentally fit to carry out their duties as authorized' and Regulation 305 specifically addresses alcohol and flying:

R305.115.1 Aircrew, including those with supervisory duties, are to ensure that they are not suffering from the effects, or after effects, of alcohol when reporting for duty. No alcohol is to be consumed during the 10 hours immediately prior to being liable for flying duties. Additionally, aircrew are to minimise their intake of alcohol during the 24-hour period before flying (as a guide no more than 5 units of alcohol).

b. Armed Forces Act 2001. Separate statutory provision does exist for alcohol and drugs testing within the armed forces. No penal sanctions are attached to this regime however. It is provided by section 32 Armed Forces Act 2001. The section grants powers to a designated officer (the Unit Commanding Officer) to test for alcohol and drugs following a serious incident, where an incident ***either resulted in, or created risk*** of death or serious injury to any person or serious damage to any property; and where in the opinion of the designated officer, it is possible that one or more persons subject to service law ***may have caused, or in any way contributed*** to the occurrence of the incident, or to any death or serious injury to any person or serious damage to any property resulting from it, or to the risk of any such death, injury or damage occurring. The complete text of this Paragraph is at Annex G.

On account of a number of factors, section 32 has not been brought into statutory force as yet. It is intended to bring the provision into force by November this year and the opportunity will then exist to test aircrew for alcohol and drugs. Weaknesses have been identified in section 32, not least in the taking of samples, which will have to be taken by personnel who are neither Service policemen nor medical staffs. The longer term aspiration of the RAF in particular is to replace section 32 by RTSA as quickly as possible and to ensure the timely taking of samples by police constables or Service policemen.

Conclusion 12: Securing evidence. Measures have been put in place to ensure that available aircraft data can be obtained from all military aircraft equipped with data recording facilities. Standard operating procedures have been introduced to ensure rapid and efficient investigation together with evidence gathering following an aircraft incident or accident. Withdrawal from the exemption provided in the Railways and Transport Safety Act 2003 is being taken forward by MOD.

RECOMMENDATION 8: RADALT WARNING SYSTEM

> The loadmaster who sits at the left rear of the aircraft is not able to hear or see the radalt warning devices. He has no alternative other than to rely upon visual assessment when judging the height of the Chinook. I would recommend that enquiries be made to ascertain whether or not it would be technically possible for this member of the crew to receive the same audible information as the remainder of the crew.

45. The Radio Altimeter (RADALT) accurately measures the distance between the Radalt aerial, fitted to the underside of the aircraft, and the nearest object below the aircraft. This information is displayed via an instrument to the both pilots in the cockpit. On a Chinook, and in common with most other helicopters, each Radalt instrument presented in the cockpit has a manually adjusted height indicator ('bug') that is used to set a predetermined height on the gauge. This 'bug', when set to a specific height, will indicate when the aircraft is at the pre-set height by a warning light on the instrument and a warning audio tone heard through the intercom. In the Chinook, the Number two Crewman also receives the same audible Radalt information as the pilots.

46. During normal operating procedures, each Radalt 'bug' is set independently of each other. The pilot handling the aircraft will set one height with the 'bug' on his Radalt instrument and the non handling pilot sets another slightly lower height. The warning light is selected to the higher of the 'bugged' heights on the Radalt and the audio warner to the lower. This then means that the handling pilot has a visual warning when he flies below his set height and once at the lower set height, the audio warner then sounds. Normal operating procedures at this point would be to conduct an immediate climb to at least above the highest 'bug' setting. However, if landing, the audio warner can be cancelled by using a paddle switch located on the collective lever flying control.

47. During all flight regimes both crewmen have the responsibility of monitoring Radalt settings through event checks and are encouraged to question the flight deck crew should the situation not be clear to them. Event checks can be initiated by any crew member and are invariably challenge and response. However, neither crewman has any way of checking Radalt settings short of looking at the flight deck Radalts. If a Radalt audio sounds the crew expects the ac captain to initiate a climb and to call 'Rad Alt protected'. If this procedure is not followed, any member of the crew *could* call for a climb. Nonetheless, primary responsibility for ensuring the aircraft maintains appropriate heights throughout a sortie is firmly placed with the handling and non-handling pilot, for the simple reason that neither crewman can effect control of the helicopter. Therefore, there is no **operational** benefit to be gained by providing an additional low-height warning to the number one (rear-left) crewman, as this would not prevent a height infringement. Consequently, it is concluded that the current arrangement for the provision of audio radalt warning in the Chinook is satisfactory for all **operational** purposes.

Conclusion 13: The existing arrangements for the provision of audio warnings of low height in the Chinook are satisfactory for all operational purposes.

RECOMMENDATION 9: RETENTION OF THE CURRENT AVOID OVER MARKET RASEN

> It is understood that as a mark of respect for Heather Bell and her family that no LFTH is currently taking place over the Market Rasen area. I was informed that this will be reviewed after Mrs. Bell's Inquest has been determined.
>
> I would strongly recommend that the current ban on low flying in the Market Rasen area should be permanently retained. It is a well known horse racing town and there are a significant number of horses ridden on a regular basis in this area. Further, I believe that it is a gesture that would be gratefully appreciated by Mrs. Bell's immediate family and the local community in general.

48. MOD policy is that the maximum possible area of the UK should be available for low flying in order to distribute any disturbance as widely as possible. Consequently, there is a strict policy on the granting of permanent avoidance areas, although temporary avoidance areas are granted for a variety of equine events, but are limited in duration. Typically this type of avoidance is given to major agricultural shows, events and competitions following a request from the event organiser.

49. The death of Mrs Bell was a tragic accident and the MOD is aware of the deep distress that this has caused not only to the immediate family of Mrs Bell, but also to the community in the Market Rasen area. Consequently, as a mark of respect to the Bell family, the avoidance area centred on the Middle Rasen church will be retained, and reviewed in 2009. The avoidance area is applicable to military helicopter traffic only, and extends for a radius of 1.5nm centred on the Church, and up to a height of 2000ft.

Conclusion 14: The avoidance area at Middle Rasen will be retained as a mark of respect for the Bell family, and reviewed in 2009.

CONCLUSIONS AND RECOMMENDATIONS

50. The following conclusions have been drawn from this review:

Conclusion One: The Operational Imperative. The threat faced by helicopters, their vulnerability due to speed and manoeuvre limitations, the need for surprise and the requirement to operate in marginal weather conditions all strongly support the imperative for helicopters to operate at very low altitudes.

Conclusion 2: DUAs. The existing geographical size and location of DUAs must be retained to ensure training efficiency and to minimize the potential of disturbance to the public.

Conclusion 3: Low Level Training Requirements outside DUAs. The amount of low level training conducted is closely matched to the operational role of each helicopter type and, providing a DUA is available for that helicopter type, only a small proportion of this training is conducted outside the DUA. Low level training requirements are retained at a minimum level to ensure operational proficiency is maintained. Any reduction in the current allocation of low level training hours would cause a loss of operational proficiency.

Conclusion 4: the area in which helicopter tactical low level training takes place. Most helicopter tactical low level training takes place in DUAs, or close to DUAs in ‘routine’ operating areas, with only a small proportion of activity being conducted at longer ranges throughout the UKLFS. Nonetheless, this smaller proportion of activity provides a high proportion of the most realistic training and therefore the ability to conduct such training must be retained to ensure operational readiness. Reversion to the pre-1979 low flying system would result in an increase in helicopter activity because of the need for longer transits, and is therefore counterproductive to the aim of this recommendation. Routinely used training areas should be re-designated as Helicopter Training Areas (HTAs) to indicate to the public the routine use of these areas for helicopter tactical training activities, and to provide a much better forecast of training activity. To mitigate the effects of tactical training outside HTAs, detailed information on the conduct (location and routes) of pre-planned training activities will be made available to the public to enable more informed decisions to be made.

Conclusion 5: the supervision and control of low level tactical training. Authorization of military low level training activities is tightly controlled at every level, and the authorization process provides a fully auditable trail of the conduct and justification for these activities.

Conclusion 6: Exporting helicopter low level flying training. Military helicopters already participate in a variety of exercises outside the UK, thereby reducing the impact of low flying training to the public. To gain sufficient effective training during overseas low flying exercises, ground forces must be involved, thereby considerably increasing the cost and complexity of any deployment. Issues of transportation add significant costs, and aircraft availability issues also considerably detract from this option if the National capability to meet operational tasking and to respond to crises is to be maintained. The overall effect of adopting this measure would be to impose an unrealistic demand on the Defence Budget, and therefore this option is neither practical nor affordable.

Conclusion 7: Increased Use of Simulation. Maximum possible use is currently made of available simulation capability within the limitations of existing technology. A number of initiatives are being introduced to increase the use of the synthetic environment and further reduce live flying requirements. As more modern simulators are introduced, the requirement for live flying training may decrease. However, unlike civilian helicopter aviation where a high level of simulation can be used due to the comparative simplicity of the simulation requirement, there will always be a limitation on the overall use of military simulation because the operational imperative to train as a full crew in a realistic environment with external agencies remains outside the capability of existing and near future simulation.

Conclusion 8: Better Communication with the Public. There are a number of measures that can be taken to considerably improve the utility of the telephone helpline that will enable horse riders to make better informed decisions. Measures have been taken to ensure that major exercises will be fully publicised to the public and to interested organisations. Equally, there are a considerable number of local initiatives that are being conducted to reduce the impact of helicopter low flying, and the MOD is working with a variety of organisations to explore potential ways ahead. The excellent working relationships established between the MOD and the BHS will be continued, and joint safety initiatives will be pursued in the future.

Conclusion 9: The use of Tracker Devices to locate Horse Riders. Although radio frequency and infra red devices could indicate the presence of horse riders, they are not suitable for use on BHs in a dynamic environment as they cannot provide precision location at sufficient range to effect avoidance. Individual strobe lights, whilst effective at night, also do not offer sufficient range detection for daylight use. The use of high visibility clothing however offers a significant increase in visual detection range, and whilst high visibility clothing can never provide a total solution because of masking by terrain or vegetation, it is a simple and cost-effective option for horse riders to employ, and has a dual benefit of not only increasing visibility from the air, but also increasing visibility on the roads, where the majority of riding accidents occur.

Conclusion 10: Data Recorders. Where fitted, current helicopter data recorders meet CAA requirements for accident recorders, but consideration will be given to fitting enhanced recording systems in future helicopters or during upgrade programmes.

Conclusion 11: Video Recording. Using an off-the-shelf video system to record both cockpit data and the external scene would require multiple recorders and does not provide a permanent and robust solution for the low level environment. Where fitted, aircraft data recorders already can provide sufficient accurate data for post-incident reconstruction. The Puma, which currently does not have a data recording facility is scheduled to be retro-fitted with the GHUMS system, and only the Gazelle will have no data recording facility. Aircraft data therefore should be sufficient for all evidential purposes.

Conclusion 12: Securing Evidence. Measures have been put in place to ensure that available aircraft data can be obtained from all military aircraft equipped with data recording facilities. Standard operating procedures have been introduced to ensure rapid and efficient investigation together with evidence gathering following an aircraft incident or accident.

Withdrawal from the exemption provided in the Railways and Transport Safety Act 2003 is being taken forward by MOD.
Conclusion 13: Audio Warning of Low Height. The existing arrangements for the provision of audio warnings of low height in the Chinook are satisfactory for all operational purposes.

Conclusion 14: The Avoidance Area at Middle Rasen. The avoidance area at Middle Rasen will be retained as a mark of respect for the Bell family, and reviewed in 2009.

51. It is therefore recommended that:

a. No additional changes are made to the way in which helicopter tactical training is supervised, authorized or conducted within the UKLFS.

b. Existing DUAs are retained at their current geographical size.

c. Helicopter Training Areas (HTA) are established to clearly define areas of routine helicopter training activity, to enable more accurate information about use of these areas to be given to the public.

d. Booking of pre-planned helicopter training outside DUAs and HTAs will require the route and geographical locations of tactical training so that more accurate information can be given to the public in areas not accustomed to helicopter training.

e. Continuing efforts are made to develop existing simulation capabilities to further reduce the requirement for live low flying training.

f. The helicopter free-phone advice line is further developed to be able to handle more accurate information provided by recommendations c & d above.

g. Further measures to improve communication with the public at a local level are pursued, and a joint safety campaign with the British Horse Society to promote the use of high visibility clothing for riders is taken forward.

ANNEXES

A. Low Level Tactical Training Requirements By Organisation And Aircraft Type.
B. The Pre-1979 Low Flying System.
C. The Area In Which Helicopter Low Level Tactical Training Is Routinely Conducted.
D. Technical Appraisal Of Avalanche Transceivers, Personal Locator Beacons And Man-Overboard Beacons For Use In Detecting Horse-Riders From Low Flying Helicopters.
E. Trial Report - Trial Bright Eyes.
F. Accident Data Recorder Replay Facilities.
G. Armed Forces Act 2001 Chapter 19.

LOW LEVEL TACTICAL TRAINING REQUIREMENTS BY ORGANISATION AND AIRCRAFT TYPE

The tables below show the number of hours of tactical low flying training (below 100 ft AGL) outside DUAs necessary for each helicopter type to maintain operational proficiency.

RN HELICOPTERS

Specific training activities require a reconnaissance of the area before they are conducted and consequently, RN Tactical Training Requirements should have no adverse impact on either public or livestock.

JHC OPERATIONAL BHs

Unit (a)	Proportion of tactical training conducted outside DUAs. (% of overall training hours) (b)	Total Annual Requirement for tactical training outside DUAs (hours) (c)
Chinook/Lynx, JSFAW (7&657 Sqns)	18.75%	1125
Chinook, 18 Sqn	12.5%	1075
Chinook, 27 Sqn	12.5%	1760
Merlin, 28 Sqn	9%	1123
Puma, 33 Sqn	8%	672
Lynx/Gazelle, 3 Regt AAC	18%	240
Lynx/Gazelle, 4 Regt AAC	18%	182
AH/Lynx, 9 Regt AAC	100%	5472[25]
CHF	4.5%	77.4
JHC TOTAL		**11726.4**

Table A1: Low level tactical flying requirements for JHC operational helicopters.

JHC OPERATIONAL CONVERSION COURSE AND SUPPORT UNIT REQUIREMENTS

Aircraft Type (a)	Course Requirement for tactical training (hours) b)	Proportion of tactical training conducted outside DUA. (c)	Maximum annual throughput of students (d)	Total Annual Requirement for tactical training outside DUAs (hours) (e)
Chinook	10	50%	24	120
Merlin	3	90%	8	22
Puma	13	40%		150
Sea King Mk4	8.75	28%	16	39
AH AMTAT	N/A	12%	-	278
R & S Wing	5	50%	-	280
TOTAL				**889**

Table A2: Low level tactical flying requirements for JHC operational conversion helicopters.

[25] Note: 9 Regt AAC does not have a DUA available for tactical training activities.

SEARCH AND RESCUE TACTICAL LOW FLYING REQUIREMENTS

RAF SAR

Specific training activities require a reconnaissance of the area before they are conducted and consequently, RAF SAR Tactical Training Requirements should have no adverse impact on either public or livestock.

RN SAR

Specific training activities require a reconnaissance of the area before they are conducted and consequently, RN SAR Tactical Training Requirements should have no adverse impact on either public or livestock.

DEFENCE HELICOPTER FLYING SCHOOL

The majority of low level helicopter training takes place within DUA 9, centred on RAF Shawbury, the home of the Defence Helicopter Flying School (DHFS). The Search and Rescue Training Unit (SARTU) does not have its own DUA, but these helicopters operate within the RAF Valley Military air Traffic Zone and the Holyhead Range Danger Area which is set aside for training purposes.

Unit (a)	Total Annual Course Requirement (hours) (b)	Proportion of LL flying below 100ft conducted outside DUA. (c)	Proportion of flight below 100ft agl outside dedicated range areas (hours) (d)	Total Annual Requirement for flight below 100ft agl outside DUAs (hours) (e)
DHFS Shawbury	977	5%	N/A	36
SARTU	348	N/A	0%	0
TOTAL				**36**

Table A3: Low level tactical flying requirements for DHFS helicopters.

THE PRE-1979 LOW FLYING SYSTEM

The graphic below depicts the pre-1979 UK Low Flying System. The areas coloured orange are low flying areas, and these low flying areas are connected by ‘link routes’ that could also be used at low level. This system of areas and routes was designed to provide long-range training opportunities for the Vulcan bomber, and was superseded in 1979 by the current UK low flying system.

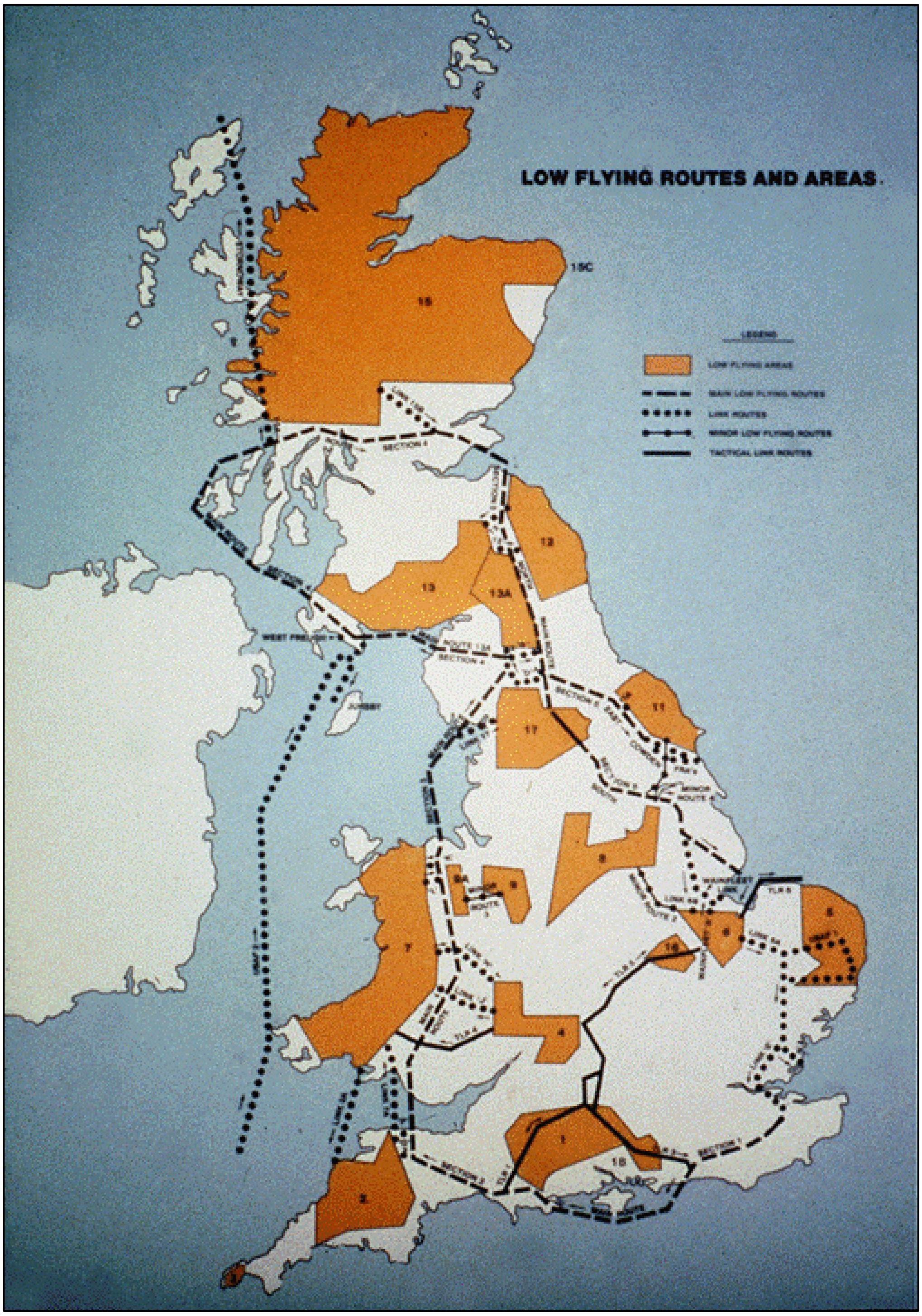

Figure B1: The pre-1979 UK Low Flying System.

Whilst Figure B1 shows the pre-1979 low flying system, it does not show areas where military low flying is **not** conducted due to avoidances afforded to the larger centres of population, and therefore Figure B2 incorporates these avoidance areas to present a more complete picture. Low flying exclusion zones are shown in red.

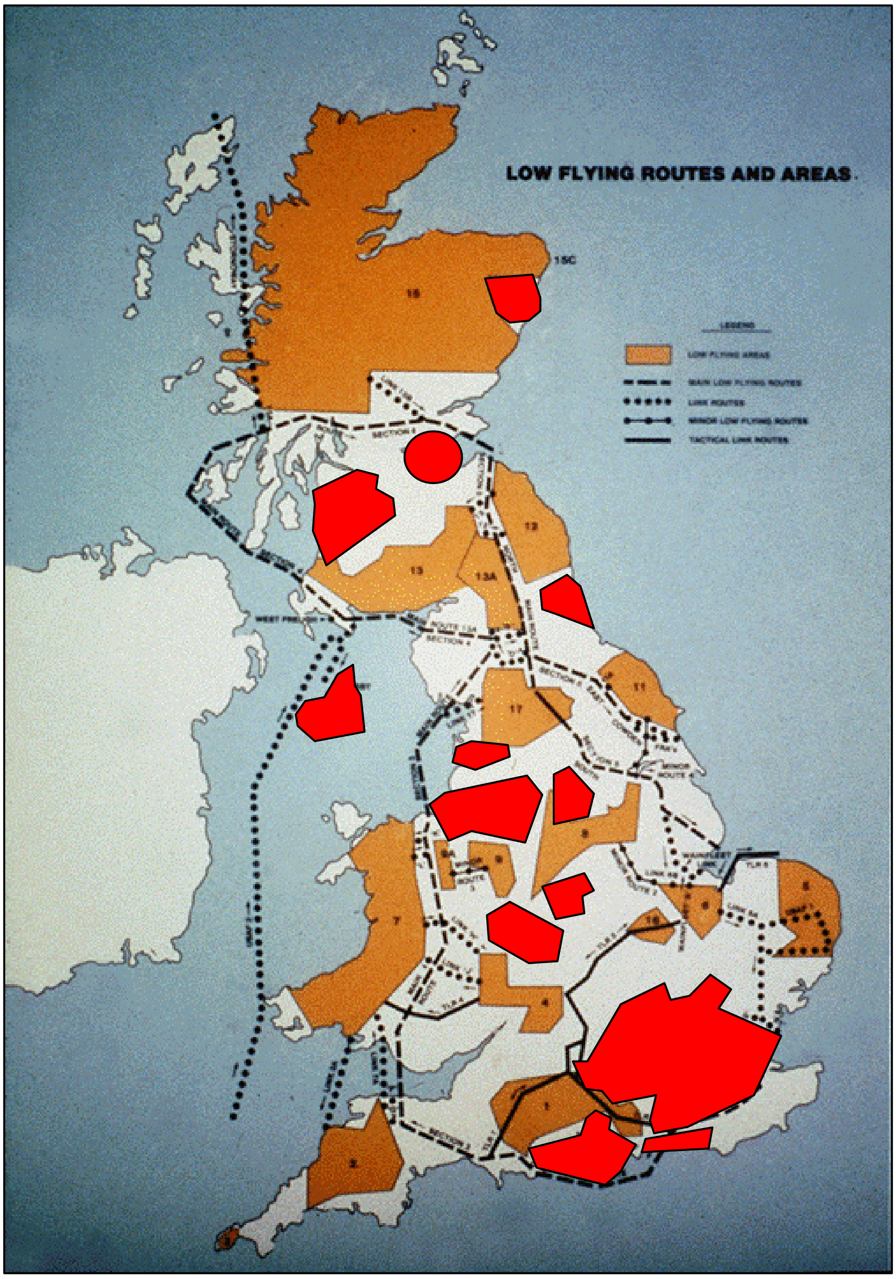

Figure B2: the pre-1979 low flying system including permanent avoidance areas.

THE AREA IN WHICH HELICOPTER LOW LEVEL TACTICAL TRAINING IS ROUTINELY CONDUCTED

Tactical helicopter training can take place throughout the UKLFS however, because of current helicopter basing patterns together with range limitations, a large proportion of helicopter tactical training takes place either within DUAs or in adjacent areas. The pattern of helicopter low flying represented in white on the map represents 80-85% of all activity outside DUAs during a 3 month period from Feb – May 05. These patterns represent 'routine' training activities, but the remaining 15-20% of training activity includes major and minor exercises together with deployments from home base, and these are the activities that provide the highest value training, by most closely representing operational missions.

Yellow Areas - Helicopter DUAs

Blue Areas - No Low Flying

White Areas - Areas outside DUAs frequently used for helicopter low level tactical training

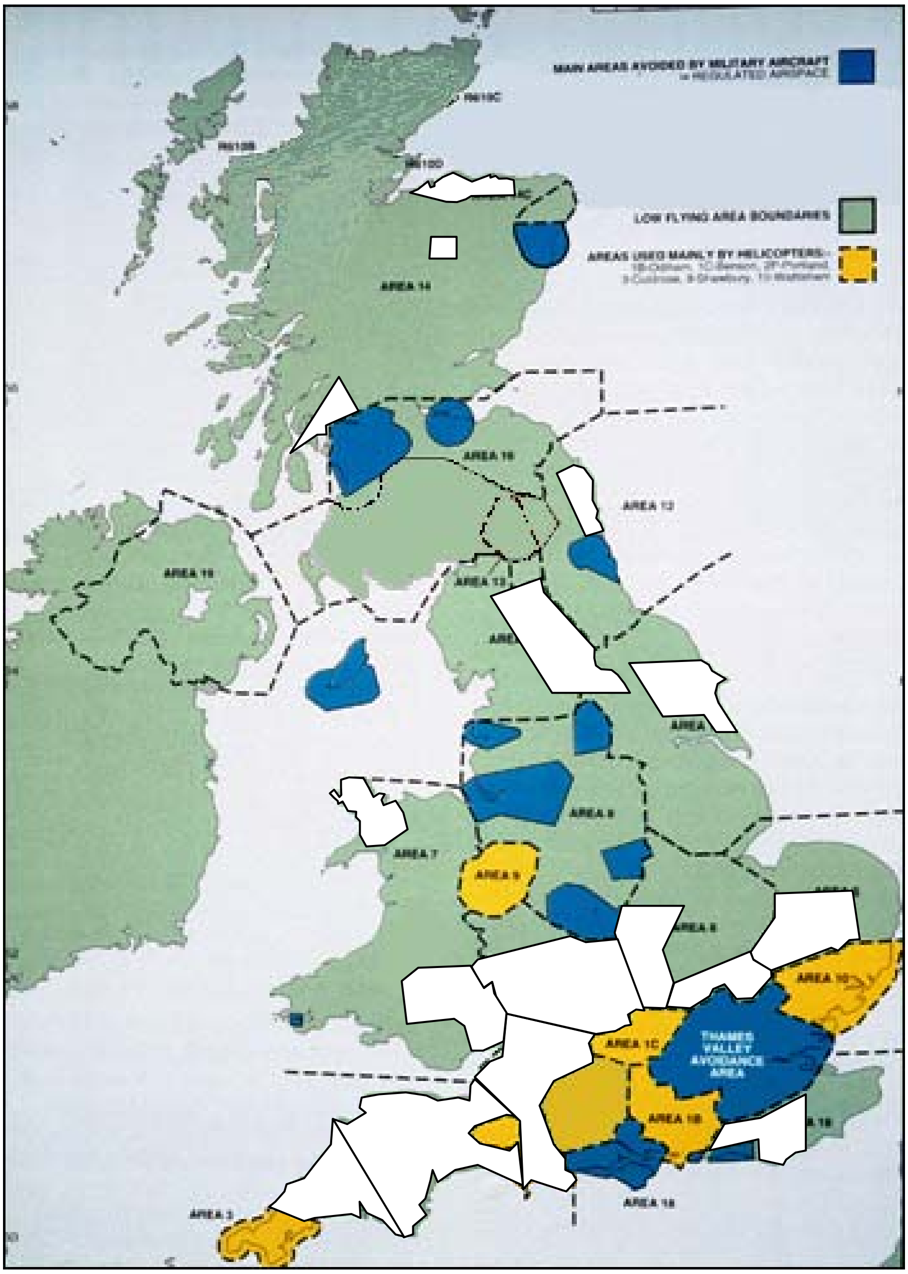

Figure C1: Areas of frequent helicopter tactical training activity.

TECHNICAL APPRAISAL OF AVALANCHE TRANSCEIVERS, PERSONAL LOCATOR BEACONS AND MAN-OVERBOARD BEACONS FOR USE IN DETECTING HORSE-RIDERS FROM LOW FLYING HELICOPTERS

Avalanche Transceivers.

Avalanche transceivers are small, portable devices designed that are designed to allow mutual rescue within a group of mountaineers following an avalanche, without having to wait for mountain rescue services. Transceivers are therefore designed to work in 2 modes: transmit and search. In transmit mode, the transceiver emits a low-power signal. This signal can, in theory, be detected by any other transceiver unit, as all beacons on the market use a standardized frequency of 457 kHz, although interoperability between differing makes of beacon is dependent on the accuracy of the quartz crystal that regulates frequency. All transceiver beacons use analogue transmission technology that when transmitting, emits an elliptical electromagnetic field that can be detected by a transceiver set to receive. Maximum signal strength is obtained when both antennas are parallel, and weakest when at right angles. How this information is displayed depends on the type of processing used by the transceiver.

> Analogue Signal Processing Transceivers. Analogue processors convert the received radio frequency signal into an audio output that is amplified through a loudspeaker. To home to the emitter the receiving transceiver must first be rotated to find the strongest flux line that will determine the direction to search (loudest sound in a static position), and then the flux line followed towards the target (increasing sound as range decreases). Some analogue devices have additional Light Emitting Diodes to assist with direction.

> Digital Signal Processing Transceivers. Digital transceivers use a microprocessor to perform an algorithm on the received signal, and will display both direction and range to the target emitter. Digital transceivers therefore offer the operator improved ease of use due to a lower requirement to interpret the received signal.

The major drawback for the potential use of avalanche transceivers as a locating device for horse-riders is their limited range. In a comparison test of 5 beacons conducted by The Swiss Federal Institute for Snow and Avalanche[26], the mean detection range was 30.8 metres at a buried depth of one metre. When used over-ground, this range potentially increases to a maximum of around 80 metres for analogue devices, and slightly less for digital devices that require a higher signal strength to perform the range processing algorithm. A report entitled 'Terrestrial and Helicopter Based Transceiver Search with Long Range Receivers[27]' indicates that long-range transceivers can offer increased range of 180 metres but necessitate a 3 antenna fit to the helicopter to provide a search strip of 120 metres wide. An additional drawback with avalanche transceivers is critical interference between two transceivers. The Swiss Federal Institute for Snow and Avalanche report indicates that in trials using two transmitter units, some receiving units were unable to detect the presence of the second unit in 15 out of 17 trials. There is no data for multiple devices, a situation that could clearly be encountered with multiple horse-riders in the field, but it would appear unlikely that detection would be improved.

[26] Online, available from www.climber.org/Resource/avalancheRecv.html accessed 7 April 2005.
[27] Online, available from www.genswein.com/long range receivers.doc accessed 7 April 2005.

Extensive trials of avalanche transceivers have been conducted by authorities in the Alps and in the United States, and there is little doubt of the utility of these devices for immediate avalanche search. However, all these devices have very limited range capability, with a maximum for ‘long-range’ systems of about 180 metres. For a helicopter flying at 120kts, this distance represents 2.9 seconds flying time, insufficient to effect avoidance. It has therefore been concluded that a further trial by the Ministry of Defence of these types of device for use by helicopters to avoid horse-riders offers little possibility of success, and that avalanche tracker devices are impracticable for use in the detection of horse riders by helicopters.

Personal Locator Beacons.

There are a wide variety of locator beacons currently available, and these beacons fall into 3 categories: Emergency Positioning Indicating Radio Beacons (EPIRB) for maritime use, Emergency Locator Transmitters (ELT) for aviation use, and Personal Locator Beacons (PLB) that are portable units designed to be carried on the person, and it is this last category that will be considered further. All PLB are designed for emergency use only in situations of distress and can be further sub-divided into 2 categories: PLB that utilize the Cospas-Sarsat satellite system, and homing beacons that are optimized for local search.

The Cospas-Sarsat System.

Cospas-Sarsat uses a system of satellites and ground stations to provide global detection of distress beacons operating on 406 and 121.5 MHz. However, because of the 98% false alarm rate of beacons using 121.5 MHz, this capability will cease to be available from 2009. The Cospas-Sarsat 406 MHz system comprises the PLB, polar orbiting satellites in low-earth orbit (LEOSAR) and geostationary satellites (GEOSAR) together with their associated local user terminal (LUT) ground-based receiving stations.

406 MHz PLB. Second generation PLB were introduced in 1997 and transmit a 5 Watt Radio Frequency signal of 0.5 second duration every 50 seconds. In addition, these PLB also transmit digitally encoded data that carries a unique 15 digit hexadecimal identification and where enabled, position information derived from the Global Position System (GPS). The unique beacon identification allows retrieval of information on the beacon owner from the relevant national registration database.

LEOSAR Satellite System. The LEOSAR system comprises four polar-orbiting satellites that provide complete coverage of the earth’s surface every three hours. As the satellite is in an active orbit, it uses Doppler processing techniques to calculate the position of the PLB.

GEOSAR Satellite System. The GEOSAR system comprises three stationary satellites that provide continuous coverage of the earth’s surface from 70 degrees North to 70 degrees South. As these satellites are stationary, there is no Doppler shift on the received signal and therefore Doppler positioning cannot be used. Consequently, the GEOSAR system requires either an encoded GPS position from the PLB or additional information from the LEOSAR system.

LUTs. A total of 60 LUTs are available worldwide to receive signals from either the LEOSAR or GEOSAR systems, and these terminals feed into 26 Mission Control Centres that control the operation of Search and Rescue forces. Within the UK, the Mission Control Centre is located at the Air Rescue Co-ordination Centre at RAF Kinloss in Morayshire.

Cospas-Sarsat System Accuracy. The Cospas-Sarsat system is designed to get Search and Rescue forces close enough to the PLB to allow local search techniques to be used, and most 406MHz beacons also have an auxiliary low-powered 121.5 MHz transmitter for this purpose. For PLB without GPS data, positional accuracy is approximately three to four kilometres, whereas with GPS data available from the PLB, positional accuracy improves to within 100 metres for a stationary beacon.

Limitations of the Cospas-Sarsat System as a Location Aid for Riders. The Cospas-Sarsat system is designed for global search and rescue, and there is strict legislation on the use of PLB. In the UK, the use of PLB is restricted to the maritime environment only, and there is no authority to use PLB overland. Within the Cospas-Sarsat system, the number of PLB worldwide is restricted, and unique data is held for every beacon. The system provides sufficiently accurate positional information within three hours to allow search and rescue forces to commence local search techniques. The Cospas-Sarsat system is therefore an international distress alerting service, and any other use would be wholly inappropriate.

Localized Homing Beacons.

Localized homing beacons provided a low-power distress signal on 121.5 MHz. Because of restrictions within the UK on the use of PLB for maritime purposes only, development of localized homing beacons has been for marine safety, and specifically for man-overboard purposes for yacht racing (initially for the Fastnet races). For maritime use, this type of system comprises two key components, a wristwatch transmitter worn by the individual, and a mast-mounted direction-finding receiver. The system is however capable of being detected by any search and rescue aircraft or helicopter equipped with 121.5 MHz homing equipment. The range at which the signal can be received is dependent on the height of the receiver, and estimates vary in the literature. However, McMurdo Limited[28], manufacturers of the *Guardian Wristwatch Manoverboard Transmitter (£220 approximately)*, quote a range of up to 5 nm to a search and rescue aircraft, and up to one nautical mile for a surface vessel using a mast-mounted receiver. A low flying helicopter operates at mast-top heights in the region of 50 – 100 feet, and therefore a similar reception range is likely to be achieved. Determining an accurate position for any beacon transmitting on 121.5 MHz is dependent on the type of receiver used.

Wristwatch Transmitter. Wristwatch transmitters provide approximately 8 hours transmission of a distress signal on 121.5 MHz. To conform to European legislations, these devices use interrupted rather than continuous transmission, and have differing duty cycles (how often they transmit), determined by their manufacturer.

Homing Receivers. Homing receivers generally use a pair of switched antennas, or phase detectors together with an electronic package to determine the approximate

[28] See http://www.mcmurdo.co.uk/Images/CMS_Images/Guardian%20MOB.pdf accessed 14 Apr 05.

angle of arrival of the incoming signal. This type of receiver requires antenna movement to produce a bearing, and consequently a search pattern is usually flown to determine the 'dead spot' overhead position of the emitter. RAF and Coastguard Search and Rescue helicopters are equipped with basic 121.5 MHz homing receivers, but establishing the position of the emitter requires a search pattern to be flown at 1000 feet, before reducing height to 200 feet to determine the precise location. This procedure requires at least 2 direct over-flights of the position and takes approximately 10 minutes to complete, providing that the SAR helicopter has an approximate starting location for the emitter beacon (usually relayed via the Air Rescue Co-ordination Centre and derived from Cospas-Sarsat information).

Doppler Receivers. The most modern Doppler direction finding receivers are equipped with a circular array of 4 antennas (or 8 for improved accuracy) with rapid electronic switching used to establish circular movement between the antennas that can measure the frequency shift of the incoming signal for subsequent processing to provide bearing information. Bearing accuracy is in the order of $\pm$ 5 degrees[29]. This type of direction finding receiver also provides an indication of received signal strength that gives a rough approximation to range to the emitter. These modern Doppler direction finding receivers are purpose designed as man-overboard systems and the 8 antenna array is a single unit designed to be mast-mounted on-board smaller vessels. The antenna array is not designed for, nor is it sufficiently rugged for military helicopter use, and would require considerable re-design work to be made fit for this purpose.

Limitations of Localized Homing Beacons as a Location Aid for Riders. With homing equipment currently fitted to SAR helicopters, a search pattern is required to be flown to establish the position of beacons using 121.5 MHz. Consequently, existing equipment would be inadequate to rapidly detect and display the location of this type of beacon. Nonetheless, with a modern Doppler direction finding receiver, this type of PLB appears to offer some level of utility as both bearing and rudimentary range information is provided. The accuracy of bearing information is $\pm$ 5 degrees and may therefore not be sufficiently precise to give accurate first-pass avoidance. These devices are designed for extended transmission time, and for the *McMurdo Guardian*, 8 hours transmission is possible before battery exhaustion however, to ensure this transmission time is achieved there is a trade-off in output power, thereby limiting the effective range. Given unobstructed line-of-sight from the beacon to the helicopter, if the maximum of one mile reception range is achieved, this would provide a warning 30 seconds prior to over-flight. Little information exists about the effect of multiple beacons of this type but all beacons transmit a relatively simple signal on the same frequency, and mutual interference may therefore occur, particularly with interrupted transmissions. At longer range, depending on the type of receiver, multiple signals may appear merged as a single beacon, giving a false location. As received power levels increase with reducing range, it may be possible to identify individual signals, but this may have the effect of reducing the range at which accurate detection occurs. Notwithstanding the limited range capability, there are 2 additional major drawbacks for using this type of system on a helicopter for locating and avoiding horse riders. Firstly, these systems would need to be completely re-designed for this type of use, and even re-design would give no indication of the possibility of successful integration and operation in the busy and cluttered Radio Frequency environment found on

[29] McMurdo Precision Direction Finder, online, http://www.mcmurdo.co.uk/Images/CMS_Images/88-803N%20Iss3%20Guardian%20Direction%20Finder%20manual.pdf accessed 15 Apr 05.

any BH. Secondly, these systems are designed as distress beacons that use an internationally recognised distress frequency: use for non-distress purposes in an over-land scenario would potentially endanger actual rescue operations.

R&S/J5/2/1/27

TRIAL REPORT

TRIAL BRIGHT EYES

EXECUTIVE SUMMARY

1. As a result of the Coroner's Inquest into the tragic death of Mrs Heather Bell, DAS requested that a conspicuity devices trial be carried out to determine the effectiveness of horse riders wearing High Visibility Clothing (HVC) and high visibility personal strobe lights. The RWOETU was tasked by JHCHQ to conduct the Trial.

2. The Trial was conducted in 3 stages, initially using bicycle riders to simulate horse and rider, as follows: stage one involved cycle riders on the airfield at RAF Benson, with photographs taken from the ATC tower; stage 2 involved cycle riders in the local fields system, with photographs taken from a Puma helicopter flying from different directions at 50 and 100 feet AGL and, finally, stage 3, following consultation with the British Horse Society, involved real horses and riders and a Puma helicopter taking video footage whilst flying from different directions at 50 and 100 feet AGL.

3. HVC (yellow Day-Glo) for the horse and rider was trialled, dressing one rider with and one without for stages one and 2. Stage 3 involved runs with and without HVC. The use of flashing and steady strobe lights was assessed during stages one and 2; following this stage, their use was discounted due to poor visual conspicuity from the air.

4. Results from the use of HVC were encouraging. During stage 2, the rider without HVC was not seen on several occasions, whereas the rider with HVC was seen on every occasion, and in enough time to effectively avoid over-flight (assessed as 0.3 Nautical Miles (NM)). Flight at 100 feet AGL usually led to visual acquisition of the rider between 0.1 and 0.2 NM sooner than at 50 feet AGL. During stage 3, the riders were not seen on 2 runs out of 10 when not wearing HVC; this was partially due to them being out of the field of view of the aircraft (to the left) and on a downslope. Of the 7 runs when wearing HVC, the riders were seen on every occasion. A subjective assessment by the aircrew flying the Trial indicated that in most situations, horse riders wearing HVC would be visually acquired considerably sooner than if they were not wearing HVC[30].

5. The Trial concludes that in most situations, a horse and rider wearing HVC (Day-Glo yellow) facilitates visual acquisition by a low flying military helicopter in sufficient time to effectively avoid over-flight, provided the horse and rider are in line of sight of the aircraft. Flight at 50 feet AGL will reduce the visual acquisition range by between 0.1 and 0.2 NM, but still allow sufficient time to avoid overflight (0.3NM)[31].

6. It is recommended that DAS informs the Coroner of the results of this trial, engages with the British Horse Society as to how they might gainfully utilise the findings, and conduct a publicity campaign to raise horse rider HVC awareness amongst military helicopter aircrew.

[30] For example, the riders in HVC stood out more clearly at distance than a parked Land Rover and 2 military personnel dressed in DPM. All Trial results are a subjective rather than scientific assessment.
[31] Provided within line of sight.

TRIAL REPORT

TRIAL BRIGHT EYES

References:

A. Letter SPGF/PD/Bell from HM Coroner For Louth and Spilsby to ACAS dated 4 Nov 04.
B. Email SO1 J7 JHCHQ to OC R&S Wg dated 23 Nov 04.
C. MOD Helicopter Low Flying Review Meeting 11 Jan 05.

INTRODUCTION

7. Mrs Heather Bell died from injuries sustained falling from her horse which had been spooked by a low flying military helicopter. Following the inquest, HM Coroner for Louth and Spilsby wrote to ACAS, at Reference A, with a number of recommendations, one of which regarded the use of devices to help locate horse riders. At Reference B, the RWOETU was tasked, via JHCHQ, to conduct a short trial into the use of such conspicuity devices. The use of technical devices such as beacons or infra red strobes was discounted at Reference C, due to the difficulties in triangulation and the difficulty in separating livestock from background IR clutter in the low level environment. The RWOETU was subsequently directed to determine the acquisition ranges of readily available and relatively inexpensive conspicuity devices such as high visibility clothing and strobes. The Trial Management Officer for the Trial was the Merlin/Puma Flt Cdr at the RWOETU.

AIM

8. The aim of Trial BRIGHT EYES was to assess the effectiveness of conspicuity devices (High Visibility Clothing (HVC) and Strobe Lights), when seen from the air, to assist in visually acquiring horse riders.

TRIAL OBJECTIVES

9. The objectives of Trial BRIGHT EYES were to:

a. Assess the effectiveness of Yellow Day-Glo HVC, when worn by horse riders, to aid visual conspicuity when viewed from the air.

b. Assess the effectiveness of high visibility personal strobe lights, when worn by horse riders, to aid visual conspicuity when viewed from the air.

ASSOCIATED TASKS

10. The following associated tasks were undertaken:

a. Assess whether flight at 50 feet above ground level (AGL) and 100 feet AGL affected visual acquisition ranges.

CONDUCT OF TRIAL

11. For safety reasons, the HVC and strobes were initially trialled (stages one and 2) using bicycle riders to "simulate" a horse and rider. Stage 3 utilised 2 real horses and riders – these were sourced via the British Horse Society.

EQUIPMENT UNDER TEST

12. The following equipment was assessed; further details can be found at Annex A:

a. High Visibility Bomber Jacket Yellow.
b. High Visibility Riding Helmet Cover Yellow.
c. High Visibility Exercise Sheet Yellow.
d. Starlight Strobe.
e. Lifesystems Survival Strobe.
f. Emergency Light Strobe.
g. Red/Amber Steady/Flashing Strobe.

TRIAL METHOD

13. The Trial was conducted in 3 stages:

a. Stage One. This was conducted on the airfield at RAF Benson on 3 Feb 05, with photographs taken from the ATC Tower. For safety, 2 bicycle riders were used to simulate horse and rider, one wearing HVC and strobe lights, the other wearing dark green/brown clothing. The "riders" were positioned on the airfield at distances from the Tower ranging from 100 metres to 1500 metres. This initial stage was to ascertain whether it was appropriate to invest further trials activity into HVC and strobes as conspicuity devices.

b. Stage 2. Conducted on 15 Feb 05, stage 2 was to assess whether the results from stage one stood true when viewed from an airborne platform, and was conducted in the RAF Benson local fields system, utilising 2 fields with differing characteristics[32]. Again, 2 bicycle riders were used to simulate horse and rider, one wearing HVC and strobe lights, the other wearing dark green/brown clothing. A Puma aircraft was flown towards the (known) positions at 50 feet AGL and 100 feet AGL, utilising differing inbound headings. Photographs were taken from the centre seat as soon as the "riders" were visually acquired, and the ranges noted.

c. Stage 3. This final assessment, on 30 Mar 05, was to ascertain whether the results of stage 2 stood true when using live horses and riders. This was conducted along a bridle way, utilising 2 real horses and riders (sourced following consultation with the Head of Safety for the British Horse Society). Again, a Puma was flown towards the riders (only approximate position known, i.e. on the bridle way) at 50 feet AGL and 100 feet AGL, again using various vectors, and filming the runs from the left

[32] Field 5 – In low ground, flat, grass surface, surrounded by scattered trees.
Field 21- On high ground, undulating, muddy surface, trees on North and West boundaries.

hand seat of the aircraft with a video camera recorder. This stage was initially flown with the riders wearing ordinary clothing and then repeated wearing HVC.

TRIAL CONSTRAINTS

14. There are many variables which were not taken into account for this Trial – the task was for a short trial to give a snapshot evaluation. Therefore, inter-alia, the following factors were not taken into account:

a. Weather, time of day, position of sun, season.

b. Type of aircraft – aircraft availability dictated that a Puma was used for this Trial.

c. Aircrew selection/individual ability.

d. Aircraft height, other than the difference between 50 and 100 feet AGL.

e. Size of rider/horse.

f. Colour of crops/surrounding area.

15. The following were taken into account, albeit in a limited capacity:

a. Terrain – undulations etc.

b. Foliage/trees/obstructions.

16. For stage 2, the simulated riders were static and in a known position.

17. For stage 3, the horses and riders were moving along a bridleway. Therefore, only the approximate position was known to the aircrew.

TRIAL RESULTS

STAGE ONE

18. For stage one, the results of the HVC were encouraging. It was obvious at all ranges from the ATC tower that there was a human wearing HVC. However, at the extremities (1000 metres plus) it was difficult to make out that he was on a bicycle. The rider not wearing HVC tended to blend with the background at ranges exceeding 500 metres, and was often not seen against the rural backdrop. The rider with HVC was always clearly visible when in line of sight.

19. The strobe lights were barely visible beyond 100 metres, and then only when looking directly at them. When looking 10 degrees or more either side of the strobe, they were no longer seen.

20. It was decided that the results of stage one were appropriate to continue to stage 2 of the trial.

STAGE 2

21. It was the opinion of the aircrew conducting stages 2 and 3 of the Trial that they would effectively be able to avoid a horse and rider if sighted from a distance of 0.3 NM at cruise speed (120 kts for the Puma).

22. The main results of stage 2 are summarised at Annex B. In essence, the rider wearing HVC was seen on every run with sufficient time to effectively avoid. Further, flight at 100 feet rather than 50 feet AGL increased the visual acquisition range by an average of between 0.1 and 0.2 NM.

23. The personal strobes were not seen on any of the runs, even when in direct line of sight. Following this stage, it was decided that no further trials time would be invested in their use as a conspicuity aid.

24. It was decided that the HVC results from stage 2 were appropriate to continue to stage 3 of the trial.

STAGE 3

25. These runs were used to confirm the results from stage 2 were true when the static riders were replaced with real horses and riders. The main results are summarised at Annex C. In sum, the riders were seen every time when utilising the HVC. Without the HVC, however, there were 2 occasions when the riders were not seen; partially, this was due to them being out of line of sight on a down slope.

26. The video footage supports the opinion of the aircrew, in that Day-Glo yellow HVC, when worn by a horse rider, significantly improves visual conspicuity when viewed from a helicopter.

TRIAL OBJECTIVES SATISFIED

OBJECTIVE 1. ASSESS DAY-GLO YELLOW HVC

27. Objective 1 addressed the effectiveness of Day-Glo yellow HVC, when worn by horse riders, to aid visual conspicuity when viewed from the air…..OBJECTIVE FULLY SATISFIED.

OBJECTIVE 2. ASSESS HIGH VISIBILITY STROBES

28. Objective 2 addressed the effectiveness of high visibility personal strobe lights, when worn by horse riders, to aid visual conspicuity when viewed from the air………...OBJECTIVE FULLY SATISFIED.

ADDITIONAL OBSERVATIONS

29. For a helicopter to see and avoid overflight of a horse and rider, the 2 must be in line of sight of each other. Whilst HVC serves to significantly improve conspicuity and effectively speed up the visual acquisition process, it will not allow the aircrew to see through obstacles, including woods, buildings etc.

30. Whilst flight at 100 feet will increase the visual acquisition range, this is because the horse and rider will come into line of sight sooner. Flight at 50 feet AGL still allowed sufficient time for the crew to avoid overflight of the horse and rider, once seen.

ACKNOWLEDGEMENTS

31. The British Horse Society helped source highly qualified and experienced riders, and horses which were located close to an airfield, for Stage 3 of the Trial. Miss Allison Hardy, one of the horse riders, must also be thanked for her invaluable liaison with the farming community in the area of the Trial.

CONCLUSIONS

32. It is concluded that Day-Glo yellow HVC, when worn by horse riders, considerably aids visual conspicuity from the air and should facilitate earlier visual acquisition by a low flying military helicopter in sufficient time to effectively avoid over-flight, provided the horse and rider are in line of sight of the aircrew. Flight at 50 feet, rather than 100 feet AGL, will reduce the visual acquisition range by between 0.1 and 0.2 NM, but still allow sufficient time to avoid overflight (0.3NM). HVC will not, however, enable visual acquisition if the horse and rider is not in line of sight of the aircrew, i.e. there is an obstacle in the way.

33. It is concluded that high visibility personal strobe lights, when worn by horse riders, do not aid visual acquisition from the air.

RECOMMENDATIONS

34. It is recommended that:

a. The Trial sponsor (DAS) informs the Coroner of the results of this Trial.

b. The Trial sponsor liaises with the British Horse Society in order to publicise the results of this Trial as they see fit.

c. The Trial sponsor conducts a publicity campaign amongst military rotary aircrew to increase awareness of the HVC which may be worn by horse riders.

Original signed

J COXEN
Wg Cdr
OC R&S Wg

May 05

Annexes:

A. HIGH VISIBILITY CLOTHING AND STROBES
B. TRIAL BRIGHT EYES - STAGE 2 RESULTS
C. TRIAL BRIGHT EYES - STAGE 3 RESULTS

Distribution:

DAS LA

Copy to:

JHCHQ - SO1 J7 Trg

ANNEX A TO
R&S/J5/2/1/27
DATED 11 MAY 05

HIGH VISIBILITY CLOTHING AND STROBES

High visibility bomber jacket (front) (cost £15)

High visibility bomber jacket (rear).

High visibility Riding helmet cover (rear).
(cost £5)

High visibility exercise sheet.
(cost £10)

Starlight strobe.

Emergency light strobe

Red/Amber steady/flashing strobe

Lifesystems survival strobe

TRIAL BRIGHT EYES - STAGE 2 RESULTS

RAF Benson Field 5 – Flat grass surrounded by scattered trees

RUN	HEIGHT (ft AGL)	APPROACH FROM	DISTANCE SEEN (NM)	COMMENTS
1A	50	North	0.7	Small hill on run-in obscured line
1B	100		0.9	
2A	50	South	0.3	Fairly flat run-in, but hidden by fence/tree line
2B	100		0.5	
3A	50	East	0.9	Fairly clear run-in with some trees
3B	100		1.2	

RAF Benson Field 21 – Flat muddy field with trees on North and West boundaries

RUN	HEIGHT (ft AGL)	APPROACH FROM	DISTANCE SEEN (NM)	COMMENTS
1A	50	North	0.4	On hill behind hedge/tree line (similar to typical Bridleway)
1B	100		0.5	
2A	50	West	0.5	Partially obscured by tree line and on top of slight rise
2B	100		0.6	
3A	50	East	0.3	Well obscured by trees
3B	100		0.4	

ANNEX C TO
R&S/J5/2/1/27
DATED 11 MAY 05

TRIAL BRIGHT EYES - STAGE 3 RESULTS

WITHOUT HIGH VISIBILITY CLOTHING

RUN	HEIGHT (ft AGL)	IAS (kts)	HEADING (°M)	RIDERS SIGHTED (Y/N)
1	100	90	260	Y
2	100	90	210	Y
3	100	90	110	Y
4	80	90	260	Y
5	75	90	210	N
6	75	90	210	N
7	75	90	110	Y
8	50	100	280	Y
9	50	90	210	Y
10	50	90	030	Y

WITH HIGH VISIBILITY CLOTHING

RUN	HEIGHT (ft AGL)	IAS (kts)	HEADING (°M)	RIDERS SIGHTED (Y/N)
1	100	110	280	Y
2	100	110	190	Y
3	100	105	110	Y
4	50	100	280	Y
5	80	110	200	Y
6	50	110	130	Y
7	60	80	110	Y

ACCIDENT DATA RECORDER REPLAY FACILITIES AT QINETIQ BOSCOMBE DOWN

Prepared by ADR Systems, QinetiQ Boscombe Down Jan 2005

Fast Jets

Aircraft Type	***ADR Type***	**Replay Capability for Serviceable Recorder**	**Replay Capability for Crash Damaged Recorder**	**Authority Responsible for Recorder Equipment**	**Comments**
Tornado	BAES SCR200 (Tape) Data: 2 hours 128 words Audio: 40 min. x 1 channel	Yes	Yes	RAF Wyton	ADR being replaced by Penny & Giles solid-state MPFR. QinetiQ has also handled and replayed accident damaged mission video recording tape (ADV: Video 2000, GR4: S-VHS multiplexed image).
Harrier GR7/T10	Penny & Giles D50330 (Tape) Data: 2 hours 256 words Audio: 2 hours x 1 channel	Yes	Yes	RAF Wyton	QinetiQ has also routinely handled and replayed many accident damaged mission video recording tapes (HUD: Hi-8 PAL, DLT: Hi-8 NTSC). New combined GRE (with Tucano) requisitioned by Authority (technical specification compiled by QinetiQ). RN Harriers: HUD (S-VHS) only.
Hawk T1	Leigh M10 (Tape) Data only: 4 hours	Yes	Yes	RAF Wyton	Data drop out under high ‘g’. No audio. ADR being replaced by Penny & Giles solid-state MPFR. May also include 2 x 2 hour audio channels. Some of fleet have HUD video (S-VHS) / GPS / cassette EUMS recorder.
Hawk 128	Typhoon CSMU	NO	NO	MoD Abbey Wood	
Hawk 200	BAES SCR300 Combined Voice & Data, (Tape) Data: 2.5 hours Audio: 30 min.	Yes	Yes	BAES	

Aircraft Type	***ADR Type***	**Replay Capability for Serviceable Recorder**	**Replay Capability for Crash Damaged Recorder**	**Authority Responsible for Recorder Equipment**	**Comments**
Tucano	Penny & Giles D50769 (Tape) Data: 2 hours 256 words Audio: 1 hour x 3 channels	Yes	Yes	RAF Wyton	New combined GRE (with Harrier) requisitioned by Authority (technical specification compiled by QinetiQ).
Jaguar	No ADR fitted to RAF aircraft				QinetiQ has routinely handled and replayed many accident damaged mission video recording tapes (VHS PAL)
Typhoon (Development Aircraft)	BAE Systems CSMU 6MB solid-state Data: 90 min Audio:10 min x 1 channel	BAES Warton	BAES Edinburgh	MoD Abbey Wood	BAES flight recorder business sold to Meggitt plc in Autumn 2002. Chip level data recovery capability believed to remain at Edinburgh for 6MB CSMU.
Typhoon (Production Aircraft)	BAE Systems CSMU 128 MB solid-state Data: 4 hours Audio: 4 hours x 1 channel	No	No	MoD Abbey Wood	BAES flight recorder business sold to Meggitt plc. New enhanced 128 MB CSMU memory module under development/production. Still won't meet current survivability standards. Availability of chip level data recovery capability unknown for 128 MB CSMU.
JSF	Electrodynamics CSMU (Solid-state) Data Only	No	No	MoD Abbey Wood	Specification of CSMU under review.

Heavy Aircraft

Aircraft Type	*ADR Type*	Replay Capability for Serviceable Recorder	Replay Capability for Crash Damaged Recorder	Authority Responsible for Recorder Equipment	Comments
Nimrod MR2	Plessey PV1584 (Tape) Data only: 25 hours	Yes	Yes	RAF Wyton	
Nimrod MRA4	Penny & Giles Inc, Wichita (was B&D) Solid State ADR P/N 91005-0042 Data: 25 hours, 128 words CVR P/N 89085 0041 Audio: 2 hours x 4 channels	No	No	MoD Abbey Wood	Penny & Giles Flight Recorder business now owned by Curtiss Wright, EXCEPT Penny & Giles Inc, Wichita who are now owned by Teledyne Controls, Los Angeles. Teledyne Controls are responsible for support of these recorders. Aircraft also has a Quick Access Recorder.
Sentry E3D	Leigh Tape Recorder? Deployable?- Data only	RAF Waddington	No	RAF Wyton	Being replaced with ED-112 compliant dual redundant Honeywell Solid State AR Recorders.
Tristar Ex British Airways	Plessey PV1584 ADR (Tape) 25 hours Daval 1192-002/003 CVR (Tape). 30 min x 4 channel?	AAIB	AAIB	RAF Wyton/RAF Brize Norton	Aircraft also has a Quick Access Recorder.
Tristar Ex Pan-Am	Lockheed 209 ADR (Tape) Data only: 25 hours	AAIB	AAIB	RAF Wyton/RAF Brize Norton	Aircraft also has a Quick Access Recorder.
BAe 125 Mk3	BAE Systems SCR500 Dual Combined Recorder. (Solid State) Data: 25 hours Audio 1 hour x 4 channels	No	No	RAF Wyton	BAES flight recorder business sold to Meggitt plc. Procedures and equipment are still required to support downloads from both damaged and undamaged recorders. File conversion software will also be required.
BAe 146 Mk2	BAE Systems SCR500 Dual Combined Recorder. (Solid State) Data: 25 hours Audio 1 hour x 4 channels	No	No	RAF Wyton	BAES flight recorder business sold to Meggitt plc. Procedures and equipment are still required to support downloads from both damaged and undamaged recorders. File conversion software will also be required.

Aircraft Type	***ADR Type***	**Replay Capability for Serviceable Recorder**	**Replay Capability for Crash Damaged Recorder**	**Authority Responsible for Recorder Equipment**	**Comments**
VC10	Plessey PV1584 ADR (Tape) Data only: 25 hours	Yes	Yes	RAF Wyton	
Hercules C130J	L-3 (USA) Model F1000 DFDR (solid-state) Data: 25 hours Model A200A CVR (solid state) Audio: 2 hours x 4 channels	Yes	Yes	RAF Wyton	Accident Investigator Kit to enable crash damaged replay to board level obtained. Support for crash damaged replay to chip level available at manufacturer's facility in USA. QinetiQ have attended Accident Investigators Workshop in USA, Autumn 2002 and also carryout serviceability checks on the DFDR system for the fleet aircraft at RAF Lyneham. Fleet problem with noise on rudder, elevator and aileron parameters identified. Lockheed-Martin tasked to investigate.
ASTOR	Allied Signal (Honeywell?) Model 980-4700-027 SSFDR Data: 25 hours? Model 980-6022-001 SSCVR Audio: 2 hours x 4 channels?	No	No	MoD Abbey Wood	
C17 Heavy Lift	Smiths Industries PN RO-626/A FDR (Solid-state) Data: 25 hours? L-3com Model A200A CVR (Solid state) Audio: 2 hours x 4 channels	No	No	WPAFB	Data Recorder to be replaced by a Smiths Industries Enhanced Crash Survivable Memory Unit (ECSMU) Aircraft also has a Quick Access Recorder.
Future Transport Aircraft (A400M)	Not Known			MoD Abbey Wood	Believe specification calls for recorders to be compliant with ED-112.
Future Strategic Tanker Aircraft (A330)	TBA			MoD Abbey Wood	Specification under review.

Rotary Wing

Aircraft Type	*ADR Type*	Replay Capability for Serviceable Recorder	Replay Capability for Crash Damaged Recorder	Authority Responsible for Recorder Equipment	Comments
Chinook Mk2	Smiths Industries Model 3255C DAPU. CSMU is a sub-system of GHUMS. Solid-state Combined Voice & Data Recorder Data: 10 hours Audio: 1 hour x 3 channels	Yes	Yes	Yeovilton	DRAPES equipment supports crash damaged replay to board level. Replay to chip level will need assistance from manufacturer in USA. (DRAPES upgraded Autumn 2002 to also support Apache C4 & E4 VADR). QinetiQ also carryout serviceability checks on the CSMU for the fleet aircraft at RAF Odiham.
Chinook Mk3	BAES SCR300 (MAR Aircraft at BD only) Data: 2.5 hours 128 words Audio: 30 minutes x 1 ch.	Yes	Yes		
Sea King 3A	L-3 (Fairchild) A100A CVR (Tape) Audio: 30 min + rotor speed)	Yes	Yes	LSS AMDS Helicopter Project Team	Scheduled to be retrofitted with Smiths Industries GHUMS. Can be supported by upgrading DRAPES. Some RN aircraft have video recording capability.
Puma	No recorder installed.	-	-		Scheduled to be retrofitted with Smiths Industries GHUMS. Can be supported by upgrading DRAPES.
Merlin Mk1 & Mk3	DRS Hadland EAS3000 Combined Voice & Data (Solid-state) Data: 10 hours Audio: 1 hour x 4 ch. (Mk1) Audio: 1 hour x 3 ch. (Mk3)	Yes	Yes	MoD Abbey Wood RNAS Yeovilton	Replay to chip level will need assistance from manufacturer in Canada.
Merlin OEU / Development aircraft	Penny & Giles D50330 (Tape) Data: 2 hours 256 words Audio: 2 hours x 1 channel	Yes	Yes	MoD Abbey Wood RNAS Yeovilton	GSE not supported beyond April 2005.

Aircraft Type	***ADR Type***	**Replay Capability for Serviceable Recorder**	**Replay Capability for Crash Damaged Recorder**	**Authority Responsible for Recorder Equipment**	**Comments**
AH-64 Apache (Pre HUMS)	Smiths Industries Model 3253C4 Voice And Data Recorder (VADR) (36 Mbyte solid-state) Data: 10 hours Audio:1 hour x 3 channels	Yes	Yes	MoD Abbey Wood	DRAPES equipment supports crash damaged replay to board level. Replay to chip level will need assistance from manufacturer in USA.
AH-64 Apache (With HUMS)	Smiths Industries Model 3253E4 Enhanced Voice And Data Recorder (144 Mbyte solid-state) Data: 10 hours Audio:1 hour x 3 channels	Yes	Yes	MoD Abbey Wood	As for C4 VADR.
Bell 412EP Griffon (RW Training School)	BAE Systems SCR500 CVR only (Solid State) Audio: 1 hour x 4 channels	No	No	RAF Shawbury	BAES flight recorder business sold to Meggitt plc. Procedures and equipment are still required to support data recovery from both damaged and undamaged recorders.
Army Lynx AH Mk9 & Islander	Fairchild (L-3) A100A 30 min CVR (Tape) Audio: 30 min x 4 channels	Yes	Yes	School of Army Aviation, Middle Wallop	Lynx scheduled to be retrofitted with Smiths Industries GHUMS. Can be supported by upgrading DRAPES.
Navy Lynx					RN Lynx- palletised Instrumentation Data Capture Package with Heim D4 data recorder and dual Hi-8 PAL video recorders

Abbreviations:

ADR	-	Accident Data Recorder
CVR	-	Cockpit Voice Recorder
CSMU	-	Crash Survivable Memory Unit
CPM	-	Crash Protected Module
DRAPES	-	Data Recovery & Playback Evaluation System
FDR	-	Flight Data Recorder
GHUMS	-	Generic Health & Usage Monitoring System
HUMS	-	Health & Usage Monitoring System
VADR	-	Voice & Data Recorder

Armed Forces Act 2001[33]

2001 Chapter 19 - *continued*

PART 4

MISCELLANEOUS AND GENERAL

Testing for alcohol or drugs

32 Powers to test for alcohol or drugs after serious incident

(1) This section applies where-

(a) an incident has occurred which, in the opinion of an officer designated for the purposes of this subsection in accordance with regulations made by the Defence Council (in this section referred to as "the designated officer")-

(i) resulted in, or

(ii) created a risk of,

death or serious injury to any person or serious damage to any property; and

(b) in the opinion of the designated officer, it is possible that one or more persons subject to service law may have caused, or in any way contributed-

(i) to the occurrence of the incident, or

(ii) to any death or serious injury to any person or serious damage to any property resulting from it, or to the risk of any such death, injury or damage occurring.

(2) Any designation made for the purposes of subsection (1) may be expressed to have effect only in relation to a particular incident or description of incident.

(3) Where the designated officer is the commanding officer of any person in relation to whom he is of the opinion referred to in subsection (1)(b), the designated officer may request that person to provide a sample for the purpose of ascertaining whether, or to what extent, that person has, or has had, alcohol or drugs in his body.

(4) Where the designated officer is of the opinion referred to in subsection (1)(b) in relation to one or more persons as respects whom he is

[33] Available from http://www.hmso.gov.uk/acts/acts2001/10019--e.htm accessed 10 Mar 2005.

not the commanding officer, the designated officer may direct the commanding officer of any person specified in the direction, or of persons falling within a class so specified-

(a) to request that person, or (as the case may be) every person appearing to the commanding officer to fall within the specified class, to provide a sample for the purpose referred to in subsection (3); or

(b) to consider whether the commanding officer is of the opinion referred to in subsection (1)(b) in respect of that person or (as the case may be) of any persons falling within the specified class and, if so, to request that person or (as the case may be) every person who appears to him to fall within that class and as to whom he is of that opinion, to provide a sample for the purpose referred to in subsection (3).

(5) The Defence Council may by regulations make provision about the obtaining of samples under subsection (3) or (4) and the testing of such samples; and any such regulations may in particular make provision-

(a) as to the number of samples which a commanding officer may request a person to provide;

(b) as to the circumstances in which a commanding officer may request a person to provide more than one type of sample;

(c) enabling the commanding officer making the request to specify the manner in which the sample is to be provided;

(d) as to the circumstances in which a person who would (apart from regulations made under this paragraph) be liable to be requested to provide a sample under subsection (3) or (4) is not to be so requested;

(e) as to the equipment to be used, and the procedures to be followed, in obtaining samples and conducting tests;

(f) as to the qualifications and training of any persons engaged in obtaining samples and conducting tests.

(6) The results of tests performed on samples provided by a person pursuant to a request made under subsection (3) or (4) shall not be admissible in evidence against-

(a) that person, or

(b) any other person,

in proceedings before a court-martial, commanding officer or appropriate superior authority.

(7) The Defence Council may by regulations provide for the delegation-

(a) by a designated officer of his functions under subsections (1), (3) and (4); and

(b) by a commanding officer of his functions under subsection (4).

(8) Nothing in this section-

(a) limits the powers conferred by-

(i) sections 6 and 7 of the Road Traffic Act 1988 (c. 52) (breath tests and provision of specimens for analysis), as applied by section 184 of that Act, or

(ii) any provision of Part 5 of the Police and Criminal Evidence Act 1984 (c. 60) as applied by order under section 113(1) of that Act; or

(b) affects the admissibility in any proceedings of evidence obtained under those powers.

(9) Schedule 5 (which contains amendments of the 1955 Acts and the 1957 Act relating to testing for alcohol and drugs) shall have effect.

33 Interpretation of s. 32

(1) The provisions of this section have effect for the interpretation of section 32.

(2) "Drug" means-

(a) a controlled drug as defined by section 2 of the Misuse of Drugs Act 1971 (c. 38), or

(b) any other drug, or description of drug, specified in an order made by the Secretary of State for the purposes of this paragraph.

(3) "Sample" means-

(a) where the sample is requested for the purpose of ascertaining whether, or to what extent, a person has, or has had, alcohol in his body, a sample of urine or breath,

(b) where the sample is requested for the purpose of ascertaining whether, or to what extent, a person has, or has had, drugs in his body, a sample of urine, and

(c) in either case, any other sample specified by the Secretary of State in an order made for the purposes of this paragraph.

(4) The power conferred by subsection (2)(b) includes power to specify a description of drug by reference to the effects or likely effects of taking drugs within that description.

(5) The power conferred by subsection (3)(c) does not include power to specify a sample of blood, semen or other tissue fluid or anything which would have to be provided from a person's body orifice (other than the mouth).

(6) In the case of a sample falling within subsection (3)(c), any reference to a person being requested to provide a sample includes a reference to a person being requested to consent to the taking from him of a sample.

(7) In section 32, any reference to a person subject to service law is a reference to-

(a) a person subject to military law, air-force law or the 1957 Act, or

(b) subject to subsection (8), a person to whom any provisions of Part 2 of the Army Act 1955 (c. 18) , Part 2 of the Air Force Act 1955 (c. 19) or Parts 1 and 2 of the 1957 Act apply by virtue of-

(i) section 209(1) or (2) of either of the 1955 Acts (application of Act to civilians), or

(ii) section 118(1) or (2) of the 1957 Act (application of Act to civilians).

(8) A person is not to be regarded for the purposes of section 32 as a person subject to service law if provisions of either of the 1955 Acts or the 1957 Act apply to him only by virtue of his falling within any description specified in paragraphs 5 to 9 of Schedule 5 to the 1955 Acts or (as the case may be) paragraphs 5 to 9 of Schedule 3 to the 1957 Act.

(9) For the purposes of section 32, the commanding officer of a person subject to service law is-

(a) in relation to a person subject to military law, the officer who would be that person's commanding officer for the purposes of section 82 of the Army Act 1955 if he were charged with an offence;

(b) in relation to a person subject to air-force law, the officer who would be that person's commanding officer for the purposes of section 82 of the Air Force Act 1955 if he were charged with an offence;

(c) in relation to a person subject to the 1957 Act or a person to whom provisions of that Act apply by virtue of section 118(1) or (2) of that Act, the officer in command of the ship or naval establishment to which he belongs or any other person who, by virtue of regulations made under section 52E of that Act, would be able to exercise the powers conferred by that Act in relation to that person if he were charged with an offence;

(d) in relation to a person to whom provisions of Part 2 of either of the 1955 Acts apply by virtue of subsection (1) or (2) of section 209 of the Act in question, the person who is by virtue of regulations of the Defence Council made for the purposes of section 209(3)(f) of that Act the commanding officer for the purposes of Part 2 of that Act in relation to him.