



Aerial Mustering

Task Risk Assessment

for

**NSW Department of Primary Industries
Emergencies and Animal Welfare Branch**

Section 1 – Introduction

Mustering Operations in support of the NSW Department of Primary Industries (NSW DPI) Emergency Management operations is a demanding and hazardous activity. Although mustering is considered a hazardous activity, Department personnel face minimal personal safety hazards in regard to this activity, as the only person permitted on board a helicopter conducting mustering is the contracted pilot.

In discharging its obligations under the Work Health and Safety (WHS) Act for activities conducted, the Department is committed to using risk management processes. This Risk Assessment has been conducted following procedures detailed in 'Procedure – Aviation Risk Assessment and Management Process'. A company that is either under contract, or regarded as a preferred supplier, is referred to as 'contractor' in this document. A 'contract' refers to the life of an established contract or the expected period between Department-sponsored reviews of an operation.

Risks are categorised into seven (7) elements, which may have a number of sub-elements.

- A. Operator competency
- B. Crew competency
- C. Flight preparation
- D. Aircraft preparation
- E. Pre-flight discussion
- F. Flight Operations
- G. Accident

Section 2 - Risk assessment

Context - Mustering of animals by air using only helicopters during emergency operations for NSW DPI with landings and take-offs at non-aerodromes. Further details describing the context of this risk assessment are:

Description of task	<p>The task involves planned and short notice callout to at risk areas as part of emergency management. Heights flown en-route shall be a minimum of 500ft AO unless landing, taking off or due stress of weather. Landings and takeoffs at non-aerodromes will be required. Task entails locating and aggregating stock in affected areas and driving them by means of aerial manoeuvring to safer areas. Mustering operations will be conducted below 500ft AO. No other person shall be carried in the helicopter during mustering operations.</p>
Number of and type of engines	<p>Single or multi-engine turbine or piston.</p>
Task profile (sequence)	<ul style="list-style-type: none"> • Callout • Planning include map reconnaissance for hazards, assessments of takeoff and landing areas, aircraft and pilot support availability where appropriate • Briefing including update of hazards as shown on appropriate map, flight following procedures, weather, task objectives, landing/takeoff areas, communications, aerial risk assessment. • Fuelling when required • Start/Taxi/Takeoff • Transit to area of operation at a height commensurate with conditions and regulatory requirements but in any case at a height not below 500 feet (ft) Above Obstacles (AO). • Conduct route and area of operations identification, and aerial hazard survey prior to descent below 500ft AO at Helicopter Landing Sites (HLSs) and non-certified Aircraft Landing Areas (ALAs) or aerodromes. • Conduct area surveillance if landing at a non-certified HLS or ALA initially not below 500ft AO. Further descent requires prior authorisation (to use the HLS/ALA), risk assessment, and hazard identification. • Descend to conduct task commensurate with task objectives, authorisations, and conduct further hazard/target identification if required. • If operating to a certified aerodrome, conduct operations in accordance with standard regulatory, advisory and Company procedures and documentation. • Communicate with Air Services as required by standard regulatory, advisory and Company procedures and documentation. • Communicate with LCC or Operator (as approved) for flight following and/or task update. • Transit to operating base/fuelling area. • Land / Shut Down. • Debrief and report.

Terrain description	<p>The areas of operations will encompass all types of terrain including paddocks, hills, and urban areas.</p> <p>The high terrain areas can experience high density-altitudes which can adversely affect helicopter's performance. Also, the terrain can experience severe downdraughts and turbulence as a result of the strong winds. Cloud can roll in quickly.</p> <p>The lower areas can experience extensive areas of fog, mist or smog, which can limit visibility.</p> <p>The areas can be extensively wooded and/or populated with domestic structures in close proximity to power lines. Fences may be hidden in long vegetation.</p> <p>Areas may be flooded or affected by other natural emergencies.</p>
Limitations	<p>Flights into or out of non-certified landing areas conducted in day visual conditions only.</p> <p>Landings at, and departures from non-certified areas shall be preceded by an appropriate risk assessment including aerial aviation hazard identification and assessment, assessment of environmental risks.</p> <p>Descent below a safe height clear of all known and potential obstacles is not to be conducted prior to confirmation of hazards and considering aircraft performance, environmental conditions and the assessment of the risk associated while low flying.</p> <p>This is a single pilot operation only. No passengers or other personnel are to be carried on mustering flights.</p> <p>(CAAP 92-2) Helicopter Landing Site (HLS) are normally required for landings and departures however, should the task require, operations to other areas may be authorised following a risk assessment.</p> <p>Pilots should be aware of the chances of blockages in aircraft intakes due to flying through insect swarms.</p>
Crew composition	1 - person crew; Pilot
Qualification / Training of each Crewmember	Pilot – CASA licenced, medically current, appropriate approvals, map and GPS navigation, Crew Resource Management, Fly the Wire (or similar), HUET (for flood work), mustering endorsed and experience (see EOI)
Role of each crew member	Pilot – Identify hazards and maintain hazard clearance, operate aircraft, navigation, communication, responsible for safety of the aircraft, pre-flight briefings.

Discussion Operator Competency:

The competency of the Operator is fundamental to safe and efficient helicopter operations. The thrust of the risk control is to ensure that the Operator has suitable culture, systems, processes and procedures to provide NSW DPI some confidence that the Operator is approaching the task appropriately and to minimise the NSW DPI risk exposure. The proposed controls are intended to address the requirements for a safety management system (SMS), Operator accident history, reporting, and senior Operator management roles. The proposed controls identified include additional requirements in the EOI to include Operators to have an effective SMS and more comprehensive auditing and assessing requirements. This also includes a historical review of the Operator's operations and culture including a review of previous CASA audit reports.

Mustering represents a lower risk to NSW DPI when compared to the Operator as the operation does not involve NSW DPI personnel being airborne in the helicopter and therefore the safety risk exposure is primarily on the Operator. The department still is exposed, as there will be impacts on reputation and image and organisational capability.

A. OPERATOR COMPETENCY		1. Operator Factors							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Lack of Operator competency leads to unsafe practices, inefficient and/or illegal operations	<p>1. Operator checked by the NSW DPI to ensure that it has an Air Operating Certificate endorsed for mustering operations.</p> <p>2. Operator ensures that it has an Air Operating Certificate.</p> <p>3. Operator audited /assessed on behalf of the NSW DPI for mustering operations within the last 12 months by a competent company or authority.</p> <p>4. NSW DPI contracting requires the Operator to demonstrate that it has an effective SMS structured to the size and function of the Operator that includes required elements of accountability, risk management, etc.</p> <p>5. Operator has been assessed by the NSW DPI to ascertain that it has not had an accident attributable to maintenance or operational management in the previous 5 years or if it has, it can demonstrate that suitable actions have been taken to address any identified or perceived deficiencies.</p> <p>6. NSW DPI requires the operator to report all occurrences as part of the safety management of the contract and services.</p> <p>7. Operator is checked by the NSW DPI to ascertain that there has been and is an on-going substantive investment in the company safety and operational management systems.</p> <p>8. Operator is checked by NSW DPI to ascertain that its senior management staff can demonstrate competent management of low-level training, operations and safety.</p> <p>9. NSW DPI reviews and actions as part of the auditing/assessing process the Operator's and senior management history, operational and SMS.</p> <p>10. NSW DPI investigates any occurrences while performing NSW DPI tasks to ascertain operator management / competency.</p> <p>11. NSW DPI reviews prior CASA audits to establish any non-compliances /conformances that may impact aircraft safety/performance.</p>	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>10</p>	<p>ATSB has identified issues in the past with company culture and poor management contributing to accident causation. Historical data shows that organisational failure has been a contributor to accidents on 5 known occasions in the last 5 years indicating likelihood as <i>Almost certain</i>.</p> <p>Due to the multiple current controls to ensure the Operator is competent to conduct low level helicopter operations, assess the likelihood as <i>Possible</i></p>	<p>The failure of an operator to properly manage and control operations may directly lead to an accident.</p> <p>Consequence of an accident can be catastrophic due to potential for loss of life. Assessed as Catastrophic</p> <p>But due to no NSW DPI personnel being involved, assessed as Major to NSW DPI based on economic loss and impact on reputation and image</p>	<p>High</p>	<p>The following controls seek to establish that an operator is competent in managing aviation operations.</p> <p>The following controls should reduce the likelihood of an accident regardless of the environment in which the helicopter is operating.</p> <p>7</p> <p>8</p> <p>9</p> <p>11</p>	<p>Controls put in place to reduce the likelihood that a Contractor is not competent to conduct mustering operations and to ensure the operator is able to manage risk</p> <p>Rare</p>	<p>If management controls fail then the consequence of an accident may be fatal therefore assessed as Catastrophic</p> <p>As noted before due to no NSW DPI personnel involved, assessed as Major to NSW DPI based on economic loss and image</p>	<p>Medium</p> <p>Note: All controls to be implemented and checked through EOI and audit processes</p>

Discussion Crew Competency:

The role of the pilot in decision making, attitude and approach to safety is paramount to safe and efficient NSW DPI operations. The proposed controls include a review the pilot's history and training as well as emphasising the role of an effective SMS, and a more comprehensive auditing and assessment protocol. Poor decision making by pilots has been identified in many accidents in all aircraft types. Although a difficult aspect to measure, controls are required to assure as far as possible that proper decision making is conducted and poor decisions do not impact on aircraft safety.

The pilot is the sole occupant during mustering operations so the risk is confined to him/her and not a NSW DPI employee or non-aviation contractor/person. The greatest risks faced by the pilot as regards decision-making and experience are the handling of the helicopter to avoid (in the piston engine case) low rotor RPM stall events and ensuring adequate power margins. Also poor appreciation of structures and lines are significant hazards.

B. CREW COMPETENCY		1. Pilot Aspects							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Lack of pilot proficiency / experience leads to poor decision making and/or flying ability resulting in an accident	<ol style="list-style-type: none"> 1. Pilot is properly licenced to conduct required operations. 2. Pilot has sufficient experience to properly assess conditions and requirement and to conduct required operations. Experience as detailed in EOI. 3. Pilot has had no accidents involving poor decision making or mishandling of the aircraft in the previous 5 years and 1000 flight hours unless adequate rectification and supervision demonstrated and assessed as appropriate. 4. Pilot has undergone ‘fly the wire’ or similar course. 5. Pilot has undergone any aircraft-specific safety courses if available (e.g. Robinson safety course). 6. NSW DPI conducts audit/assessment to assure pilot has appropriate experience and qualifications to conduct task. 7. Operator has a robust training and checking system to ensure aircraft is handled properly and proper decision-making encouraged. 8. Operator has a functioning, effective and appropriate SMS in operation. 9. Operator has fatigue management policies to provide support to pilots to avoid fatigue lessening the chances of poor decision-making. 10. Operator has functioning and effective drug and alcohol management policies and procedures in place. 11. Operator has a detailed manual that provides the appropriate information on such things as operations in turbulence, wind and heat and has stipulated power margins and control recovery guidance. 	1 2 4 6 7 8 9 10	Poor pilot decision making has been identified in at least 15 helicopter industry accidents in the past 5 years. With the controls imposed, there should be some reduction from Almost Certain to Possible	Consequence of poor pilot decision making is often fatal and therefore considered Catastrophic Due to no NSW DPI personnel being involved, assessed as Major to NSW DPI based on economic loss and image	For NSW DPI and the operator High (the safety risk is confined to the pilot)	3 5 11	Other than removing the human from the consideration, it is almost impossible to eliminate poor decision making by pilots but the extra defences identified should lower the likelihood or at least identify those who may be prone to making poor decisions Unlikely	Consequence is likely to be Catastrophic noted before due to no NSW DPI personnel involved, assessed as Major to NSW DPI based on economic loss and image	Medium For NSW DPI High For the Operator Note: All controls to be implemented and checked through EOI and audit processes

Discussion Flight Preparation Aspects:
PPE (personal protective equipment) is an important final control in reducing the severity of an accident. PPE should provide protection against ambient conditions (e.g. noise), impact and fire. The current controls appear sufficient to ensure that effective PPE is in place. Incorrect PPE for aircraft can affect communications and impact on hazard identification.
Environmental considerations such as noise should be addressed through wearing correct PPE.
Minimum of bare skin to be exposed, gloves, sturdy leather footwear shall be worn. Helmet with visor(s) should be worn in helicopters.
Preference for Nomex-type flying suits for aircrew.

C. FLIGHT PREPARATION		1. PPE							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Not wearing or having available appropriate PPE leads to a compromise in safety for pilot exposing him/her to impact and noise hazards	<ol style="list-style-type: none"> 1. EOI specifies PPE requirements for helicopter operations. 2. NSW DPI procedures require the wearing of correct PPE 3. Operator has been audited/assessed within the last 12 months by a competent company or authority to ensure compliance and conformance with regulations, EOI, NSW DPI Procedures and industry practice 4. Operator has procedures that requires all personnel on-board an aircraft are wearing the appropriate PPE and where required, the PPE is compatible with aircraft communication / intercom equipment 5. Operator issues appropriate PPE to its crews 6. NSW DPI checks that Operator has published procedures to ensure its crews wear appropriate PPE for Department operations 	<ol style="list-style-type: none"> 1 2 3 4 5 6 	Lack of appropriate PPE has been identified in accidents. Unlikely	Lack of appropriate PPE has been identified, as a reason for causing greater injury than would otherwise be expected. Due to the required PPE, assessed as Moderate	Medium	No further controls considered necessary			Medium

Aircraft Preparation Discussion:

The proposed and current controls review the maintenance organisation's procedures, culture and standards. Historical information is also sought to establish prior practices. SMS for maintenance organisations will be relatively new and therefore the requirement may require relaxing for some time to allow a maintenance organisation to work towards developing a suitable system.

A mechanical failure can be critical due to height to fall or impact with obstacles/ground. Therefore, mechanical reliability and maintenance are essential in reducing the risk. Expressions of Interest / Requests for Tenders and ultimately contracts should stipulate the requirements for demonstrably effective SMSs and Maintenance Procedures Manuals. The Australian agricultural and mustering industry has experienced high accident rates and therefore any operator intending to work for NSW DPI must display the appropriate culture and management systems.

Fuelling standards are important to safe operations and can receive little review despite its importance. The proposed controls are focused at the organisation having the proper procedures in place to ensure the quality of fuel delivered to the aircraft.

An engine failure due to poor fuel could be critical especially at low height.

Several standards exist to ensure the proper quality of fuel is delivered. Aircraft also have filters to ensure as much as possible the proper quality of fuel is delivered to the engine.

D. AIRCRAFT PREPARATION		1. Maintenance							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Improper maintenance leads to mechanical failure of critical system(s) such as tail rotor, main rotor, controls or engine.	<ol style="list-style-type: none"> 1. Operator and Maintenance Organisation have a functional and appropriate safety and quality management system that includes risk management, reporting, training and accountabilities. 2. Maintenance Organisation has appropriate CASA approvals. 3. Operator and Maintenance Organisation have a trend recording system to detect potential failures in systems before they actually occur. (Although a possible control, trend recording of parts in the mustering industry is considered impractical at this stage) 4. Maintenance Organisation has an appropriate management culture that continually assesses the company and its operating procedures for continual improvement. 5. Operator charges appropriate charter rates to ensure company has sufficient resources to properly maintain aircraft including replacement of components. 6. Maintenance Organisation has an effective Maintenance Procedure/Quality Manual and complies with that manual. 7. Operator and Maintenance Organisation regularly audited and assessed to ensure compliance with regulations and good maintenance practices. 8. Maintenance Organisation is checked to ensure that only approved parts are likely to be used on the aircraft. 9. Maintenance Organisation is checked to ensure the major maintenance is conducted in controlled environmental conditions i.e. clean conditions. 10. Maintenance Organisation 5-year history is reviewed for prior inappropriate maintenance standards. Review should include review of CASA audits and the EOI should reflect the requirement for prior audits to be available for review. 	<p>2 4 6 7 8</p>	<p>ATSB historical data indicates that the industry has had more than 5 instances of maintenance failure in helicopters in the last 5 years leading to accidents indicating that the likelihood is <i>Almost Certain</i>.</p> <p>It is considered that with the current controls, the likelihood will be <i>Possible</i></p>	<p>ATSB historical data indicates that the instances of maintenance failure leading to accidents were non-fatal although the on at least 3 occasions, the aircraft suffered significant damage. The consequence is therefore assessed as <i>Major</i></p>	<p>High</p>	<p>1 to help assure that there are proper systems in place, risk assessment and review occurring</p> <p>5 (to help assure parts replacement and overhaul)</p> <p>9 (major maintenance including engine removal shall be done within the hangar environment – contract /RFT requirement)</p> <p>10 (to assist in reviewing organisation culture and prior work)</p> <p>Note: Not all proposed controls implemented – see 3.</p>	<p><i>Unlikely</i></p>	<p><i>Major</i></p>	<p>Medium</p> <p>Note: All proposed controls except #3 to be implemented through the EOI and auditing processes</p>

		2. Fuelling							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Incorrect fuel used to fuel the aircraft leading engine failure and aircraft forced landing	<ol style="list-style-type: none"> Operator and Maintenance/Fuel Supply Organisation have operating SMS that includes risk management, reporting, training and accountabilities. Operator and Maintenance/Fuel Supply Organisation have correct published procedures for the storage, security, testing and dispensing of fuel. Operator and Maintenance /Fuel Supply Organisation have appropriate management cultures that continually audit and assess the operating procedures and practices for conformance and continual improvement including ensuring conformance with fuel industry standards (consider ASTM, JIG). 	7 8	There have been few accidents attributed to poor quality fuel according to ATSB data although report from maintenance organisations indicate that the last line of defence (aircraft systems) have been catching issues associated with fuel indicating that the likelihood is Unlikely	An engine failure or dual engine failure as a result of poor quality or incorrect fuel would likely lead to loss of aircraft with associated fatalities and therefore would be Catastrophic	High	<ol style="list-style-type: none"> (to help assure that there are proper systems in place, risk assessment and review occurring) (to assure that the fuel supply organisation has the proper procedures in place for the handling of fuel) (to assure provision of quality of fuel) (to assure the proper record keeping to ensure fuel can be tracked) (to assure appropriate procedures in place) (to assure that fuel is being correctly tested and quality maintained) 	With the further controls in place, assess the likelihood of poor quality fuel being delivered is considered Rare	An engine failure or dual engine failure as a result of poor quality or incorrect fuel would likely lead to loss of aircraft with associated fatalities and therefore would be Catastrophic	Medium Note: All controls to be implemented and checked through EOI and audit processes
b. Poor quality fuel is used to fuel the aircraft leading to engine failure and aircraft forced landing	<ol style="list-style-type: none"> Operator and Maintenance Organisation keep proper records of fuel uplift and aircraft filter replacements to identify potential poor sources of fuel. 								
c. Incorrect procedures used that create a hazard during refuelling that could lead to injury, death or damage to aircraft or facilities	<ol style="list-style-type: none"> Operator and Maintenance/Fuel Supply Organisation have effective maintenance and fuel supply Procedure/Quality Manual and complies with that manual. Operator and Maintenance /Fuel Supply Organisation checked to ensure that proper testing of fuel is conducted and records kept. Operator has procedures that direct pilots to ensure correct type of fuel and to ensure quality of fuel. Aircraft equipped with suitable filters and mechanisms for early detection of poor quality fuel. 								

Pre-flight Discussion:
Poor planning has been cited in many occurrences but the current controls appear to be adequate in minimising the risks associated with poor planning.
Operators should demonstrate that it has the systems, practices, procedures and management oversight in place to ensure flights are well-planned.

E. PREFLIGHT PLANNING		1. Planning							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Inadequate planning information leads to task failure, aircraft being out of limits, inadequate fuel, weather-related problems and thereby placing the task or aircraft at risk of an accident.. Poor planning may add additional unnecessary cost.	<ol style="list-style-type: none"> 1. NSW DPI conducts pre-flight briefing and provides written details and planning material to help assure pilot fully understands requirements and to achieve task outcomes, safely and efficiently. 2. Operator provides pilot with sufficient planning material and access to information to ensure the flight can be conducted safely while achieving the task objectives 3. Operator provides guidance within operational documentation to pilots on the required per-flight planning activities including any NSW DPI required procedures. 4. NSW DPI details requirement in EOI for proper planning including hazard identification to be included in Operator’s documentation. 5. NSW DPI audits and assesses the Operator to ensure that the required processes and procedures are in place. 6. Operator has an operating SMS that includes risk management, reporting, training and accountabilities 7. Operator ensures adequate communications are in place to ensure proper briefing material is available 8. Operator has a strong fuel reserve and planning policy and associated procedures 9. Operator has a strong oversight policy and practice to ensure pilots are conforming with company requirements 	<ol style="list-style-type: none"> 1 2 3 4 5 6 7 8 9 	<p>Poor planning can include the failure to survey for wires, ensuring sufficient power margin and not accounting for wind correctly.</p> <p>As a result there have been 3 accidents in the past 5 years attributed to poor quality planning according to ATSB data indicating that the likelihood is</p> <p><i>Likely</i></p> <p>However due to the controls identified, lowers the likelihood to</p> <p><i>Rare</i></p>	<p>Poor planning can result in the aircraft running out of fuel or striking a wire or other obstruction or other aircraft resulting in fatalities.</p> <p>Catastrophic</p>	<p>Medium</p>	<p>No further controls are considered to be required based on the current risk profile</p>			<p>Medium</p>

Discussion Flight Operations:

- 1. Start:** Current auditing and assessing protocols should adequately address the controls. Pre-flight inspections and system checks are important to ensuring an aircraft is ready to fly.
- 2. Navigation:** Current auditing and assessing protocols should adequately address the controls. The likelihood of poor navigation issue even in remote areas has been significantly reduced by the use of GPS.
- 3. Fatigue:** The control requiring an SMS will assist in detecting fatigue and addressing causes before fatigue leads to an accident. Inattention and fatigue can only be controlled through administrative measures. The Operator must ensure that the pilot is fully ready for operations especially when operating low level and the pilot must be encouraged to take a break if feeling fatigued or tired when operating low level.
- 4. Ground impact:** Inadvertent ground impact most likely the result of inattention or mishandling of the helicopter. Rotor stall issues are addressed later in assessment.
- 5. Wire and obstacle strike:** Operations at low level are significantly impacted by the chances of wire strike. Any operations below 500ft AO are regarded as low flying and therefore pose the highest risk. Current procedures require pilots to climb to at least 500ft between survey areas. Standard high tension power line structures are up to 55m (180ft) excluding heights of the hills they may be erected on. The operation of the aircraft at low levels with the present administrative controls is assessed as a high risk. Risk is lowered to High/Medium if the aircraft operating height is raised to above likely obstacle height. Consideration should also be made of using helicopters that have demonstrated good crashworthiness capability and occupied seats should have 4 point harnesses (vice lap belts) which would lower the risk to Medium.
- 6 & 7. In-flight emergency & collision:** Knowledge, practice, and assessment currency are required to ensure that a pilot is able to handle most emergencies properly. Procedures should be clearly laid down in aircraft and company documentation.
- 8. Power margin:** For piston engine helicopters specific reference and training should be made to rotor stall conditions, entry and recovery.

F. FLIGHT OPERATIONS		1. Start							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Incorrect pre-flight, system checks or role equipment checks leads to compromise in safety	<ol style="list-style-type: none"> Operator has published checklists that conform to the Original Equipment Manufacturer publications. Operator conducts training and checking to assure crew conduct checks as published. NSW DPI conducts audit/assessment to assure Operator has a robust training and checking, and SMSs (including requirement for checks to be conducted in adequate lighting). 	<ol style="list-style-type: none"> 1 2 3 	ATSB reports have not indicated poor pre-flight or starting procedures as a contributor to occurrences in the past 15 years. Assessed as Rare	Incorrect preflights' or checks could lead to aircraft failure in flight with leading to fatalities and is therefore rated as Catastrophic	Medium	No further controls are considered to be required based on the current risk profile			Medium
		2. Navigation							
a. Poor navigation leads to helicopter arriving late, not arriving at correct location or not doing the required task	<ol style="list-style-type: none"> Operator has training and checking to assure crew can map-read and use navigation equipment. NSW DPI requires GPS installed (EOI). Operator provides GPS equipment in helicopter. NSW DPI has published procedures that ensure correct information is briefed to crews before their departure. 	<ol style="list-style-type: none"> 1 2 3 4 	No significant occurrences recorded related to aircraft becoming lost. Assessed as Rare	Consequence of crew poor navigation in a helicopter is considered Minor provided the pilot decision making is sound	Negligible	No further controls are considered to be required based on the current risk profile			Negligible

		3. Fatigue							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Fatigue causes the pilot to be less attentive and not notice obstructions such as wires and towers.	<ol style="list-style-type: none"> 1. Operator has fatigue management policies and management system to provide support to pilots to avoid fatigue 2. Operator has operating and effective SMS to ensure any fatigue events are captured and analysed to ensure effective remedies are put in place. 3. Operator has a requirement that the aircraft lands about every 2 hours (except in normal transit) to allow pilot time to have a reasonable break. 4. Operator ensures that adequate drinking water is carried and accessible by pilot inflight 5. NSW DPI conducts investigations into occurrences where fatigue may be a contributing factor 6. NSW DPI conducts audit/assessment of Operator to ensure proper policies, procedures and systems are in place that addresses fatigue 	<ol style="list-style-type: none"> 1 2 3 4 5 6 	<p>Fatigue is suspected in several occurrences where wire strikes have occurred but with management /administrative protocols identified consider the likelihood of fatigue as Unlikely</p>	<p>The potential consequence due to chances of wire strike or flight into terrain causing fatality is Catastrophic</p> <p>The potential consequence is limited to the Operator and the pilot. NSW DPI personnel not exposed to safety risk but there may be negative comment or exposure to query.</p> <p>Consider the consequence to NSW DPI as Major</p>	<p>High for operator</p> <p>Medium for NSW DPI</p>	No further controls are considered to be required based on the current risk profile			<p>High for operator</p> <p>Medium for NSW DPI</p>

		4. Ground Impact							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Inadvertent ground impact made during low level operations being a significant safety hazard for the pilot and Operator	<ol style="list-style-type: none"> Operator has fatigue management policies and system to provide support to pilots to avoid fatigue. Operator has operating SMS to ensure any fatigue events are captured and analysed to ensure effective remedies are put in place. Operator has appropriate publications and guidance in place to ensure pilots are provided with the knowledge to competently do the work. Operator has a strong and effective checking and training system that ensures pilots are fully competent to conduct the work. NSW DPI specifies minimum experience levels in EOI to help ensure pilot is competent to conduct work. NSW DPI conducts investigations into occurrences to derive any organisational or human factor considerations and apply corrective actions as required. NSW DPI conducts audit/assessment of Operator to ensure proper policies, procedures and systems are in place that addresses flying operations and management. Pilot and Operator history reviewed for any occurrences in the previous 5 years that indicate poor pilot decision making or poor aircraft handling. 	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>7</p>	<p>There have been 4 inadvertent ground impacts during similar types of operations in the last 5 years. Historical likelihood is assessed as <i>Likely</i></p> <p>But with the current controls in place, assess the likelihood as <i>Unlikely</i></p>	<p>While usually fatal, the safety exposure is limited to the Operator and pilot although negative comment in the press, or legal action possible for the Department.</p> <p>The consequence for the Operator is assessed as Catastrophic</p> <p>but for NSW DPI the consequence is assessed as Major due to negative comment and exposure to enquiry.</p>	<p>High for operator</p> <p>Medium for NSW DPI</p>	<p>8 (reduce the likelihood of utilising error-prone pilots)</p>	<p>Rare</p>	<p>Consequence is unchanged by proposed controls</p> <p>Catastrophic For operator</p> <p>Major for NSW DPI</p>	<p>Medium for Operator and NSW DPI</p> <p>Note: Control #8 to be implemented through EOI and auditing processes.</p>

		5. Wire & Obstacle Strike							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Impact with wire or obstacle causes aircraft to impact ground in uncontrolled manner impinging on the safety of occupants	<ol style="list-style-type: none"> 1. Operator has published guidance to pilots on the avoidance of wire & obstacle strike. 2. Operator trains pilots specifically in wire & obstacle avoidance including 'fly the wire' course or similar. 3. Pilots have specific training & experience for mustering. 4. NSW DPI specifies minimum experience & training levels in EOI to help ensure pilot competent. 5. Pilot is to remain above 500ft AO unless descending to/departing from task, or landing/taking off. 6. Operator has published procedures for descent and operations below 500ft AO. 7. NSW DPI requires Operator to prepare, where practical, hazard maps for operations below 500ft AO in the designated area. 8. Pilot obtains a brief from landowners & others about potential hazards, where practical. 9. NSW DPI requires, where possible, property owners provide a diagram of the HLS or ALA including surrounding obstacles & wires to the LCC for on-forwarding to the pilot. 10. NSW DPI requires Operator to have policies & procedures that require landings & takeoffs should where possible be made at HLS & ALAs that conform to CAAP 92 more stringent requirements. 11. NSW DPI requires Pilot to make vertical takeoffs & landings to avoid flying into unseen wires (must have sufficient power margins to do so) when operating from non-surveyed HLS 12. Operator polices & procedures require NSW DPI operations only conducted Day VMC. 13. Operator, required helicopters with Wire Strike Protection System installed if the helicopter can be so equipped. 14. NSW DPI briefing includes known hazards. 15. NSW DPI conducts audit/assessments Operator has proper systems and practices to avoid wire & obstacle strikes. 	<ol style="list-style-type: none"> 1 2 3 4 5 6 7 8 9 10 12 13 14 15 	<p>ATSB database shows at least 6 known wire strikes by helicopters in the past 5 years to be a common occurrence. Historical likelihood is assessed as Almost certain</p> <p>The present controls are largely administrative controls, which are the least effective controls in managing risk. However while they are the least effective, the number of controls presents a 'defence in depth' approach to the risk. With the present controls, likelihood is assessed as Unlikely</p>	<p>ATSB records show most accidents result in fatalities assessed for the Operator / Pilot as Catastrophic</p> <p>but for NSW DPI the consequence is assessed as Major due to negative comment and exposure to enquiry.</p>	<p>High</p> <p>For Operator</p> <p>Medium</p> <p>for NSW DPI</p>	<p>11 (vertical take-offs prevent helicopters taking off into wires masked by environment from non-surveyed sites)</p>	<p>Further control is assessed as reducing the chances of wire impact during take-off and landing. Rare</p>	<p>Catastrophic for Operator</p> <p>Major For NSW DPI</p>	<p>Medium</p> <p>Note: Control #11 to be implemented through EOI and auditing processes.</p>

		6. Inflight Emergency							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Pilot mishandles emergency or malfunction which leads to an accident	<ol style="list-style-type: none"> Operator has adequate published guidance and training to pilots on the handling of malfunctions and emergencies. Pilots have specific training and experience for mustering operations (which includes the handling of malfunctions and emergencies including rotor stall at low level) Pilot has suitable number of total hours, hours on type and recent flying. Operator to ensure suitable and adequate records of pilot training is kept. Pilot history reviewed for any occurrences in the previous 5 years that indicate poor pilot decision-making or poor aircraft handling. NSW DPI conducts audit/assessments to assure as far as practicably possible that Operator has proper systems and practices to ensure pilot can handle emergencies. NSW DPI require pilot to have undergone Emergency check ride with in the month prior to commencing operations. Operations generally conducted over areas that provide the pilot with emergency landing options. While this may not be totally true for operations over floodwaters, it provides for a relatively clear area to arrive. 	<p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>6</p> <p>8</p>	<p>Pilot mishandling of emergencies do not appear to have been a causal factor in any accidents in the last 10 years. However, reviewer is aware of non-reported occurrences. With the current controls, assessed as</p> <p>Unlikely</p>	<p>Mishandling of an emergency could lead to the aircraft impacting the ground therefore assessed for the Operator and pilot as</p> <p>Catastrophic</p> <p>but for NSW DPI the consequence is assessed as</p> <p>Major</p> <p>due to negative comment and exposure to enquiry.</p>	<p>High</p> <p>for Operator / Pilot</p> <p>Medium</p> <p>for NSW DPI</p>	<p>5</p> <p>(check history to ensure no adverse trends)</p> <p>7</p> <p>(ensure pilot is current in emergency training)</p>	<p>The additional controls provide greater assurance that the pilot is current and has a history</p> <p>Rare</p>	<p>Mishandling of an emergency could lead to the aircraft impacting the ground therefore for the Operator/Pilot, assessed as</p> <p>Catastrophic</p> <p>For NSW DPI</p> <p>Major</p>	<p>Medium</p> <p>Note: Control #5 to be implemented through EOI and audit processes.</p> <p>Control #7 requires consultation with industry for practicality and cost effectiveness considerations (if not implemented residual risk remains medium).</p>

		7. Inflight Collision							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Mid-air collision between aircraft on similar task or with other aircraft (e.g. low flying military aircraft on published Low Jet Routes) impinges on safety of helicopter occupants.	<ol style="list-style-type: none"> Operator installs radios to ensure pilot can communicate with other aircraft in the area. Operator installs TCAS to assist with potential collision identification and avoidance. Operator has training and checking systems and practices that ensure pilot is properly trained in communicating and identifying potential conflicting traffic. NSW DPI briefing informs pilot of any potential traffic in the area where this traffic may be known or planned Pilot checks maps, NOTAMs and/or briefing office for potential traffic Operator ensures aircraft are equipped with high-visibility markings Operator ensures aircraft have high-intensity strobes 	<p>1 3 4 5</p>	<p>ATSB historical data indicates 2 occurrences in the past 5 years which is <i>Likely</i> but with current controls, assessed as Possible</p>	<p>Consequence of a mid-air is usually Catastrophic One of the two accidents in ATSB database within last 5 years was fatal. But for NSW DPI the consequence is assessed as Major due to negative comment and exposure to enquiry</p>	<p>High For Operator / Pilot High for NSW DPI</p>	<p>6 (fitment of high-vis markings to improve visibility) 7 (fitment of high intensity strobes to improve visibility) Note: Not all proposed controls implemented – see 2.</p>	<p>Strobe lighting and improved visibility markings should improve visibility - likelihood assessed as Rare</p>	<p>Catastrophic for Operator Major for NSW DPI</p>	<p>Medium For Operator & NSW DPI Note: Controls 6 & 7 to be implemented through EOI and auditing processes. Control #2 is not practical to implement as would require all aircraft to operate with transponders which may not be practical or cost effective.</p>
		8. Power Margin							
a. Failure to ensure adequate power margins leads to loss of control and impinges on the safety of helicopter occupants.	<ol style="list-style-type: none"> NSW DPI requires Operator to have policies, procedures and guidance requires that pilots assess power margin availability in flight. NSW DPI requires Operator to have properly operating training and checking system in place that checks that power margins are being applied. NSW DPI details minimum power margin requirement in EOI. NSW DPI conducts audit/assessments to assure as far as practicably possible that Operator has proper systems and practices in place to ensure pilots operate with appropriate power margins. 	<p>1 2 3 4</p>	<p>ATSB records indicate possible 3 occurrences in past 5 years indicating likelihood is <i>Likely</i> but with controls in place, assessed as Unlikely with the controls identified</p>	<p>Consequence is assessed as Catastrophic Due injuries potential for Operator / Pilot. For NSW DPI the consequence is assessed as Major Due to negative comment and exposure to enquiry.</p>	<p>High For Operator / Pilot Medium for NSW DPI</p>	<p>No further controls are considered to be required based on the current risk profile</p>			<p>High For Operator / Pilot Medium for NSW DPI</p>

		9. Landing							
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. Landing at non-surveyed areas poses a risk due to size or obstructions	<ol style="list-style-type: none"> 1. NSW DPI requires Operator to operate wherever possible to areas that comply with CAAP 92-2 more stringent limitations. 2. NSW DPI requires Operator to have laid down procedures that include reconnaissance requirements before making approach to pad. 3. NSW DPI provides any known information about pad area in briefing. 4. NSW DPI requires Operator to have procedures that ensure the aircraft have adequate power margins before arriving on task. 5. NSW DPI requires landings to be vertical from a safe height into pads to ensure clearance from unseen obstructions and wires on the approach to previously unsurveyed HLSs. 6. NSW DPI requires Operator to have an effective SMS to capture any issues or occurrences and to manage risk. 	<p>1 2 3 4</p>	<p>Historical data shows more than 5 accidents in past 10 years indicating likelihood as Possible</p> <p>With the current controls, likelihood assessed as Unlikely</p>	<p>Due high chance of fatality assessed as Catastrophic</p> <p>For NSW DPI the consequence is assessed as Major</p> <p>Due to negative comment and exposure to enquiry.</p>	<p>High for Operator / Pilot</p> <p>Medium for NSW DPI</p>	<p>5 (vertical landings and take-offs minimises chances of hitting unseen obstructions/wires)</p> <p>6 (SMS to capture lessons and apply risk assessment)</p>	<p>Extra controls expected to lower likelihood to Rare</p>	<p>Assessed as Catastrophic for Operator / Pilot</p> <p>Consequence remains Major for NSW DPI</p>	<p>Medium for Operator, Pilot & NSW DPI</p> <p>Note: All controls to be implemented and checked through EOI and audit processes</p>

Discussion Accident Considerations:
 The risk assessment identifies the considerations, risks and controls in the event of an accident.
 The quick notification, location and recovery of personnel involved in an accident is essential for survival

G.	ACCIDENT	1.	Survival						
Risk	Possible Controls	Current Control	Likelihood	Consequence	Current Risk	Proposed Controls	Revised Likelihood	Revised Consequence	Residual Risk
a. If an accident occurs, survival of the occupant depends on having appropriate equipment and rapid recovery	<ol style="list-style-type: none"> NSW DPI requires Operator to carry a survival kit in its aircraft. NSW DPI requires Operator to carry medical kits in the aircraft. NSW DPI ensures that full flight following is conducted to help assure rapid recovery. NSW DPI requires Operator to equip aircraft with Satellite tracking equipment to ensure aircraft whereabouts known at all times. NSW DPI requires Operator to have an effective SMS to capture any issues or occurrences and to manage risk. NSW DPI requires carriage of ELB by pilot. 	<ol style="list-style-type: none"> 1 2 3 5 	There have been at least 5 accidents in the last 10 years where the location of aircraft following an accident was not quickly known. Likelihood based on data is Possible With the current controls, assess the likelihood as Rare	Failure to quickly find survivors may lead to Catastrophic Results for the Operator/pilot For NSW DPI the consequence is assessed as Major due to negative comment and exposure to enquiry	Medium	<ol style="list-style-type: none"> 4 (Satellite flight following would enable knowing precise aircraft location should an accident occur) 6 (Aircraft ELT failure rate is high and individual ELBs would enhance recovery likelihood) 	Assessed as Rare	With these controls, assessed as Major	Medium Note: Control #4 may require consultation with industry and/or RFS before implementation

Risk assessment summary:
 Current risk for NSW DPI and the Operator is **HIGH**.
 Risk can be reduced to **MEDIUM** for DTRIRIS through the introduction of the proposed controls and improved technology which are primarily administrative controls such as requiring Operators to have an SMS, in-depth auditing and assessing, reviewing historical performance, and procedures.
 Risk remains at **HIGH** for Operators as the consequence due to the safety of the pilot cannot be reduced.

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