# SECTOR RISK PROFILE
# AGRICULTURAL AVIATION

**DEVELOPED BY:** Aerosafe Risk Management

September 2013

## ABOUT SECTOR RISK PROFILES (SRP)

A Sector Risk Profile (SRP) presents a strategic picture of the key risk issues that face a specific sector of the aviation industry at a given point in time. An SRP contains the definition of the context of the sector and the context of the risk profile, identifies key strategic and operational risks, their associated impacts and a resultant risk rating and then presents proposed high level treatments, the associated residual risk and the risk ranking. An SRP provides the platform for the agricultural aviation sector to develop detailed risk reduction plans, outline the agreed risk reduction measures, as well as timelines for implementation and accountability.

## ABOUT AEROSAFE RISK MANAGEMENT

The Aerosafe Group is a global safety and risk management company, which provides services, support and tailored products in the fields of governance, risk management and safety management systems to companies around the world. With over fifteen years in operation, Aerosafe offices are located in Australia, North America, India, China and New Zealand. The integrated business model allows Aerosafe to support its global client base across the aviation, defence, regulatory and transport sectors. Recognised as international experts in these sectors, Aerosafe has been invited to set standards with government regulators, industry groups and companies alike.

Aerosafe represents the leading edge of governance, risk management and safety management system consulting internationally. Through cutting edge methodology and practice, the company provides services, support and tailored solutions through its consulting, training and risk network divisions. In recent years, Aerosafe has developed the methodology and expertise to lead the industry in Strategic and Industry Risk Profiling.

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**DEVELOPED BY:** Aerosafe Risk Management
Date of development: September 2013 Version: 1.0

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AEROSAFE RISK MANAGEMENT

CAA CIVIL AVIATION AUTHORITY OF NEW ZEALAND
Te Mana Rererangi Tūmatanui o Aotearoa

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# TABLE OF CONTENTS

# PART 1:
# OVERVIEW OF THE SECTOR RISK PROFILE DEVELOPMENT

# PART 1: BACKGROUND AND INTRODUCTION

## 1.1 BACKGROUND

### 1.1.1 CAA RISK-BASED APPROACH

The Civil Aviation Authority of New Zealand (CAA) has adopted a risk-based approach to regulatory oversight to align with the global transition to risk-based regulatory regimes. This is driven by the International Civil Aviation Organization (ICAO) requirement for States to implement a State Safety Program (SSP) which incorporates risk management and assurance components.

Sector Risk Profiling (SRP) is a tool that the CAA can use to target the CAA's effort towards areas of the industry of greatest risk. The SRP for the agricultural aviation sector will enable the CAA to have an accurate understanding of the full range of risks which impact the safety outcomes of this sector. National Aviation Authorities across the globe have commenced this shift to risk-based regulatory oversight; however New Zealand is one of the first to actively use Sector Risk Profiles as a standard tool for enhancing safety across the industry.

### 1.1.2 CONTEXT OF THE SECTOR RISK PROFILE

The Agricultural Aviation sector has been selected by CAA as the first sector to be profiled due to a number of reasons, including the following:

A. As the first of what will be numerous SRPs, the Agricultural Aviation sector is more easily defined in terms of the activities that are undertaken
B. The safety performance of the sector to date is lower than other sectors, as evidenced by accident and incident rates. . Despite attempts to improve safety within the last sector, agricultural aviation has not significantly improved, and therefore a new approach was required
C. There has been a relatively high number of safety and economic studies aimed at agricultural aviation. The SRP facilitates a means of bringing all of this information together
D. The New Zealand Agricultural Aviation Association (NZAAA) volunteered to co-sponsor the development of the SRP as a means of facilitating proactive improvement of the sectors' safety performance
E. The development of the SRP allows the agricultural industry to actively contribute to the identification of risks.

## 1.2 COMMISSION

Aerosafe has been commissioned by the CAA to develop the Agricultural Aviation SRP, partially as a means of maintaining an independent approach to its conduct, and partially to introduce the methodology of risk profiling into the CAA's risk-based approach to Regulation.

## 1.3 OBJECTIVES

**The following objectives of the SRP have been identified:**

01. To gain an accurate and holistic understanding of the full range of risks that exists within the agricultural aviation sector
02. To present the risks in relation to their impact on the safety and sustainability of the sector
03. To identify risk drivers within the sector and subsequently describe risk treatments which will reduce unacceptable risk, providing the basis for future sector safety initiatives.

## 1.4 SCOPE

The scope of this report includes the identification, assessment and treatment of agricultural aviation sector risks, and sufficient contextualising information to facilitate this as a stand-alone document.

## 1.5 ASSUMPTIONS

**The following assumptions have been identified:**

- This report will be used by the CAA and the NZAAA to consider prioritised actions that they and other key stakeholders can take to effect continual improvement in the agricultural aviation sector
- Given the relative scale of the NZ agricultural sector and breadth of consultation, the nature of the information available is considered to be representative that is there are no unknown aspects of the sector that have not been captured, reviewed or considered
- All agricultural aircraft operations are governed by civil aviation legislation, that is there are no operators who are 'exempt' from the legislative requirements
- All references to agricultural operations exclude any fire-fighting activities by either fixed wing or helicopters.

## 1.6 LIMITATIONS

**The following limitations have been identified in the course of the project:**

- The project team was not able to benchmark statistics and other information with other countries, due to New Zealand's unique operating environment (e.g., topdressing, terrain)
- CAA statistics regarding accident and incident rates amongst the agricultural sector have small inaccuracies where statistics are based on returns, and/or occurrence data.[1] Also, the definition of agricultural operations for the purposes of the SRP does not include some of the activities described in CAA safety reports (for example, fire fighting)
- Agricultural aviation safety reports in the CAA databases appear to have an inconsistency in accuracy of the root cause analysis undertaken
- Whilst nearly all data collection methods were able to be classed as qualitatively or quantitatively significant, the survey issued to all Federated Farmers members was only classed as qualitatively significant, due to low numbers of responses (as a result of a short timeframe for responses to be submitted).

## 1.7 METHODOLOGY

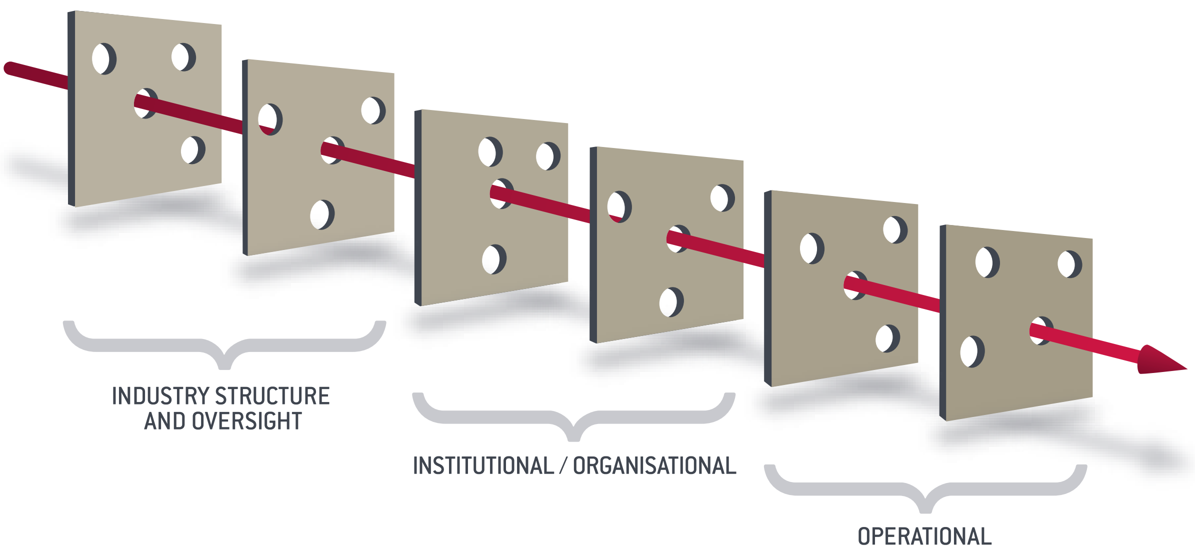
The Aerosafe Sector Risk Profile Methodology was utilised in order to develop this SRP for NZ Agricultural Aviation. This unique and innovative approach leverages off the general application of the risk management process to collate and present a wide amount of risk information at the strategic and industry-wide level. The profiling methodology enables a balanced and holistic description of the risks within the area of examination, which are presented in a manner to facilitate communication, monitoring and treatment of the Sector Risk Profile.

The SRP Model described further in Section 1.9 forms the centrepiece of the SRP Methodology. This Methodology is based on the philosophy of Reason's Accident Causation Model, whereby organisational accidents are considered to be the result of contribution from various levels within the system, including organisational influences and strategic provision of resources, as opposed to an individual action at the operational level. This concept is expanded to a sector level, as shown in Figure 1, highlighting the higher-level or 'industry-wide' influences on individual organisations and their operational activities.

The Reason Accident Causation Model has been widely used within the aviation industry, as a framework to determine the contributions to accidents or incidents. Reason used to model to describe how accidents occur when there are multiple failures in the various levels of organisational defence's organisations – when all the holes line up. This model can also be used to design safety systems by identifying 'defences in depth'.

Analysis of 'defences in depth' allows safety experts to identify potential points of failure and minimise the possibility of total system failure. Risk identification and analysis is a tool that identifies potential points of failure in the defences. An SRP identifies the potential points of failure or 'holes' at the 'Organisational' and 'Industry Structure and Oversight' levels, and what treatments may be implemented to mitigate these risks.

**FIGURE 1** *Reason Accident Causation Model (adaptation)*




## 1.8 RISK MANAGEMENT PROCESS

The Aerosafe SRP methodology utilises the risk management process defined in AS/NZS ISO 31000:2009 *Risk Management – Principles and Guidelines*. This international industry standard process provides a systematic and transparent approach to establish the context for the risk profile, assess risk, identify risk treatment options, and communicate and monitor the process throughout. Figure 2 depicts how the generic risk management process is incorporated in the SRP development.

**FIGURE 2** *Risk Management Process as applied to the SRP development*

| | |
|---|---|
| **COMMUNICATION AND CONSULTATION** | Communication and consultation with stakeholders underpins all steps in the risk management process. Through an early stakeholder analysis, a range of internal and external stakeholders were identified and an appropriate level of communication and consultation planned. Through input from a wide range of stakeholders a holistic and balanced risk profile is developed. Key personnel from Government and Regulatory bodies, Sector Participants (operators), Supporting Sectors (including Industry Associations), Clients (such as the farmers) and the wider community were provided with an opportunity to contribute to the SRP and shape the final outcome |
| **ESTABLISH THE CONTEXT** | Establishing the context of the SRP defines the parameters and influences that are taken into account in assessing the risk profile, informing the risk criteria definition, defining the scope of the profile and the way in which the SRP will be used beyond its initial development. The area under examination in this risk profile was determined to be the agricultural aviation sector, with consideration of external influences only given in instances where this had a direct impact |
| **RISK IDENTIFICATION** | A key strength of an SRP is the complementary use of risk identification techniques and data sources to provide a high level of reliability in the resultant risk profile. Ten different risk identification methods were used including stakeholder interviews; a series of Workshops for operators and pilots; safety reports; audit findings; safety culture survey; literature review; environmental scan; media analysis; surveys for pilots/operators and clients. In all, 855 data points were identified through the process and were subject to analysis. From this process 16 risks were identified |
| **RISK ANALYSIS** | Risk analysis is the careful consideration of the source, consequence, likelihood and current controls in place for each risk using the 855 data points. A semi-quantitative risk analysis tool and associated algorithm developed in the context of the NZ agricultural aviation sector was then used to calculate the level of risk on a scale of 1 to 16 for each risk |
| **RISK EVALUATION** | Building on the risk analysis, the set of risks were ordered and ranked from highest to lowest priority for risk treatment. Where more than one risk had the same level of risk, additional criterion were applied to determine the ranking. This facilitates decision making about risk treatment implementation |
| **RISK TREATMENT** | Where risks are outside the pre-determined risk criteria, treatment is required to reduce the risk to an acceptable level. Multiple risk treatments are identified to address each risk. They vary in their scope, depth and sustainability but are designed to complement each other and provide a comprehensive response to reduce the collective risk profile of the agricultural aviation sector. A projected level of residual risk is then made in light of the combined effectiveness of the treatment strategies. It is acknowledged that many activities to treat the risks, individually or as a whole, are under the guidance of several responsible or accountable stakeholder groups. The provision of resources and appointment of a person to implement the risk treatment options and monitor their effectiveness is the next phase of the SRP |
| **MONITOR AND REVIEW** | Monitoring and review throughout the development of the SRP ensures that it retains its technical integrity and is responsive to the consultation with stakeholders. However, the most significant monitoring and review takes place after the development of the SRP to ensure that risk treatment options are implemented and are having the desired impact; and to monitor the context to identify new or changing risks within the sector. The SRP is a dynamic document and becomes the centrepiece of an ongoing process to manage risks within the sector |

## 1.9 SECTOR RISK PROFILE MODEL

The Sector Risk Profile Model, shown in Figure 3, provides the framework in which the risks are presented. The model consists of ten elements, selected for their impact to the delivery of sector or industry objectives. These elements, detailed in Figure 3, represent factors which contribute to uncertainty at the sector strategic-level from the highest levels such as governance arrangements, to operational level aircraft and safety performance issues.

Each element can be further examined, analysing the tier of risks below which contribute to the higher level element.

**FIGURE 3** *Sector Risk Profile Model – Source: Aerosafe Risk Management*

**FIGURE 4** *Sector Risk Profile Model Elements*

| | |
|---|---|
| **OVERSIGHT MODEL** | This refers directly to the governance and oversight regime that exists within the industry at the highest level. It covers all facets of business activity. This element of the SRP model is closely aligned with the compliance and assurance elements |
| **COMPLIANCE REGIME** | Considers the statutory and regulatory and framework in which the industry operates. The compliance element, along with the assurance element, is a sub component of the overall oversight model. At the industry risk profiling level, these two pieces are addressed individually |
| **ASSURANCE MODEL** | This element investigates two primary issues: what level of assurance is provided and, to what level of depth. The objective of assurance is to provide 'confidence' |
| **OPERATOR PROFILE** | The operator profile looks at the composition, structure and models of the operator groups within the industry. A greater level of depth can be provided for this element if required. This can be done by conducting an individual risk profile of each operator within the industry sector. Individual operator risk profiles are normally undertaken by the Regulator as part of the regulator's routine surveillance and intervention regime |
| **ACTIVITY PROFILE** | This element of the SRP examines the range of operational activities undertaken by the industry |
| **AIRCRAFT CAPABILITY PROFILE** | This element looks at the aircraft capability, technology and equipment |
| **INDUSTRY OPERATING ENVIRONMENT** | The industry operating environment includes the overall setting and landscape of the environment in which the industry operates in its entirety |
| **PASSENGER AND PARTICIPANT PROFILE** | Considers the demographics of the participants who are involved in the activity. This element excludes crew members or employees of the aviation operator who are covered in the operator profile |
| **SYSTEMS PROFILE** | The definition and maturity of the various management systems available and utilised within the industry are covered in the scope of this element of the SRP. The scope includes but is not limited to management systems, business systems, information systems and safety management systems |
| **SAFETY PROFILE** | This element of the SRP takes into account the incident and accident statistics and the overall safety profile of the industry sector. Much of the information and data covered in this element is historical in nature |

## 1.10 DEPTH OF ANALYSIS

Sector Risk Profile was developed through the collation and analysis of a wide range of available data. In order to provide a complete and objective description of the risks within the agricultural aviation sector a wide range of data from stakeholders was collected and supported by a process of validation and iterative comparative analysis. The qualitative nature of the data is tempered by a structured and proven analysis phase, numerous risk assessment techniques and validation by a team of strategic risk specialists. The following sub-paragraphs highlight the key inputs and depth of data utilised to analyse the capability risks within the agricultural aviation sector.

### 1.10.1 STAKEHOLDER INTERVIEWS

Face-to-face and telephone interviews were held with approximately 35 individuals as part of all stakeholder groups identified. This included 10 from the CAA, 15 staff/crew from agricultural operators, 8 from supporting sectors and 2 from clients.

### 1.10.2 WORKSHOP WITH INDUSTRY PARTICIPANTS

Four workshops were held around New Zealand in Taupo, Hastings, Rangiora and Gore. A total of 39 individuals attended the workshops which enabled a significant amount of risk information to be captured during these interactions.

### 1.10.3 'STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS' (SWOT) ANALYSES

As part of the Risk Workshops, participants were invited to complete a SWOT analysis. A total of 28 were completed.

### 1.10.4 RISK PERCEPTION SURVEY: PILOTS AND OPERATORS

A survey was sent to all known current agricultural pilots and operators that was designed to gauge risk perceptions regarding agricultural aviation, as well as some key demographic information. Of the 201 invitations sent out, 79 responses were received.

### 1.10.5 RISK PERCEPTION SURVEY: CLIENTS

A risk perception survey (with modified questions) was also distributed to clients via Federated Farmers. A total of 141 responses were received in a restricted timeframe.

### 1.10.6 STAKEHOLDER ENGAGEMENT WITH PROJECT SPONSORS

Throughout the project, extensive stakeholder engagement was conducted with both the CAA and NZAAA (and AIA) in order to provide updates on project progress, gain risk information, and to provide feedback about emerging risks.

### 1.10.7 OBSERVATIONS FROM SITE VISITS

The project team was able to conduct a number of site visits with operators that provided insights into the day-to-day operations of an agricultural aviation organisation.

### 1.10.8 CAA ACCIDENT AND INCIDENT DATA AND AUDIT CONTENT

Extracts of all agricultural aviation-related accident, incident and occurrence data were used in data collection and analysis, as were all audit findings for the last five years. Additional information such as 'risk profile' scores for individual operators was also gathered and reviewed.

#### 1.10.9 LITERATURE REVIEW

An extensive literature review was conducted including relevant CAA documentation (both strategic and operational), reports from other Government agencies (including the Transport Accident Investigation Commission, Department of Labour, Department of Primary Industries, etc.), information from operators, and all publically-available information sources. Over 300 documents were reviewed in the compilation of the SRP.

#### 1.10.10 MEDIA REVIEW

All media information sources with reference to agriculture, agricultural aviation, and other relevant information were sourced and analysed. This included printed and audio media.

## 1.11 RISK CRITERIA

The risk criteria for the agricultural aviation sector were developed to allow for the evaluation and quantification of risks. Since risk has two components (consequence and likelihood) consideration was given to issues including the following:

- It is not acceptable for New Zealand to lose any productivity within the agricultural industry (which is in part facilitated by agricultural aviation activities)
- It is not acceptable for the accident and incident rate to remain as high at it has been over the past ten years.

# PART 2:
# SECTOR RISK PROFILE CONTEXT

# PART 2: SECTOR RISK PROFILE CONTEXT

## 2.1 NEW ZEALAND AGRICULTURE: A SHORT OVERVIEW

Agriculture plays a fundamental role in the New Zealand economy and is currently at its highest level in a number of years.[2] Agriculture, forestry production and processing make up more than 5% of NZ Gross Domestic Product (in the December 2012 quarter), and a total of $8,791 million (in 2012).

Nearly 14 million hectares of the total New Zealand land area (26.7 million hectares) is used for pastoral agriculture, arable and fodder cropping, or production forestry.[3] The greatest area of arable land is under grazed, permanent pasture. The fertiliser industry is one of a number of service industries that underpin the agricultural and forestry industries. Fertilisers are necessary for maintaining the productivity of the land, and in some cases without it, the land would become unusable for industry.

## 2.2 NEW ZEALAND AGRICULTURAL AVIATION HISTORICAL BACKGROUND

Early trials of aerial application of seed and later fertiliser, a process called topdressing, commenced in New Zealand in 1947.[4] This addressed the problem of servicing the country's mountainous terrain, greatly improving agricultural productivity, as well as reducing soil erosion. By 1958 there were 73 commercial topdressing operators in New Zealand.[5] In 2012, almost 130,000 hours per year were flown aircraft engaged in agricultural activities; 43,909 were conducted by aeroplanes and the remaining 75,654 by helicopters.[6]

Early aircraft were modified fixed wing aeroplanes. The American-based Fletcher Aviation Corporation presented the Fletcher FU 24 aircraft in 1953 which was quickly taken up by many in the industry. The FU24 series and subsequent versions, such as the Cresco, remain the most commonly used agricultural aircraft in New Zealand, comprising more than 70% of the fixed wing aeroplanes operating in the period 1970 to 2007.[7]

Agricultural aviation activities have expanded to include aerial application of lime, minerals, and specialised trace elements, animal control and data capture. Global Positioning Systems (GPS) now guides aerial application to improve accuracy, and agricultural helicopters now outnumber fixed wing aircraft, providing additional flexibility in the operating environment.

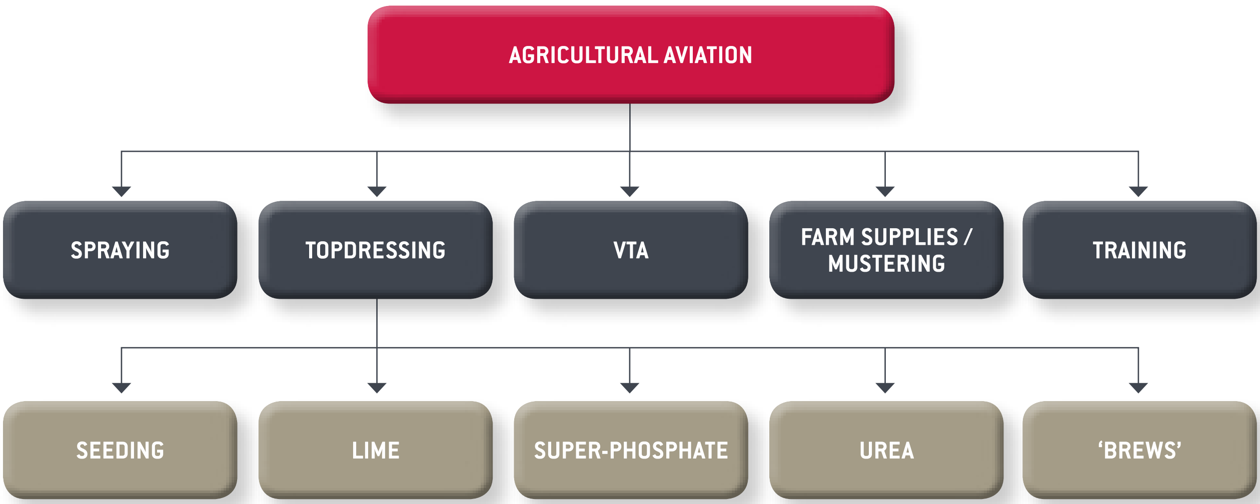
## 2.3 THE AGRICULTURAL AVIATION SECTOR: A DEFINITION IN THE CONTEXT OF THE SRP

**Agricultural aviation operations include the use of an aircraft for the purpose of:**

- Dispensing substances such as agricultural chemicals (agrichemicals) or others for the purpose of plant nourishment, soil treatment, propagation of plant life, pest control or other impacts on agriculture and forestry
- Delivery of farm supplies on farms in rural areas
- Surveying agricultural, forest or water areas
- Feeding or transferring livestock on farms in rural areas
- Reconnaissance activities for any of the above operations (CAR Part 1).[8]

For the purposes of the SRP, Figure 5 illustrates how the activities of agricultural aviation operations have been defined. Each of these activities has been described in more detail within Figure 6.

**FIGURE 5** *Definition of New Zealand agricultural aviation activities*




In the 1960's and 70's all operations including topdressing, spraying, VTA and transfer of livestock/ mustering were conducted by aeroplanes, which continued till the mid 90's. Over time, the use of helicopters for agricultural operations has become increasingly popular in NZ. The helicopters' flight characteristics have proven to be more suitable for the range of activities, particularly the application of product onto smaller or more targeted treatment areas requiring greater manoeuvring ability and application of product (fertiliser of spray) where no or unsuitable airstrip infrastructure exists within an economical flying distance.

Aeroplanes remain suited to the broadcast application of larger treatment areas, applying traditional products such as lime and superphosphate. Figure 6 is an overview of activities undertaken.

**FIGURE 6** *Description of agricultural aviation activities in New Zealand*

| NAME | DESCRIPTION | AIRCRAFT TYPE(S) USED | PRODUCT USED |
|---|---|---|---|
| Spraying | Application of agrichemicals – mainly herbicides and desiccants for the control of weeds in forestry, pasture or marginal land, and to a lesser degree, insecticides for the control of insect pests. Occasional application of soil and plant nutrients by the methods also (e.g. Lime emulsion) | Almost exclusively helicopter. Some specialist fixed wing operations still exist | Herbicides, pesticides, desiccants (or some fertilisers) in liquid or slurry form |
| Topdressing (seeding) | Aerial distribution of grass (or other) seed for propagation or land stabilisation. Often mixed and applied coincident with topdressing products | Helicopter or fixed wing | Grass or other seeds |
| Topdressing (lime) | Aerial distribution of crushed lime rock in flowable form | Mainly fixed wing | Crushed lime rock |
| Topdressing (super phosphate) | Aerial distribution of solid fertilisers and trace elements in a flowable medium or granulated form to agricultural land for soil improvement or plant propagation | Predominantly fixed wing. But helicopter application also | Superphosphate |
| Topdressing (Urea) | Aerial distribution of nitrogen rich plant nutrient as a flowable medium onto pasture and forestry | Helicopter and fixed wing | Urea |
| Topdressing (brews) | Specialist mixes of trace elements determined to be deficient in the soil | Helicopter or fixed wing | |
| VTA | Aerial distribution of Vertebrate Toxic Agents in a pelletised form or 'laced bait' for control of rodents and possums | Predominantly helicopter. Some fixed wing | 1080 Sodium Fluoroacetate |
| Farm supplies / mustering | Mustering/transferring livestock and or delivery of farm supplies, predominantly fencing material, animal feed supplements or erosion control | Almost exclusively helicopter as external load | N/A |
| Training | Specialist helicopter or fixed wing training for the issue of an agricultural pilot rating conducted in accordance with Part 61 | Helicopter and fixed wing | N/A |

## 2.4 REGULATORY CONTEXT

### 2.4.1 AVIATION REGULATORY CONTEXT

Agricultural aircraft operations in New Zealand are conducted in accordance with the Civil Aviation Act 1990, specifically Civil Aviation Rule (CAR) Part 137, the scope of which includes agricultural aircraft operations and training, as well as certification and aircraft instrument requirements. Many operators who hold an Agricultural Aircraft Operator Certificate (AAOC) hold other certificates issued by CAA such as for training, aircraft maintenance, manufacture and air operations.

A large proportion of agricultural helicopter operators hold a Part 119/135 Air Operator Certificate (AOC) allowing full utilisation of the helicopter's multi-role capability to conduct passenger transport flights. Part 119 mandates the organisations use of a management system. Operations under Part 137 are not subject to the Quality Management Systems requirements of Part 119.

The government believes that aviation organisations should meet the full cost of regulating these operations. The civil aviation sector derives benefits from the CAA's services and therefore the sector should meet the related costs, both under the CAA's funding principles and also under the charging guidelines set by Treasury and the Office of the Auditor-General.[9]

The CAA performs its functions of oversight and surveillance through the conduct of routine inspections, education and research initiatives. The inspection frequency is partially influenced by on the organisation's risk profile score, as determined by the CAA. Inspections are conducted through a 'user-pay' system, with the operator paying a set rate per hour for the surveillance conducted by the CAA. Other forms of surveillance include spot-checks, reviews of available occurrence reports, special purpose audits and safety investigations.

In 2007 the CAA responded to concerns over the efficacy of Part 137 (Lewis Report 2005) and commenced development of a more detailed, prescriptive approach to the rule set in terms of certification standards, and to correct deficiencies or anomalies in the existing rule. In 2008 the CAA conducted a detailed Review of Agricultural Aircraft Safety[10] which identified numerous inconsistencies across the agricultural aviation sector apparent at the time. A conclusion of this review was to rewrite Part 137. The CAA published the Proposed Rule [11] and subsequently support for the initiative was withdrawn by the NZAAA due to concerns about the content of the proposed Rule and the potential costs of compliance. The rule amendment was shelved in 2012.

### 2.4.2 OTHER GENERAL REGULATORY CONSIDERATIONS

On 5 May 2003, the Civil Aviation Authority was designated to administer the provisions of the Health and Safety in Employment Act 1992 with respect of the aviation sector. The scope of the designation covers the administration of the Act for work on board aircraft and for aircraft as places of work while 'in operation'.[12]

To a large extent agricultural aviation activity can fall under the provisions of the Resource Management Act (RMA) 1991.[13] The purpose of this Act is to promote the sustainable management of natural and physical resources. The RMA is then exercises by Regional Councils in differing ways (e.g., some require letters of consent for the conduct of certain types of aerial spraying)

The Hazardous Substances and New Organisms (Low Risk Genetic Modification) Regulations 2003 also pertains to agricultural aviation operations. It was enacted to reform the management of hazardous substances and new organisms. There is a strong relationship between the HSNO Act and the Health and Safety in Employment (H&SE) Act 1992 because hazardous substances are often found in workplaces.[14]

### 2.4.3 OPERATOR 'COST OF COMPLIANCE'

Industry have estimated the total cost of compliance for small agricultural operators to be in the vicinity of NZ$58,000.00 per annum for helicopter operators and NZ$51,000 for fixed wing operators, of which $19,000 and $13,000 respectively are attributed to CAA costs.[15]

## 2.5 AIRCRAFT AND PILOT CONTEXT

### 2.5.1 AIRCRAFT

**A. Fixed wing**

Types of aeroplanes used in agricultural operations are relatively few, although a number of FU24 series aircraft have been modified to have more engine power, creating more variants. The Air Tractor, Gippsland GA200 and a few other types comprise the remainder of the aeroplanes in use.

The modification of aeroplanes for agricultural operation, particularly increased weight and turbine conversion, has changed the overall performance. The basis for performance calculations, and particularly the application of Part 137 Appendix B for increased payloads above that of the MCTOW, has been impacted by this shifting aeroplane capability, and can result in an exceedence in the manufacturers' MTOW.

There is a decline in the number of aeroplanes available to conduct aerial operations. The existing fleet is ageing due to the financial viability regarding replacement aeroplanes, which is exacerbated by the lack of new and suitable aeroplanes being manufactured or certified.

**B. Helicopters**

A specific range of helicopters service agricultural operations, with the Robinson R44, Eurocopter AS350 and Bell 206 dominating the fleet. There are more modern helicopters which are available for use, which are better suited to the more specialised and targeted applications required under modern farming needs. The growing popularity and versatility of helicopters creates an environment of pressure for the fixed wing operators who, in some areas, are unable to compete financially and operationally.

Modifications to role equipment used and equipment on the helicopter occur in New Zealand in order to maintain competitive advantage. Anecdotally, some modifications are un-approved due a reluctance to undertake the certification process through the CAA.

### 2.5.2 PILOTS

Pilots conducting Part 137 operations hold Agricultural and Chemical Ratings. However, CAA rules require that these ratings are entered into the pilot logbook rather than license. Consequently CAA does not have specific data on the number, location, age or experience of the agricultural aviation pilot fraternity, nor the individual hours flown per year.

Agricultural pilots in New Zealand must hold at least a private pilot's licence and have logged a minimum of 200 hours total time with at least 100 of these hours on the category of aircraft they will operate – fixed wing or helicopter. To conduct agricultural operations for hire or reward a pilot must be the holder of a commercial pilot licence. An agricultural pilot rating requires 75 hours specialised agricultural flight training. The first 1000 hours of productive flying, as a Grade 2 agricultural pilot, must be attained under the supervision of a qualified Grade 1 agricultural pilot. Once 1000 hours productive agricultural flying is achieved, the pilot becomes an unrestricted Grade 1. Then, each year pilots undertake a competency assessment with an instructor or Flight Examiner.

The current demographics of agricultural pilots is such that the existing fixed wing pilot pool is predominantly pilots who are very experienced and approaching retirement age. Helicopter operators have an increasing number of pilots entering the industry with a lower average age and experience than the fixed wing pilot population.

The conversion of a number of fixed wing aeroplanes from piston to turbine engines led to the airframes operating under more power and carrying greater weights. These engines have a longer service life and are easy to maintain and source replacement parts for.[16] However, in the airframes were not designed for this increased power. This has subsequently led to an increase in defect rates on modified aircraft.

## 2.6 OPERATIONAL CONTEXT

### 2.6.1 VOLUME AND FREQUENCY OF ACTIVITY

**The following trends were noted through the review of agricultural operational return data:**

A. **Fixed wing**

- Between 2009 and 2012 there was a relatively stable trend in the number of loads carried (e.g., an average of approximately 350,000 per year). This is less than helicopter load carriage overall
- Super-phosphate is predominantly spread by fixed wing aircraft, and there has been a gradual increase in the amount used
- Between 2009 and 2012, the carriage of urea has gradually declined, although urea was a small proportion of the topdressing activities
- Fixed wing delivered most super-phosphate and lime over this period with stable loads over 2011 and 2012.

B. **Helicopters**

- Between 2009 and 2012, the number of loads carried by helicopters has continued to steadily grow, also noting a significant spike in activity seen in 2011 also (approx. 700,000 loads). In 2012 the CAA recorded approximately 420,000 loads conducted by helicopters)
- Helicopters delivered nearly all urea since 2009 with a very large increase in 2012.

### 2.6.2 NUMBER OF OPERATORS

There are presently 104 agricultural aviation certificate holders in New Zealand, 22 of which operate fixed wing aeroplanes only, and another 3 operators using a mix of fixed wing and helicopters. There is estimated to be a total of 81 fixed wing aeroplanes and 199 rotary aircraft being operated.[17]

Apart from several substantially sized fixed wing organisations, most remaining fixed wing agricultural operators utilise 1 or 2 aircraft. This organisational model is subject to greater commercial pressure due to competition from similar operators. Some of the larger fixed wing operators who are under corporate ownership with greater resources and personnel have voluntarily implemented these systems which may reduce the safety risk to their operation.

### 2.6.3 AIRSTRIPS AND SUPPORTING INFRASTRUCTURE

The CAA, NZAAA, Federated Farmers and the Department of Labour, jointly developed the *Safety Guidelines: Farm Airstrips and Associated Fertiliser Cartage, Storage and Application*, which outlines how to manage risks within this 'workplace'. [18] The purpose of this document was to ensure that the quality of the fertiliser available is 'fit for purpose' and provides information about the farmer's role in providing an adequate and reasonable strip, and appropriate fertiliser storage facilities'.

There are approximately 3670 airstrips in New Zealand which support the agricultural industry; however it is not clear how many align with the published Guidelines.[19] Airstrip conditions that do not meet the guidelines may adversely affect or restrict the type of aircraft which can safely use it.

The fertiliser must be stored so that it maintains its integrity for free flowability, which is essential to ensure the safe dispersal of the load from the air, and also for the ability to safely jettison the load in case of emergency. Weather proof storage facilities that have unobstructed access are vital to assure fertiliser flowability and truck manoeuvring ability. Loader/drivers are utilised to ensure the safe delivery of product to the aircraft. These loader/drivers roles include; assessing the product for free flowing characteristics, establishing the suitability/ weight and mass measurements of the product and passing these on to the pilot.

## 2.7 SAFETY CONTEXT

There is a widespread belief that agricultural aviation, by its nature, is 'riskier' than other forms of aviation due to the nature of the activities undertaken; very low level flying, high workload, subject to the negative' effects from weather, terrain and obstacles.

The CAA state the safety performance of the agricultural aviation sector has been resistant to improvement, despite CAANZ and industry research and initiatives.[20] This has included the conduct of the Agricultural Aircraft Safety Review in 2008 and the introduction of the industry-initiated voluntary safety and compliance programme AIRCARE in 2011.

The social cost of an aviation industry sector is defined as *"the annual cost of machines damaged plus the assumed costs of injury and the statistical value of human life, divided by the number of hours flown by the industry sector."*[21] The CAA states that the social cost for agricultural operations was approximately $200 per hour (1997-2007[22]) which far exceeds the CAA targeted $14 per hour. For aeroplane operations this figure has been trending downwards and achieved $14 an hour in 2012. For helicopter operations, these were below the target (at $8.56) since 2009, but a fatal occurrence in 2012 resulted in an exceedence during that year[23]. The loss of an agricultural aeroplane with a pilot or additional passenger maintains a high cost to the families of those persons, the loss to the operator and client, the negative effect on the public perception of agricultural aircraft safety and the public's perception of overall aviation safety.

### 2.7.1 ACCIDENT AND INCIDENT RATES

In 2008, the accident rate was at approximately 66 per 100,000 flying hours for fixed wing, and approximately 46 per 100 000 hours for helicopters. In 2012 this had dropped to 40 and 34 per 100 000 hours respectively, but this is still considered high. In terms of the incidents reported to CAANZ, in 2012 the rate was 40.1 per 100 000 flying hours for agricultural aircraft, compared to 33.7 per 100 000 flying hours for helicopters.

The majority of fixed wing-related safety reports occurred within the 'Fletcher' family of aeroplane, which is predominantly as a result of this being the most commonly-operated model. The Robinson fleet of helicopters reported the majority of occurrences, including those associated with not becoming airborne (sometimes due to overloading). Reports with active errors classified as 'structural / mechanical' have continued to rise, as did reports classified as 'actions inconsistent with procedures' (until 2012).

### 2.7.2 FATALITIES AND INJURIES

Since the 1950's approximately 140 fatalities have occurred in agricultural aviation. Between 2003 and 2012 there were 19 fatalities, 12 serious injuries and 8 minor injuries in fixed wing occurrences, and 9 fatalities, 4 serious injuries and 11 minor injuries as part of helicopter occurrences.[24]

## 2.8 ECONOMIC CONTEXT

Agriculture is very important to New Zealand's economy and continues to be a core part of the economy. The services that agricultural aviation organisations provide to this industry are key to the sustainable future of the agricultural products and therefore the continuance of agriculture to the overall economic future of New Zealand.

The relatively high number of agricultural aviation operators throughout New Zealand appears to be threatening the sustainability of some, who are not as competitive as required. Evidence from statistics, surveys and interviews of stakeholders suggests that there is an oversupply of smaller operators whose pricing models are promoting unsustainable competition. In addition, with the introduction of the 2 large co-operatives, their capacity for very competitive pricing can create additional financial pressure and the associated safety concerns that arise from smaller operators trying to cut corners to compete.

## 2.9 GEOGRAPHICAL AND ENVIRONMENTAL CONTEXT

The nature of the geography of New Zealand makes for challenging conditions for any aviation organisation. Varying weather results in runs of 'windows of opportunity', when conditions are conducive to safe operations. Favourable conditions are sporadic, and operators must be ready to provide fully serviceable aircraft and available crew at short notice. After periods of unfavourable weather and 'downtime' with an associated loss of productivity, there is pressure on operators to service the backlog of work. This is of the highest priority to clients and operators cannot always meet these expectations.

Droughts and floods influence the farming communities which has a flow on negative effect to the aviation community. These geographical and environmental influences directly affect farming returns which, in turn, affects the disposable income available for the maintenance of nutrients and weed eradication (spraying and topdressing).

There are a multitude of environmental risks that require management when aerial spraying crops and agricultural aviation organisations are bound by numerous environmental regulations surrounding the application of agrichemical sprays and powders. Spray drift can occur when droplets of vapour or dust associated with agricultural spraying drift away from the target area, and can come into contact with unintended land based recipients or contaminate water ways.

## 2.10 SUPPORTING SECTOR CONTEXT

### 2.10.1 TRAINING

Overall, flight training in New Zealand is a diverse and economically significant sector of the industry. Agricultural aviation training is unique in a number of respects:

- Fixed wing agricultural aircraft are generally single-seat / single control, which do not accommodate the normal pilot / instructor dynamics
- There is no industry-wide oversight of the number of instructors permitted to provide agricultural aviation training. Under Civil Aviation Rules E Category instructors are not subject to the same requirements to hold and retain this qualification as are D, C, B or A category Instructors, including not being required to hold any preceding instructing qualifications or experience, to be under the supervision of a more senior instructor, or to demonstrate ongoing competency of their instructional ability on an annual basis
- Due to the small market for fixed wing agricultural training, there are few specialised dual-control agricultural aircraft. Therefore, some training and competency checks are conducted by 'observation from the ground'
- There is industry-agreed standardised training syllabus; instructors (or companies certificated to provide agricultural training) are required to submit individual training syllabi for the approval of the Director using AC61-15.

The NZAAA has a Code of Practice for Agricultural Pilot Training which supplements the guidance in CAA AC61-15. The Code of Practice was last updated in 2007, as was the AC-615-15. However, and this is not widely used.

### 2.10.2 MANUFACTURING AND MAINTENANCE

The NZ general aviation aircraft manufacturing, parts and maintenance sectors comprises approximately 184 organisations.[25] This includes 20 manufacturing organisations and a range of 15 to 20 major maintenance companies which service both fixed and helicopter aircraft.[26] For the agricultural aviation industry, the shift to modified aircraft and engines in particular has depended on the skills and availability of parts from these supporting sectors. The two corporately owned operators conduct in-house maintenance, parts and component manufacturer, while a number of other fixed wing and helicopter operators hold approval to conduct aircraft maintenance in-house. Smaller operators will tend to contract out their maintenance

### 2.10.3 FERTILISER

In New Zealand over 2 million tonnes of fertiliser are applied annually to pastures, crops and forests by truck, tractor or by fixed wing or helicopters.[27] Fertiliser use in 2010-2011 increased for the first time in three years to 3 million tonnes.[28] About 40% is spread by aircraft onto steep hill-country pastures and production forestry land – the highest proportion in the world. Two large fertiliser and agrichemical companies, Ravensdown and Balance Agri-nutrients together make up the majority of the fertiliser manufacturing industry in New Zealand.

Fertiliser and agrichemicals have an impact on the environment, through direct application to waterways, or from nutrient run-off and leaching from enriched soil into waterways, which can cause a rapid increase in algal or weed growth. The Resource Management Act 1991 promotes the sustainable management of natural and physical resources, and one of the basic principles is to 'avoid, remedy or mitigate adverse effects on the environment'. Agricultural aviation activities such as topdressing will be permitted by a regional council plan, but often with specific conditions. Compliance with the Resource Management Act is a shared responsibility between the agricultural aviation operator and the client and adds to the regulatory requirements placed on the operators.

### 2.10.4 INDUSTRY ASSOCIATIONS

A. **Aviation Industry Association (AIA) and the Agricultural Aviation Association (NZAAA)**

The AIA supports all aspects of aviation with 369 (as at July 2013) aviation companies in its memberships. It is aimed at taking an entire industry approach to developing and improving aviation. Under the banner of the AIA an accreditation scheme was developed and introduced in 2011, named AIRCARE. AIRCARE is a voluntary code of practice, aimed at the NZ general aviation industry to which agricultural aviation belongs. The programme focuses on flight safety, environmental safety and quality assurance, streamlining a host of compliance requirements.

The NZAAA is a Division of the Aviation Industry Association (AIA). NZAAA was established "to ensure the sustainability of Agricultural Aviation in NZ by developing and advocating best practice in both flight safety and environmental safety, promoting professionalism and profitable business, facilitating adoption of best practice programmes by members and stakeholders, and engaging in research opportunities.[29]" NZAAA currently represent 73 agricultural aviation operators. From the 102 agricultural aviation certificates currently held, this would suggest that membership represents approximately 75% of the sector. The NZAAA website claims that they represent 95% though, as some of the 102 certificate holders are not currently actively undertaking agricultural aviation operations. Currently, there are no other Industry Associations that represent agricultural aviation in New Zealand.

B. **Fertiliser Association**

The Fertiliser Association of New Zealand was founded over 60 years ago with the aim to promote best management practices for managing nutrients. The two major co-operatives manufacture, distribute and market around 98% of all fertilisers sold in New Zealand.[30]

C. **Fertiliser Quality Council**

The Fertiliser Quality Council of New Zealand was formed to provide farmers with quality assurance with the purchase of fertiliser. The initiative named Fertmark is an independently assessed quality assurance programme and Code of Practice.[31] In addition the Council established the Spreadmark programme in 1994 which is a fertiliser placement quality assurance programme. This code addresses the production, security, economic, environmental and social aspects of aerial application of fertiliser.

The Federated Farmers of New Zealand is member based organisation that represents the interests of farmers and promotes the business of farming by encouraging sustainability through best practice.[32]

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# PART 3:
# SUMMATION OF RESULTS

# PART 3: SUMMATION OF THE RISK PROFILE

A risk profile is a description of the set of risks within a predetermined scope. In order to best present the risk profile of the SRP, a collective set of risks across the Industry is presented graphically. This provides the necessary 'snapshot' of the SRP. The second aspect is the detailed description of individual risks, including a complete risk assessment and suggested risk treatment options for each risk. This provides the appropriate context for each risk and ensures that the summation or collective profile is not considered in isolation.

## 3.1 PRESENTATION OF THE COLLECTIVE SET OF RISKS

The set of risks are presented using two methods—against the level of risk and against the SRP Model elements. These two approaches allow the cumulative risks within the Agricultural Aviation sector to be considered, enabling aspects of greater risk (in terms of the magnitude or number of risks within that element) to be identified and communicated, with holistic risk treatments identified accordingly.

### 3.1.1 AGRICULTURAL AVIATION INDUSTRY RISKS BY RISK LEVEL

A risk is measured in terms of the magnitude of its consequence and likelihood. The presentation of results for these two functions can be communicated by plotting them on a two-dimensional risk analysis tool or matrix.

The two matrices, Figure 7 and Figure 8, provide a visual representation of the level of risk before and after risk treatment. The matrix indicating the risk level after treatment is often referred to as depicting the 'projected residual risk.' That is, it shows the risk that remains after the full implementation of risk treatment measures is achieved.

It should be noted that the allocation of resources or decision making to implement the risk treatment strategies is a key part of the risk accountability and escalation process achieved in the risk evaluation and treatment steps of the risk management process as described in AS/NZS ISO 31000:2009.

**FIGURE 7** *Current Risk Profile, presented by Consequence and Likelihood*

| CONSEQUENCE \ LIKELIHOOD | CERTAIN | LIKELY | POSSIBLE | UNLIKELY |
|---|---|---|---|---|
| EXTREME | VERY HIGH (1) | VERY HIGH (2) | HIGH (5) | HIGH (9) 10 |
| CRITICAL | VERY HIGH (3) 1 | HIGH (4) 2, 3, 4 | HIGH (8) 9 | MEDIUM (12) |
| MAJOR | HIGH (6) 5 | HIGH (7) 6, 7, 8 | MEDIUM (11) 11, 12, 13, 14, 15, 16 | MEDIUM (14) |
| MINOR | HIGH (10) | MEDIUM (13) | LOW (15) | LOW (16) |

**FIGURE 8** *Projected Risk Profile following the implementation of risk treatments, presented by Consequences and Likelihood*

| CONSEQUENCE \ LIKELIHOOD | CERTAIN | LIKELY | POSSIBLE | UNLIKELY |
|---|---|---|---|---|
| EXTREME | VERY HIGH (1) | VERY HIGH (2) | HIGH (5) | HIGH (9) |
| CRITICAL | VERY HIGH (3) | HIGH (4) | HIGH (8) 1 | MEDIUM (12) 3, 10 |
| MAJOR | HIGH (6) | HIGH (7) | MEDIUM (11) 2, 4, 5, 6, 7, 8, 9 | MEDIUM (14) 11, 12 |
| MINOR | HIGH (10) | MEDIUM (13) | LOW (15) 13, 14, 15, 16 | LOW (16) |

## 3.2 PRESENTATION OF INDIVIDUAL RISKS

**The individual risks within the Agricultural Aviation Industry are presented in the following ways:**

### RISKS PRESENTED BY PRIORITY RANKING WITH RISK LEVELS

The tabulated data below in Figure 9 presents the risks from highest to lowest by risk level, with risks of equal value being prioritised accordingly. The summation of results in this presentation format only depicts the risk assessment, being the identification and quantification of risk, and does not list any treatments to reduce the risk. This information is provided as a snapshot of the issues from highest to lowest.

### RISKS PRESENTED AGAINST THE SRP MODEL ELEMENTS

Part 4 presents detailed information about each risk, grouped according to the SRP Model. This functional grouping allows the reader to examine risks in the related category. The information is presented in this way as high level stakeholders often look for information against these classification elements (such as oversight model, platform profile, safety etc). Guidance for reading this table is contained in Part 4 of the report.

These complementary tables provide a detailed description of the uncertainty regarding the Agricultural Aviation Industry. The level of description enables comparison of the individual risks by both SRP Model elements, and the quantitative measurement of the level of risk.

**FIGURE 9** *Agricultural Aviation Industry Risks presented by Risk Level and Priority*

| No. | RISK STATEMENT | RISK LEVEL |
|---|---|---|
| 1 | Some operators choose to selectively comply with the multiple regulatory requirements (i.e. environmental, HSE, commercial, and aviation requirements), creating opportunity for safety failures where regulations have not been met but no other control measures are implemented in their place | VERY HIGH (3) |
| 2 | Regulatory oversight may not adequately identify critical risks or issues that then result in safety failures in the agricultural aviation sector | HIGH (4) |
| 3 | Due to an absence of industry-agreed, best practice operational standards, agricultural aviation activities are not conducted with consistency across the sector, resulting in an overall degradation in safety performance across the sector | HIGH (4) |
| 4 | The maintenance and operational management of agricultural fixed wing aircraft as an asset can be insufficient for the type of role it undertakes over the span of its life, leading to an aircraft with reduced safety margins or airworthiness assurance | HIGH (4) |
| 5 | As a result of commonly-used 'industry pricing models' that are used to attract customers, operators undercut competitors to the extent that within that region all operators become financially unstable, leading to operational behaviour that sacrifices safety for short-term profitability | HIGH (6) |

| No. | RISK STATEMENT | RISK LEVEL |
|---|---|---|
| 6 | The financial stability of all operators is reduced by the trend towards a prevalence of smaller, inexperienced helicopter operators with minimal financial outlay entering the sector and charging reduced rates for market share | HIGH (7) |
| 7 | Degraded aircraft performance due to routine overloading of aircraft is prevalent amongst agricultural aviation operators, leading to unsafe operating margins and a higher risk of an accident | HIGH (7) |
| 8 | There is an overarching safety culture within New Zealand agricultural aviation where productivity is prioritised over safety (i.e. the 'can do' approach), where safety equipment is not always utilised, and where safety occurrences may not be reported | HIGH (7) |
| 9 | Due to the absence of consistent and robust sector training standards, the skills and knowledge of agricultural pilots and instructors vary significantly throughout the sector, leading to a degradation in overall ability to safely undertake agricultural operations | HIGH (8) |
| 10 | As a result of increasing community awareness and concern regarding environmental matters, the viability of aerial application as a farming tool may be threatened if public perceptions is not actively managed, leading to the cessation of agricultural operations | HIGH (9) |
| 11 | Current agricultural aviation legislation allows for operational practices that reduce aircraft safety margins, including the ability to carry higher than normal loads without documenting the necessary conditions under which this can be done | MEDIUM (11) |
| 12 | As a result of helicopter operator numbers increasing, there is a higher chance of the under-reporting of hours to avoid maintenance of high-value equipment to occur due to pressures to reduce business costs, leading to a poor state of maintenance of the helicopters | MEDIUM (11) |
| 13 | Operators' safety margins are reduced due to the condition of some owners' airstrips and the supporting infrastructure (i.e. fertiliser storage, windsocks, etc.) | MEDIUM (11) |
| 14 | Poor fertiliser storage facilities and methods (as well as fertiliser properties that can be conducive to degradation) and lack of consistently identifiable physical properties, aircraft can be loaded with a degraded or unknown condition of fertiliser, which can result in operational unpredictability when releasing it | MEDIUM (11) |
| 15 | Whilst industry accreditation programs provide an opportunity for operators to improve, the perception of their value has degraded as they are often viewed as an arbitrary exercise to retain clients (that require the accreditation), resulting in a reduction in the benefits that could come from present and future programs | MEDIUM (11) |
| 16 | As a result of what can be a low maturity of safety management amongst some operators, there are few incentives for operators to systematically manage fatigue, distraction and enhance non-technical skills, thereby increasing the potential of poor safety outcomes during daily operations | MEDIUM (11) |

# PART 4:
# SECTOR RISK PROFILE TABULATED DATA

# 4. SECTOR RISK PROFILE TABULATED DATA

## 4.1 READING THE RISKS PRESENTED BY SRP ELEMENT

This section of the SRP is a technical document which has been written to provide the in-depth identification, analysis and proposed management strategies to treat the risk. When reading the tabulated data, the contents are to be read from left to right. These risks are not ordered in priority from highest to lowest, but rather are grouped and classified against the SRP Model elements. The tables are separated into subsections according to the relevant SRP Model element for each risk.

Each page of the tabulated data contains explicit, in depth information. The far left column labelled 'Description of the Risk' includes the risk statement. It is to be noted that these risks statements are worded as risks (the chance something could happen - not the certainty that it is happening) to this end the risk statement is to be read in concert with the likelihood column for that item for a complete picture of the risk.

The column to the right of the Risk Description is the impact that that risk may have on. These points are potential consequences and are to be read in concert with the 'Consequence' column in the risk assessment component of the table. This consequence rating is the semi-quantitative assessment of the word picture outlined in the 'Impact' column. In essence these two columns indicate one and the same thing using different language and methods.

'Risk level' is calculated by multiplying consequence and the likelihood on a two dimensional matrix. The risk level is indicated by both a word e.g. 'High' and a number for example '5'. This number correlates to the placement on the matrix as indicated in Section 3 given each risk level spans a number of boxes.

The most critical aspect to the whole tabulated data and the SRP itself is the identification, resourcing and implementation of risk reduction measures known as 'Risk Treatment Strategies'. For the purposes of this SRP, the risk treatment strategies listed in this tabulated data are 'Performance or Outcome based' and are not specific tasks allocated to any one group in industry. These reduction measures need to be further developed into actual tasks that can be implemented, tracked and measured.

The projected residual risk rating uses this same process as the risk assessment step while taking into account the forecast of the risk level calculation (of both consequence and likelihood) once the proposed set of treatments has been implemented. The residual risk can only be claimed by the industry once the treatments have been allocated, resourced and completed. A progress report against the implementation should be undertaken regularly to track a downward motion of the risk profile.

| SERIAL A | OVERSIGHT MODEL | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES | | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
| | | | | | CAA | INDUSTRY | | |
| Regulatory oversight may not adequately identify critical risks or issues that then result in safety failures in the agricultural aviation sector | • Inability for the CAA to support or lead actions that may prevent an accident or incident<br>• Audits are of insufficient depth for operators to derive benefit from them<br>• A culture of non-compliance can develop<br>• Technical standards and airworthiness across the industry may decrease<br>• Inability to interact meaningfully with industry | CRITICAL | LIKELY | HIGH (4) | • *To be determined* | • *To be determined* | MEDIUM (11) | 2 |

## SERIAL B — COMPLIANCE REGIME

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Some operators choose to selectively comply with the multiple regulatory requirements (i.e. environmental, HSE, commercial, and aviation requirements), creating opportunity for safety failures where regulations have not been met but no other control measures are implemented in their place | • Operators then set their own standards, which may not be in alignment with ideal operational practices or regulatory requirements<br>• There is a perceived high 'cost of compliance' for operators, which can drive some operators to take actions that are non-compliant<br>• Operators can cultivate a culture of non-compliance / non-conformance that becomes an inherent part of their organisational culture<br>• A lack of systematic approach to safety can result in an accident or incident | CRITICAL | CERTAIN | VERY HIGH (3) | • *To be determined* | • *To be determined* | HIGH (8) | 1 |

## SERIAL C — COMPLIANCE REGIME

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Current agricultural aviation legislation allows for operational practices that reduce aircraft safety margins, including the ability to carry higher than normal loads without documenting the necessary conditions under which this can be done | • Accidents and incidents as a result of non-optimal operational practices, particularly those relating to loading, jettisoning, fatigue management and other human factors matters<br>• The 'overload weight determination criteria' can facilitate the overloading of aircraft to the point where safety of the flight can be compromised<br>• The practice of techniques amongst operators that create overloaded / overweight aircraft outside of their structural and/or operational limitation<br>• Long term incremental increase in structural fatigue, and subsequently reduction in structural integrity<br>• Diverging uniformity in practice between operators<br>• Inconsistent standards throughout industry facilitating further non-conformances and non-compliances<br>• The formation of two distinct types of management maturity (i.e. small, single pilot operators vs. larger operations and those with Part 135 certification)<br>• Safety risks induced by insufficient or absent organisational systems are not able to be managed through the regulator's surveillance and oversight activities as they are not required by Part 137 | MAJOR | POSSIBLE | MEDIUM (11) | • *To be determined* | • *To be determined* | MEDIUM (14) | 11 |

| SERIAL D | ASSURANCE MODEL | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES | | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
| | | | | | CAA | INDUSTRY | | |
| Due to an absence of industry-agreed, best practice operational standards, agricultural aviation activities are not conducted with consistency across the sector, resulting in an overall degradation in safety performance across the sector | • There is a higher likelihood of accidents and incidents<br>• Reduction in assurance for CAA that current operational practices are conducive to safe outcomes<br>• Industry confidence in the value of Rule-based inspection is eroded by ongoing accidents | CRITICAL | LIKELY | HIGH (4) | • *To be determined* | • *To be determined* | MEDIUM (12) | 3 |

## SERIAL E — OPERATOR PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Due to the absence of consistent and robust sector training standards, the skills and knowledge of agricultural pilots and instructors vary significantly throughout the sector, leading to a degradation in overall ability to safely undertake agricultural operations | • Reduction in the experience base of individual instructors, which may in turn not enable them to effectively impart knowledge and skills<br>• The variable quality of instruction and training fails to meet rising expectations of professionalism within the sector.<br>• A reducing standard of airmanship throughout the sector<br>• Overall reduction in sector sustainability (particularly in fixed wing) | CRITICAL | POSSIBLE | HIGH (8) | • *To be determined* | • *To be determined* | MEDIUM (11) | 9 |

## SERIAL F

## OPERATOR PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| As a result of helicopter operator numbers increasing, there is a higher chance of the under-reporting of hours to avoid maintenance of high-value equipment to occur due to pressures to reduce business costs, leading to a poor state of maintenance of the helicopters | • Under-recording of hours results in reduced maintenance integrity of the airframe, which can result in an accident or incident for this operator, or for another who is sold this airframe (without knowing its operational history)<br>• Strain on supply of critical spare parts for helicopters resulting in a higher risk of grounding airframes awaiting parts, thus reducing operational viability of the organisation (i.e. due to the consumption of high value parts in a low margin sector)<br>• Less experienced flight crew resulting in a reduction of industry knowledge, which can increase the chance of negative safety outcomes | MAJOR | POSSIBLE | MEDIUM (11) | • *To be determined* | • *To be determined* | MEDIUM (14) | 12 |

| SERIAL G | OPERATOR PROFILE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES | | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
| | | | | | CAA | INDUSTRY | | |
| The financial stability of all operators is reduced by the trend towards a prevalence of smaller, inexperienced helicopter operators with minimal financial outlay entering the sector and charging reduced rates for market share | • In times where there is little work, there are too many organisations now for all to achieve profitability, leading to an increase in the amount of under-cutting for work during slow seasonal and economic times<br>• Fixed wing operators that undertake the same activities as helicopters may become financially unsustainable, and if not able to operate, the scope of services available in NZ may reduce<br>• Accidents and incidents resulting from reduced safety margins (such as overloading, insufficient maintenance, etc), in response to financial instability | MAJOR | LIKELY | HIGH (7) | • *To be determined* | • *To be determined* | MEDIUM (11) | 6 |

## SERIAL H — ACTIVITY PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Operators' safety margins are reduced due to the condition of some owners' airstrips and the supporting infrastructure (i.e. fertiliser storage, windsocks, etc.) | • Degraded or absent infrastructure such as windsocks, fertiliser bin quality, fences not keeping out stock, etc. reduces safety outcomes<br>• Poor quality airstrips, resulting in damaged aircraft (i.e. landing gear), and higher risk of accidents<br>• Airstrips not being the correct length and width for the aircraft currently used<br>• The inability for operators to hold clients (or airstrip owners) to account, which perpetuates the lack of control over the economic viability of the operator, leads to continuing poor conditions for airstrips | MAJOR | POSSIBLE | MEDIUM (11) | • *To be determined* | • *To be determined* | LOW (15) | 13 |

## SERIAL I — ACTIVITY PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Degraded aircraft performance due to routine overloading of aircraft is prevalent amongst agricultural aviation operators, leading to unsafe operating margins and a higher risk of an accident | • Reduction in the performance of the aircraft during critical stages of flight, particularly take off, due to reduced margins of error<br>• High number of active failures during the take-off phase seen in accident statistics<br>• Normalisation in this practice, such that operators will routinely overload for the conditions. This increases the likelihood of a negative safety outcome | MAJOR | LIKELY | HIGH (7) | • *To be determined* | • *To be determined* | MEDIUM (11) | 7 |

## SERIAL J — ACTIVITY PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Poor fertiliser storage facilities and methods (as well as fertiliser properties that can be conducive to degradation) and lack of consistently identifiable physical properties, aircraft can be loaded with a degraded or unknown condition of fertiliser, which can result in operational unpredictability when releasing it | • The inability to determine the physical properties of the fertiliser affects the accuracy of placement<br>• Reduced effectiveness if the jettisoning of the load is required<br>• Increases the risks associated with time sensitive brews<br>• A propensity for operators to attempt to apply less than optimum product in order to complete the job<br>• Contributes to the factors that pilots / operators cannot actively influence | MAJOR | POSSIBLE | MEDIUM (11) | • *To be determined* | • *To be determined* | MEDIUM (14) | 14 |

## SERIAL K — AIRCRAFT CAPABILITY PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| The maintenance and operational management of agricultural fixed wing aircraft as an asset can be insufficient for the type of role it undertakes over the span of its life, leading to an aircraft with reduced safety margins or airworthiness assurance | • Little incentive to source new aircraft, loss of opportunity to take advantage of modern safety features<br>• Evidence of degraded airworthiness of fixed wing agricultural aircraft fleet<br>• The cost of certification of aircraft modifications to suit industry requirements perceived as an inhibitor to safe operations<br>• Encouragement of undeclared modifications by operators, higher defect rates for aircraft with mods<br>• There is a greater risk of metal fatigue, and the carriage of defects due to delayed or poor preventative maintenance | CRITICAL | LIKELY | HIGH (4) | • *To be determined* | • *To be determined* | MEDIUM (11) | 4 |

## SERIAL L — INDUSTRY OPERATING ENVIRONMENT

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| As a result of increasing community awareness and concern regarding environmental matters, the viability of aerial application as a farming tool may be threatened if public perceptions is not actively managed, leading to the cessation of agricultural operations | • Reduction in the sustainability of the industry under negative public perceptions, and the application of the Resource Management Act<br>• Increased burden of compliance on operators, detracting from operational activities<br>• Increasing environmental protection assurance amongst the public<br>• Reduction to NZ agricultural viability due to lack of effective methods to undertake the tasks previously done by agricultural operators | EXTREME | UNLIKELY | HIGH (9) | • *To be determined* | • *To be determined* | MEDIUM (12) | 10 |

## SERIAL M — INDUSTRY OPERATING ENVIRONMENT

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES | | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| | | | | | CAA | INDUSTRY | | |
| As a result of commonly-used 'industry pricing models' that are used to attract customers, operators undercut competitors to the extent that within that region all operators become financially unstable, leading to operational behaviour that sacrifices safety for short-term profitability. | • The overall safety of operations can be affected as a result of financial pressures, i.e. reduced maintenance, pressured operational activity<br>• Destabilisation of and reduction in the number of operators and subsequent loss of industry knowledge and experience<br>• The development of an ingrained culture where there is a chronic reluctance to increase prices | MAJOR | CERTAIN | HIGH (6) | • *To be determined* | • *To be determined* | MEDIUM (11) | 5 |

# PASSENGER AND PARTICIPANT PROFILE

No risks identified in this element

| | |
|---|---|
| RISK STATEMENT | |
| IMPACTS | |
| CONSEQUENCE: | -- |
| LIKELIHOOD: | -- |
| RISK LEVEL: | -- |
| TREATMENT STRATEGIES – CAA | |
| TREATMENT STRATEGIES – INDUSTRY | |
| RESIDUAL RISK LEVEL: | -- |
| PRIORITY (BASED ON INITIAL RISK LEVEL): | -- |

## SERIAL N — SYSTEMS PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| Whilst industry accreditation programs provide an opportunity for operators to improve, the perception of their value has degraded as they are often viewed as an arbitrary exercise to retain clients (that require the accreditation), resulting in a reduction in the benefits that could come from present and future programs | • The reduction in effectiveness of industry accreditation can intensify any weaknesses within existing legislation<br>• The reduction in effectiveness to use accreditation programs as a proactive driver of change in the future<br>• Reduced level of standard approach for safety and quality management | MAJOR | POSSIBLE | MEDIUM (11) | • *To be determined* | • *To be determined* | MEDIUM (14) | 15 |

| SERIAL 0 | SAFETY PROFILE | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES | | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
| | | | | | CAA | INDUSTRY | | |
| As a result of what can be a low maturity of safety management amongst some operators, there are few incentives for operators to systematically manage fatigue, distraction and enhance non-technical skills, thereby increasing the potential of poor safety outcomes during daily operations | • Poor safety outcomes in the form of accidents and incidents where human factors-related causal factors exist<br>• Resistance to see the agricultural pilot role as a profession<br>• Reduction in overall efficiency of operations resulting from a lack of awareness for continuous improvement and human factors integration<br>• A lack of appreciation of the reduction in physical and psychological health of pilots<br>• Reduction in the appeal of joining / remaining in agricultural aviation operations | MAJOR | POSSIBLE | MEDIUM (11) | • *To be determined* | • *To be determined* | MEDIUM (14) | 16 |

## SERIAL P — SAFETY PROFILE

| RISK STATEMENT | IMPACTS | CONSEQUENCE: | LIKELIHOOD: | RISK LEVEL: | TREATMENT STRATEGIES: CAA | TREATMENT STRATEGIES: INDUSTRY | RESIDUAL RISK LEVEL: | PRIORITY (BASED ON INITIAL RISK LEVEL): |
|---|---|---|---|---|---|---|---|---|
| There is an overarching safety culture within New Zealand agricultural aviation where productivity is prioritised over safety (i.e. the 'can do' approach), where safety equipment is not always utilised, and where safety occurrences may not be reported | • An increased likelihood of accidents and incidents as a result of compromised decision making and preventable injuries<br>• Loss of proactive safety measures taken as a result of not being able to learn from the lessons of others (i.e. through safety reports)<br>• Survivability of an accident reduced by not using safety equipment<br>• Repetition of the same errors throughout the industry | MAJOR | LIKELY | HIGH (7) | • *To be determined* | • *To be determined* | MEDIUM (11) | 8 |

# SUPPORTING ANNEXURES AND ENDNOTES

# ANNEX A

## REPORT ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAA | Agricultural Aviation Association |
| AAOC | Agricultural Aircraft Operator Certificate |
| AIA | Aviation Industry Association of New Zealand |
| AIRCARE | Trademarked program of the AIA |
| AOC | Air Operator Certificate |
| CAA | Civil Aviation Authority New Zealand |
| CAR | Civil Aviation Regulation |
| CASR | Civil Aviation Safety Regulation |
| FQC | Fertiliser Quality Council |
| GPS | Global Positioning System |
| ICAO | International Civil Aviation Organisation |
| ISO | International Standards Organisation |
| IWG | Industry Working Group |
| MCTOW | Maximum Certified Takeoff Weight |
| NZAAA | New Zealand Agricultural Aviation Association (same as AAA) |
| NZFQC | New Zealand Fertiliser Quality Council |
| QMS | Quality Management System |
| RMA | Resource Management Act 1991 |
| SMS | Safety Management System |
| SRP | Sector Risk Profile |
| TAIC | Transport Accident Investigation Commission |
| VTA | Vertebrae Toxic Agents |

# ENDNOTES


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