Advisory Circular
AC139-15

Revision 2

Aeronautical Studies for Aerodrome Operators

XX XXXX 2026

General

Civil Aviation Authority (CAA) Advisory Circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **acceptable means of compliance** with the associated Rule.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance with Civil Aviation Rule Part 139 requirements relating to undertaking aeronautical studies.

Related Rules

This AC relates specifically to Rules 139.21, 139.131, and 139.457, *Aeronautical Study.*

Change Notice

Revision 2 has the following changes:

- adds five new appendices to help aerodrome operators meet the practicability test when producing an aeronautical study proposing Runway End Safety Areas (RESA) of at least 90m or 240m
- renames Appendix 1 as Appendix F, and
- updates step 7 in the Aeronautical Study methodology example to align with ICAO requirements.

We have also added an abbreviations and definitions section, updated website links, and made stylistic and formatting updates to align with current AC style.

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Version History

Revision No.	Effective Date	Summary of Changes
AC139-15, Revision 0	23 Feb 2011	Initial issue.
AC139-15, Revision 1	5 April 2025	Updates references, contact details and links. Fixes minor errors.
AC139-15, Revision 2	XX XXXX 2026	Adds five new appendices. Replaces Appendix 1 with Appendix F. Updates step 7 in the Aeronautical Study methodology example. Adds abbreviations and definitions sections. Updates website links and makes stylistic and formatting updates to align with current AC style.

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1. Introduction

An aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria in place are appropriate. The study can be undertaken in a variety of ways, but should include:

- current state review (baseline position)
- quantifiable data analysis
- stakeholder interviews, and
- a safety/risk assessment.

Generally, an aeronautical study should be viewed as an overarching document giving a holistic view of an aerodrome's operational environment, in contrast to a safety case study which is a task-specific document

An aeronautical study may contain many elements, but must include risk assessment, mitigation, and elimination.

The goal of risk management in an aeronautical study is to identify risks and take appropriate action to minimise them. The goal is to ensure risk is 'as low as reasonably practicable' (ALARP). Decisions made in respect of risks must balance the technical aspects of risk with the social and moral considerations that may accompany it.

These decisions may have significant impact on an aerodrome's operation and for an effective outcome there should be a level of consensus amongst the key stakeholders.

While this AC focuses on the safety outcomes there may also be non-safety consequences, such as financial loss and operational loss of the aircraft, increased insurance costs, or damage to reputation. This AC discusses the concept of risk and goes on to describe the trigger factors that may lead to an aeronautical study, the conduct of the study, and the types of activities that should be included in the study.

However, the AC does not include a formula that is guaranteed to give the correct solution, and it does not tell the individual or organisation conducting a study what it should value. The appropriate constraints and goals are left to the judgement of those ruling out the study. The aeronautical study should be seen as a framework for effective decision-making, rather than as a guaranteed process to determine the correct outcomes.

This framework for conducting aeronautical studies proposes a systematic method. It gives some tools for analysing complex risk issues to help the decision-maker to make decisions with confidence and, if necessary, to articulate these decisions.

It is the aeronautical study process that determines the site-specific need for services, identifies and recommends a course of action, and presents options for decision makers to act upon. In all cases the aeronautical study should document and demonstrate the site-specific need and rationale for the level of service, procedure design, or operational requirements.

2. Abbreviations and Definitions

Abbreviations	
Air Navigation Service Provider	ANSP
Air Traffic Service	ATS
As low as reasonably practicable	ALARP
Benefit Cost Ratio	BCR
Collision Risk Model	CRM
Cost Benefit Analysis	CBA
Engineered Materials Arresting System	EMAS
General Aviation	GA
Net Present Value	NPV
Obstacle Limitation Systems	OLS
Regular Air Transport Passenger Services	RATPS
Resource Management Act	RMA
Rescue and Firefighting Service	RFS
Runway end safety area	RESA
Safety Management System	SMS
Safety Performance Indicator	SPI
Safety Performance Target	SPT
Target Levels of Safety	TLS

Definitions	
Arresting System	A system designed to decelerate an aircraft that overruns the runway, providing a stopping performance equivalent to a specified RESA length. In New Zealand, two aerodromes have introduced arresting systems known as engineered materials arresting system, commonly referred to as EMAS.
Conventional RESA	A cleared, graded, and obstacle-free zone located at the end of a runway. It acts as a safety buffer to reduce damage to aircraft and protect passengers and crew in the event of an overrun or undershoot during landing or take-off. Also referred to as a traditional RESA.

3. Trigger Factors

The aeronautical study is a tool for the aerodrome management to use as part of its operations and strategic planning and is an integral part of the aerodrome's internal Quality Assurance and Safety Management Systems (SMS).

Aerodrome operators should also undertake aeronautical studies when the aerodrome operating environment changes. These changes are normally precipitated by a trigger event such as a change or proposed change in airspace design, aircraft operations, aerodrome infrastructure, or an air traffic service (ATS).

One of the purposes of the aeronautical study is to determine levels of operational safety, service, or procedures that should apply at a particular location. The decision to undertake this type of study may be triggered by any one or more of a wide range of factors.

These may include changes to:

- the number of movements
- peak traffic periods
- the ratio of IFR to VFR traffic
- the type of operations - scheduled, General Aviation (GA), training, and so on
- the types, and variety of types, of aircraft using the aerodrome (jet, turboprop, rotary, and so on)
- aerodrome layout
- aerodrome management structure
- runway or taxiway and associated manoeuvring areas, and
- operations of a neighbouring aerodrome or adjacent airspace.

Feedback about any changes should be sought from aviation stakeholders including pilots, individuals, and other representative groups as part of the study.

An aeronautical study may be initiated by the Director of Civil Aviation, an aerodrome operator, or another interested party, such as an ATS provider or air operators.

CAA can assist in identifying whether an aeronautical study is required, the appropriate methodology for the aeronautical study, and in reviewing the aeronautical study. For further assistance please contact CAA at aeronautical.services@caa.govt.nz or info@caa.govt.nz

4. Aeronautical Study

An aeronautical study can take place anytime. It considers all relevant factors, including traffic volume, mix and distribution, weather, aerodrome role, aerodrome and airspace configuration, surface activity, and the efficiency requirements of operators using the service.

The scope of studies can range from minor adjustments to aerodrome configuration, for example, from the widening of a taxiway to a complete review of aerodrome airspace with the introduction of a new runway.

The scope of an aeronautical study usually reflects one of three situations:

1. the existing operation, for example, the aerodrome, airspace or ATS (or sometimes just a particular part of the operation)
2. a change to the existing operation, or
3. a new operation.

Where the aeronautical study is used to consider a change to existing operations or a new operation, it may not initially be possible to provide all the safety assessment and evidence required.

An aeronautical study can identify and evaluate aerodrome service options, including service increases or decreases or the introduction or termination of services, such as the introduction of a rapid exit taxiway or removal of a grass runway.

The initial baseline study will be followed by a review of operational issues. This will typically involve an in-depth safety analysis based on quantifiable data and extensive consultation with customers and stakeholders using various interview and data gathering processes. This may identify any changes that are required to ensure the safe, orderly, and efficient operation of the aerodrome.

Larger projects may have distinct phases such as requirements definition, design evaluation, introduction to service, and routine operation. The aeronautical study can be presented in parts corresponding to these phases as information becomes available as illustrated below.

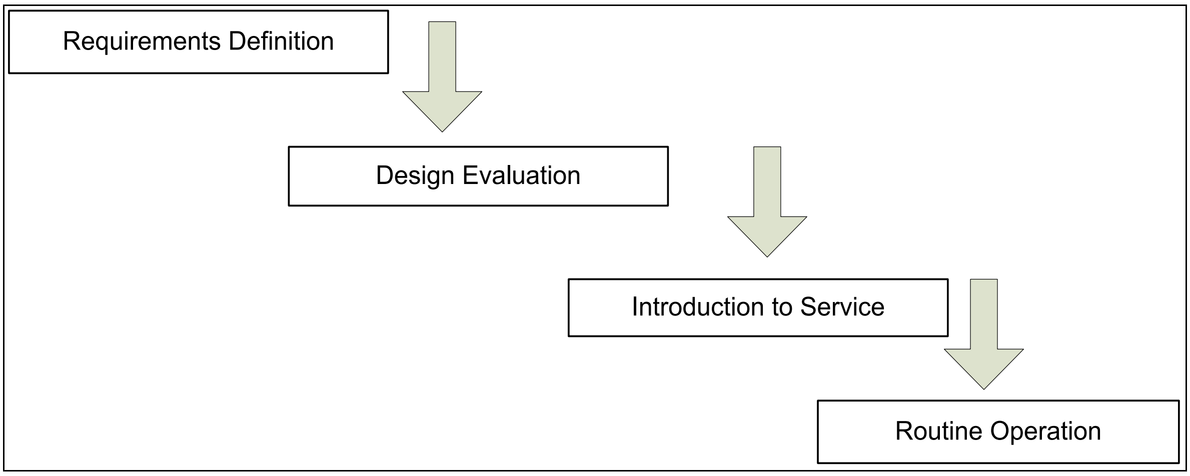

Figure 1 (CAA UK CAP 728, Chapter 3)

CAA's risk assessment model

CAA NZ has developed a risk assessment model for aerodrome and airspace. This model is detailed in the report *Development of Standards and Practices for the Management of Aerodrome*

Airspace Risk, prepared by The Ambidji Group Ltd for CAA. The report is available at this link: [Development of Standards and Practices for the Management of Aerodrome Airspace Risk]

This model has a six-step process for an initial study:

1. Initiation
2. Analysis and risk evaluation
3. Action and monitoring
4. Study
5. Consultation with stakeholders
6. Use of risk model.

This is the preferred CAA model for aeronautical studies, but operators should assess the type of process or model to be used as outlined in Section 5 of this AC.

The Concept of Risk

Risk assessment is a key area in an aeronautical study. The Joint Australia/New Zealand International Standard ASNZS ISO 31000:2018, *Risk Management—Guidelines* defines risk as the effect of uncertainty on objectives.

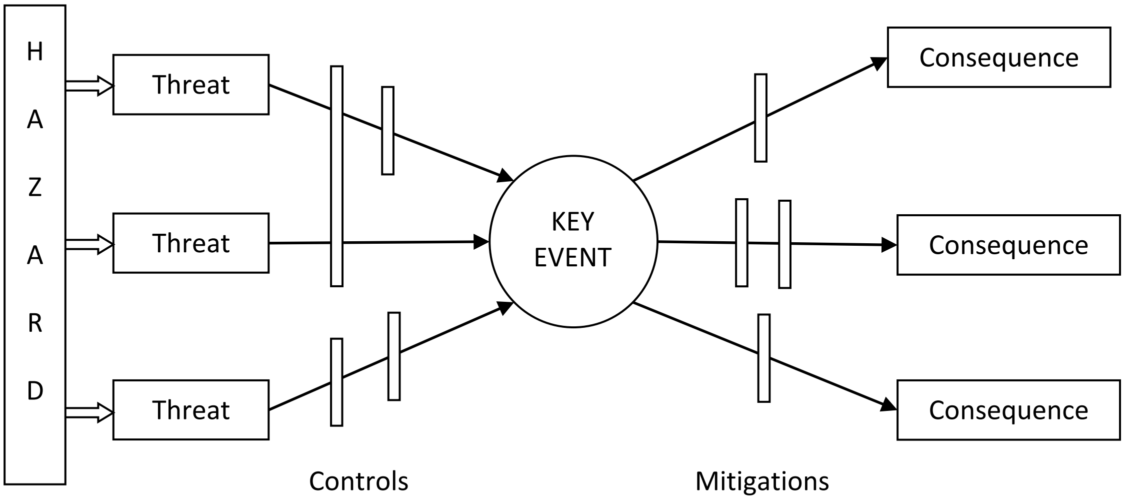

Figure 2 Generic Risk Scenario

A risk scenario can be understood as a sequence of related elements:

- **Hazard:** the source or condition that has the potential to cause loss.
- **Threats:** events or circumstances that could lead from the hazard to a loss of control.
- **Controls:** proactive defences intended to prevent the key event from occurring.
- **Key event:** the point at which control of the hazard is lost.
- **Mitigations:** measures that avoid or reduce the consequences after the key event.

- **Consequences:** the possible outcomes, such as damage or injury, if the risk is realised.

Together, these elements describe how a hazard may develop into a loss of control and then into adverse outcomes. Controls are used to prevent the key event, while mitigations reduce the consequences if it occurs.

For example, a rainstorm (the hazard) may result in sheet water on runways (a threat) and reduced braking performance (another threat). The key event in this case is loss of control of the aircraft on the runway. This may result in damage or injury (the consequences). Controls might include tyre design and anti-skid braking systems, while mitigations could include RESAs. The consequences are the damages and injuries that may result.

The risk is the likelihood (or probability) of the damage or injury resulting from the loss of control of the aircraft. It therefore includes the probability of loss of control and the probability of damage or injury. There is a study example in Appendix F.

Acceptable Risk

"Acceptable risk" is based on the concept that no activity is without some risk, however small. The level of risk that is acceptable varies with the type of activity and according to the consequences.

Generally, the acceptable level of risk for adventure activities is higher than that for normal day-to-day activities, and higher for single fatality accidents than for those with multiple fatalities.

Perceptions of risk can be divided into three broad categories:

- risks that are so high that they are intolerable
- risks that are low enough to be acceptable, and
- risks between these two categories. These need to be reduced/mitigated to an acceptable level.

If the risk does not meet the pre-determined acceptability criteria, an attempt must always be made to reduce it to a level that is acceptable, using appropriate mitigation procedures. If the risk cannot be reduced to or below the acceptable level, it may be regarded as tolerable if:

- the risk is below the pre-determined intolerable level, and
- the risk has been reduced to a level that is as low as reasonably practicable (ALARP), and
- the benefits of the proposed system or changes are sufficient to justify accepting the risk.

Voluntary and involuntary risks need to be considered as factors of acceptable risk. Tolerance of risk depends on the extent to which a person who is the subject of the consequences of that risk perceives they have control of the decision to accept the risk or not.

Typically, people are willing to take voluntary risks with probabilities of occurrence a thousand times greater than those of involuntary or imposed risks. For example, a person will accept higher levels of risk in choosing to drive than they will tolerate as a bus passenger. Most of our aviation risk relates to involuntary or imposed risk for those affected by the consequences, for example, an aircraft passenger.

Risk Management Process

Risk mitigation measures may work through reducing the probability of occurrence, or the severity of the consequences, or both. Achieving the desired level of risk reduction may require the implementation of more than one mitigation measure.

The process becomes one of iteration following the steps below:

1. Systematically identify possible hazards.
2. Evaluate the seriousness of the consequences of the key event occurring.
3. Consider the chances of it happening.
4. Determine whether the consequent risk is tolerable and within the organisation's acceptable safety performance criteria. If not, take action to reduce the risk to a tolerable level by reducing the severity of the consequences or the probability of them arising.

Risk mitigation strategies can include:

- revision of the system design
- modification of operational procedures
- changes to staffing arrangements

- training of personnel to deal with the hazard
- development of emergency or contingency arrangements and plans.

Ultimately, ceasing operation may be an option that is considered.

Summary of the Seven Step system risk process

Risk assessment and mitigation require a systematic approach. The complete process can be divided into seven steps and may be iterative. These are illustrated in Figure 3, below:

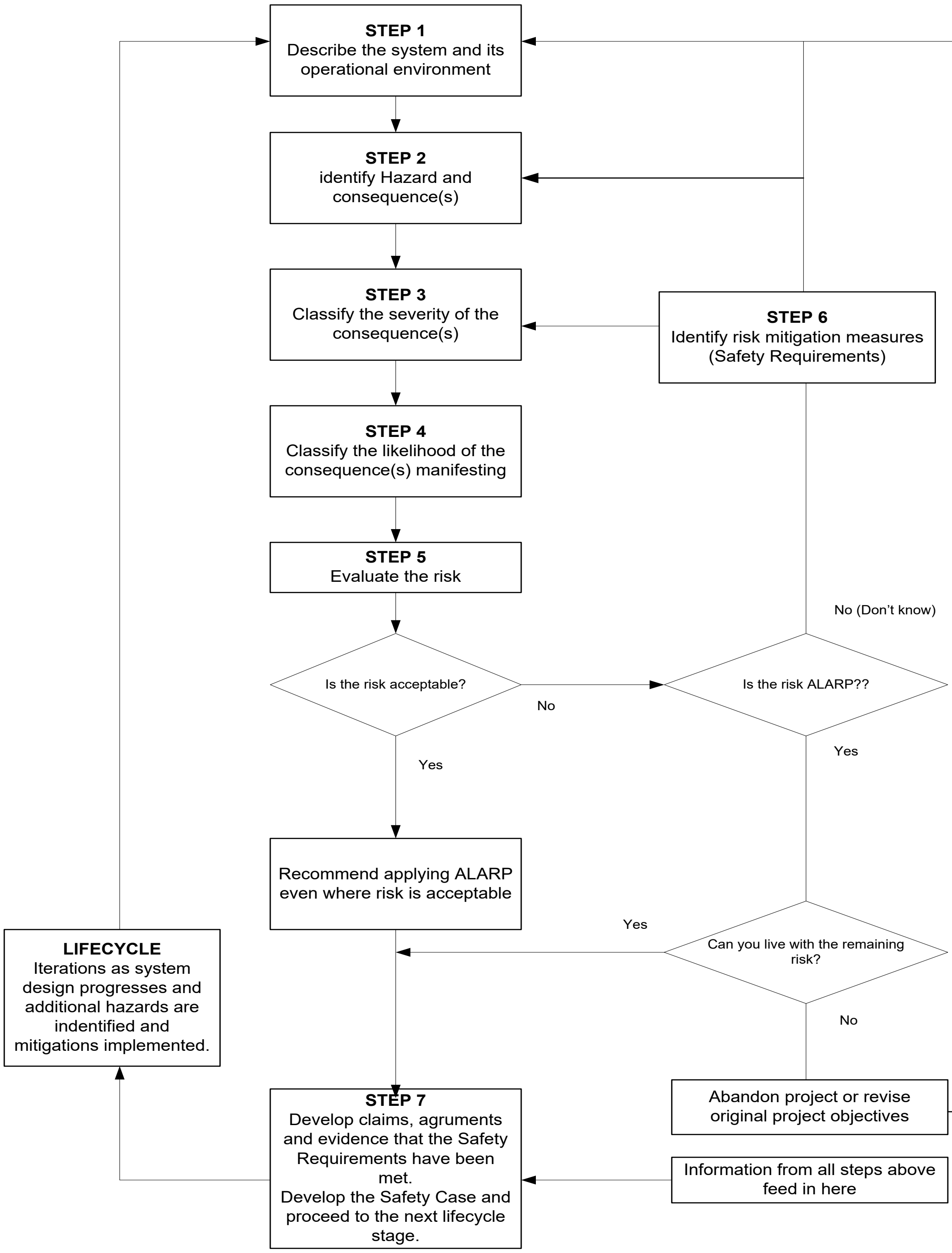

Figure 3 The Seven Step Approach (CAP 760, Chapter 2)

Note: *Having decided that a mitigation measure may be suitable it will be necessary to repeat steps 3, 4, and 5 to evaluate the acceptability of the risk with that proposed mitigation measure in place.*

Aeronautical Study methodology example

A generic model of an Aeronautical Study methodology consists of initiation, preliminary analysis, risk estimation, risk evaluation, risk control, and action/monitoring and is related to figure 3 above.

1. Initiation: Step 1

This step consists of defining the opportunity or problem and the associated risk issues, setting up the risk management team, and beginning to identify potential users who may be affected by any change.

2. Preliminary Analysis: Step 2

The second step consists of defining the basic dimensions of the risk problem and undertaking an initial identification, analysis, and evaluation of potential risks. This preliminary evaluation will help determine:

- whether a situation exists that requires immediate action
- whether the matter requires further study before any action is taken or,
- whether the analysis should end as the risk problem is determined not to be an issue.

3. Risk Estimation: Steps 3 and 4

These steps estimate the degree of risk. Step 3 estimates the severity of the consequences and step 4 estimates the probability of their occurrence.

4. Risk Evaluation: Step 5

The benefits and operational costs of the activity are integrated into the analysis, and the risk is evaluated in terms of the safety implications of the activity and of the needs, issues, and concerns of affected users.

5. Risk Control: Step 6

This step identifies feasible risk controls and mitigations which will act to reduce either the probability of the event, or its consequence should it occur.

6. Action monitoring

7. Implementation, evaluation, and programme monitoring: Step 7

This step requires implementing the chosen risk control options, evaluating the effectiveness of the risk management decision process, and implementing an ongoing monitoring programme.

The monitoring programme should track review frequency, document evidence that reviews occurred, record any changes made after implementation or review, and identify when the change management plan needs updating. These steps are summarised below:

- Review frequency — how often reviews are completed.
- Evidence of reviews — records, minutes, sign-offs.
- Post-review changes — adjustments triggered by findings or continuous improvement.
- Plan updates — triggers for revising the change management plan.

CAA review and audit

CAA may review or audit the implementation of the agreed risk controls to confirm that:

- the implementation is complete
- supporting evidence is available and traceable, and
- the aerodrome operator continues to comply with the relevant Civil Aviation Rules.

5. Process

The study content

There will be several hazards in any aerodrome environment. It can be very useful to start the process by identifying several key events and then deciding what hazards and threats can lead to those events and their possible consequences.

The class of airspace or type of air traffic service required is primarily determined by the level of risk at the aerodrome and in its immediate airspace.

The next stage is to assess the risk levels. The relative risk levels can then be used to identify the threats that have the highest risk, after which it will be possible to determine what, if any, controls can be put in place to reduce the risks.

While this type of study is aimed at determining the appropriate airspace environment at and around an aerodrome, these tools may highlight other risk areas.

Collision Risk Model

A widely used tool for this type of study is the collision risk model (CRM). This tool is normally used by airspace designers, air navigation service providers, or specialist consultants.

The basic output of the CRM is the relative risk of collision between two aircraft (or an aircraft and a parachute) whose intended tracks would bring them into a collision zone. Such pairs are referred to as ‘conflict pairs’. The relative risk is affected by the environment (type of airspace, service, aircraft) but not by the number of movements. Multiplying the relative risk of collision by the annual number of conflict pairs gives an annual collision risk, which can then be compared to some measure of acceptable risk.

The CRM estimates the risk of collision from failure to take considered action (failure of the control) and failure to take evasive action (failure of the mitigation). As its name suggests, the pilot has some time to initiate a considered action, which is generally the result of information received by radio. A problem close to the collision zone is generally detected visually and requires evasive action. An action initiated within a few seconds of the collision zone is typically too late to alter the flight path sufficiently, so whether a collision takes place or not is a matter of chance.

The model considers the various factors that can lead to the need for considered action and to evasive action and arranges them in a tree leading to the collision zone. The linking of the branches of the tree is by arithmetical ‘AND’ and ‘OR’ operators. To reach the collision zone, both considered action and evasive action must fail. If one aircraft has no radio or is on the wrong frequency, then radio communication fails.

A numerical risk is assigned to each contributory factor, and this is used to calculate the risk of reaching the collision zone. Whether the aircraft will collide in the collision zone depends on the collision geometry and a collision geometry factor is applied to allow for this.

The total number of pairs that may become conflict pairs can be calculated from traffic data.

Aerodrome Complexity Model

Another tool to estimate risk is an aerodrome complexity model. This type of model assumes that the complexity of operating at, and in the environment of, an aerodrome affects pilot workload and the risk of an accident occurring. The model identifies several complexity factors and scores these according to the relative influence that they are deemed to have. The number of movements and the VFR/IFR mix are then considered, and an overall complexity score is calculated.

Typical complexity factors include the number and disposition of runways and taxiways, the types of operation, the topography, and extreme weather conditions that may be expected.

This type of tool allows an aerodrome operator, for example, not only to determine a score that may be compared against some criterion, but to also identify those areas of aerodrome planning where complexity may be reduced.

Consultation

It is essential that, in conducting the aeronautical study, there is consultation with as wide a range of aerodrome users and other stakeholders as possible. Different users have different views of hazards and the corresponding threats, controls, mitigations, and consequences. The following should be included in the consultation:

- aerodrome operators (including adjacent affected aerodrome operators)
- aerodrome users
- airspace user groups
- aircraft operators and operator groups
- pilot organisations, and
- ATS providers.

6. References

ICAO:

Aeronautical studies and safety assessment (link to be updated in due course).

CASA:

Guidelines for preparing safety cases covering CASR Part 172 services

CAP 760 - Guidance on the Conduct of hazard identification, Risk Assessment and the Production of Safety Cases for Aerodrome Operator and Air Traffic Service providers: UKCAA (2010)

Note: *As references and guidelines change, it can be useful to check the following sites:*

https://www.caa.co.uk/

https://www.icao.int/Pages/default.aspx

https://www.casa.gov.au/

https://www.navcanada.ca/en/

Runway End Safety Area (RESA) – Guidance on Practicability and Aeronautical Studies

How to use these appendices

Appendices A to C identify the RESA expectations for different aerodrome codes. Appendix D provides supporting cost-benefit and financial evidence expectations. Appendix E provides a checklist to support preparation and review of a RESA-related aeronautical study. Readers should start with the appendix that matches their runway type, then use Appendices D and E as supporting tools.

Appendix A - Guidance on Practicability: Aerodrome Reference Code 3 & 4

A.1 Introduction

A.1.1 Purpose

The purpose of this appendix is to provide guidance to the holder of the Part 139 aerodrome operating certificate (certificate holder) on the requirements and expectations associated with an acceptable Runway End Safety Area (RESA) under Civil Aviation Rule (Rule) 139.51 at aerodromes with a reference code of 3 or 4. It includes direction on:

1. RESA configuration options, including conventional RESA, the use of arresting systems, and combined configurations (conventional RESA plus EMAS).
2. Demonstrating practicability, such as physical, environmental, operational, and economic considerations, including:
    - whether the difficulties can be overcome and, if so, at what expected cost
    - whether the costs are proportionate to the benefits an aerodrome operator certificate holder may expect from any development of which the RESA is a part.
3. Evidence for determining practicability of 240m or an equivalent safety outcome using EMAS, which may include the results of an associated cost benefit analysis (CBA) containing cost comparisons for all RESA configurations. An EMAS is a system designed to decelerate an aircraft that overruns the runway, providing a stopping performance equivalent to a specified RESA length. Currently, in New Zealand, two aerodromes have introduced arresting bed systems, commonly referred to as EMAS in this appendix.
4. Guidance on the preparation of an aeronautical study under Rule 139.131 to support a RESA proposal, including where an operator proposes at least a 90m RESA, a 240m RESA, or an equivalent safety outcome achieved through an engineered arresting system.

A.1.2 Scope

This guidance should be used by the certificate holder of an aerodrome with code 3 or 4 runways, which serve aircraft with more than 30 seats engaged in regular air transport passenger services (RATPSs) when the certificate holder proposes to construct:

1. a conventional RESA of at least 90m or 240m, or
2. an arresting system as an alternative to a conventional RESA, or

3. a combination of conventional RESA and an engineered arresting system providing an equivalent stopping distance of at least 90m or 240m.

A.1.3 Applicability

This guidance is intended for use by certificate holders, aerodrome designers and engineers, safety managers, consultants preparing aeronautical studies, and organisations supporting RESA design, construction, or assessment. The Director may use this guidance when assessing whether a proposed RESA configuration conforms with the rules and provides a safety outcome evidenced in the aerodrome certificate holder's own SMS. As a minimum the following rules are applicable and should be considered as part of any RESA proposal (others may also apply):

1. Rule 139.51 *Runway End Safety Area.*
2. Rule 139.53 *Aerodrome limitations.*
3. Rule 139.75 *Safety Management Systems* (in accordance with rule 100.3).
4. Rule 139.103 *Aerodrome maintenance.*
5. Rule 139.121 *Protection of navigation aids.*
6. Rule 139 *Appendix A.1.*
7. Rule 139.131 *Aeronautical Studies.*
8. Rule 121 *Appendix D.*

A.2 RESA configurations

A RESA should be a cleared, graded, and obstacle-free zone located at the end of a runway. It acts as a safety buffer to reduce damage to aircraft and protect passengers and crew in the event of an overrun or undershoot during landing or take-off. This traditional type of RESA provision is referred to in this appendix as a conventional RESA. A conventional RESA provision can be paved or unpaved.

The construction of a conventional RESA plus an arresting system at the same runway end can be used to provide an equivalent stopping distance of at least 90m or 240m. This will be referred to as a combination of conventional RESA plus EMAS. Examples of configurations are:

1. 240m of conventional RESA provided at each runway end.
2. EMAS equivalent to a stopping distance of 240m constructed at each runway end.
3. 240m of conventional RESA at one runway end and at least 90m of conventional RESA at the other runway end.
4. EMAS equivalent to a stopping distance of 240m constructed at one runway end and EMAS equivalent to a stopping distance of at least 90m constructed at the other runway end.
5. A combination of conventional RESA plus EMAS providing equivalent stopping distance of at least 90m or 240m constructed at each runway end.
6. At least 90m of conventional RESA provided at each runway end.
7. EMAS equivalent to a stopping distance of at least 90m constructed at each runway end.

A.3 RESA practicability factors

Under Part 139 the certificate holder must construct RESA if practicable to 240m. Factors which may be relevant to the practicability of a particular RESA length may include, but are not limited to, those referenced in Rule 139, Appendix A.1 and those below.

A.3.1 Physical or other difficulties affecting or constraining the site

These factors require a detailed, evidence-based explanation of why the recommended RESA length of 240m may not be physically achievable. Aerodromes are often located in challenging terrain, and topography is frequently the main barrier to achieving the recommended RESA length. Any RESA proposal should address, as relevant, the following considerations:

1. **Steep coastal escarpments** - many aerodromes are located near coastlines where the land drops sharply toward the sea. Extending a RESA in such locations may require large retaining structures, coastal protection works, or land reclamation in areas exposed to wave action, storm surge, and erosion.

2. **River terraces and floodplains** - some aerodromes sit on elevated terraces above rivers or wetlands. Beyond the runway end, the ground may fall away abruptly into a lower terrace or floodplain. Extending a RESA into these areas may require extensive cut-and-fill operations, flood protection, or ground stabilisation.

3. **Mountainous or hilly terrain** - inland aerodromes may be surrounded by rolling hills or steep slopes. Terrain may rise sharply, creating obstacles, or fall away, creating drop-offs. Earthworks in such terrain can be technically complex, requiring slope stabilisation, retaining walls, or large volumes of imported fill.

4. **Abrupt or minor elevation changes** - even in otherwise flat regions, localised gullies, ridgelines, or man-made embankments can create sudden elevation changes that make it difficult to construct a level, conventional RESA platform without major earthworks.

5. **Soft or unstable ground** - areas with peat, saturated soils, or liquefaction-prone ground may not support the loads required for a RESA without significant ground improvement such as stone columns, deep compaction, or geogrid reinforcement. High-water tables also require dewatering or drainage redesign.

6. **Limited flat land within the aerodrome boundary** - many aerodromes were originally built on the only available flat land in the area. Beyond the runway end, the terrain may quickly become unsuitable for safe aircraft overrun areas.

A.3.2 Land availability and boundary constraints

Even where terrain is manageable, land availability can be a major constraint. Evidence of the following considerations should be provided in any RESA proposal:

1. Adjacent land that is privately owned, used for farming, industrial activity, or residential housing.

2. Land that is subject to long-term leases, easements, or covenants that restrict modification.

3. Expansion, whether for RESA or runway lengthening or both (this is likely to require compulsory acquisition processes).

4. Some aerodromes may border public reserves, parks, or conservation land and further development of the aerodrome facility is restricted.

A.3.3 Environmental and cultural constraints

New Zealand’s regulatory environment takes environmental protection and cultural values into account. Evidence of the following considerations should be provided in any RESA proposal:

1. Wetlands, estuaries, and dune systems may be protected under resource management legislation or regional plans.
2. Habitats for protected species (for example, migratory birds, native reptiles) may restrict earthworks or require extensive mitigation.
3. Culturally significant sites, including wāhi tapu sites (such as burial or battlefield) or archaeological areas, may prevent excavation or land modification.
4. Waterways may require setbacks, stormwater controls, or erosion protection.

A.3.4 Existing aerodrome infrastructure

Infrastructure located beyond the runway end may need to be relocated or redesigned. In any RESA proposal, aerodrome operators should provide evidence of why changes to the following infrastructure are required. Operators should also state whether such requirements arise by RESA implementation, by other lengthening or development, or a combination of the two.

1. Approach lighting systems.
2. Perimeter roads.
3. Security fencing.
4. Drainage channels and stormwater systems.
5. Utility services (power, water, telecoms).
6. Navigational aids, including ILS localisers or glidepath antennas.
7. Impacts to existing obstacles and Obstacle Limitation Systems (OLS) survey results.

A.4 Guidance on the preparation of an aeronautical study under Rule 139.131

All aerodrome operator certificate holders operate under a certified SMS. Under Civil Aviation Rules, Part 100 *Safety Management*, the SMS is aligned to the complexity of the aerodrome's operations and infrastructure, and therefore the operators SMS produces documented, traceable safety risk management outputs.

Because the 13 elements of an aerodrome operator's SMS (as required by CAA and aligned with AC100-1) correspond directly to the four ICAO SMS components in Annex 19, any RESA-related aeronautical study submitted to CAA should demonstrate clear integration with:

- ICAO Annex 19 – Safety Management (State and service-provider SMS obligations).
- ICAO Annex 14 – Aerodromes (RESA standards and recommendations).
- ICAO Doc 9859 – Safety Management Manual (methodology for hazard identification, risk assessment, and mitigation).
- CAA Advisory Circular AC100-1 (New Zealand-specific SMS expectations and documentation requirements).
- The aerodrome operator's own SMS outputs (risk registers, safety performance indicators, safety assurance processes).

An example of a regulatory-aligned outline of what such a study should contain is below.

A.4.1. Regulatory Basis & Certification Context

- State that the aerodrome operates under an aerodrome operator certificate, supported by an acceptable SMS.
- Cite the following:
    - Annex 14 RESA requirements (minimum 90m, recommended 240m)
    - Rule 139 RESA requirements of at least 90m and 240m if practicable
    - Rule Part 100/ Annex 19 obligations for formal safety risk management if not meeting recommended practices.
- Reference AC100-1 as the national implementation standard for SMS processes and documentation.
- Establish that an aeronautical study is the regulatory mechanism for demonstrating ALARP, when the recommended conventional RESA length of 240m is not practicable.

A.4.2. SMS Integration & Study Governance

- Identify which SMS elements are engaged (for example, hazard identification, risk assessment, safety assurance, safety performance monitoring).
- Show how the study aligns with the aerodrome's SMS manual, risk matrix, risk tolerability criteria, and safety performance indicators (SPIs).
- Document involvement of the Runway Safety Team, aerodrome safety committee, and relevant stakeholders - ANSP, operators, Rescue and Firefighting Service (RFS).

- Demonstrate that the study is produced under the aerodrome's SMS change-management process, (refer AC100-1).

A.4.3. Operational Context & System Description

- Describe the runway(s), declared distances, traffic mix, aircraft types, and operational environment.
- Identify physical constraints preventing 240m provision of conventional RESA (refer A.2 and A.3 of this appendix).
- Include relevant safety data, consistent with Annex 19's requirement for safety information management such as, but not limited to:
  - local runway excursion history
  - global excursion statistics
  - RFS access considerations
  - meteorological and contamination patterns.

A.4.4. Hazard Identification (Rule Part 1100, Annex 19, Doc 9859 and the hazard and risk register)

- Identify primary hazards:
  - landing overrun
  - rejected take-off overrun
  - landing undershoot.
- Identify secondary hazards:
  - terrain drop-offs, water, roads, obstacles
  - non-frangible structures
  - limited RFS access.
- Use multiple sources as required by Doc 9859: safety reports, investigations, operator input, expert judgment.

A.4.5. Safety Risk Assessment

- Apply the aerodrome's SMS risk matrix and risk tolerability criteria (aligned with AC100-1).
- For each scenario, assess:
  - likelihood (based on data, modelling, and operational characteristics), and
  - severity (based on terrain, obstacles, and survivability factors).
- Compare RESA length options:
  - ICAO recommended RESA (baseline).
  - Rule 139 - at least 90m and 240m if practicable.

  - Use of EMAS and combination of EMAS and conventional RESA as per section A.2 of this appendix.
  - Proposed RESA.
  - Proposed RESA and mitigations.
- Ensure the analysis follows Doc 9859's structured methodology for risk estimation and evaluation.

A.4.6. Mitigation Measures & ALARP Demonstration

- Identify infrastructure mitigations - EMAS, grading, obstacle removal, frangible structures.
- Identify operational mitigations, such as but not limited to aircraft type restrictions, weight restrictions, tailwind limits, approach stability requirements.
- Identify procedural mitigations - AIP amendments, pilot briefings, RFS training access improvements.
- Demonstrate that residual risk is ALARP consistent with Annex 19 and AC100-1.

A.4.7. Safety Performance Requirements

- Each aerodrome operator should provide RESA related safety performance indicators (SPIs) and safety performance targets (SPTs) that align with the desired outputs of the aerodrome operators own SMS.
- An aerodrome operator may also consider setting safety outcomes or using their own target levels of safety (TLS).
- Establish monitoring and reporting processes consistent with Annex 19's Safety Assurance component.
- Define triggers for reviewing or updating the aeronautical study (traffic growth, new aircraft types, significant events).

A.4.8. Documentation, Submission & Regulatory Decision

- Provide a complete, traceable record of:
  - Data sources.
  - Hazard identification.
  - Risk assessment.
  - Evidence of the practicability test – refer A.4 of this appendix.
  - Mitigation evaluation.
  - Safety performance plan.
- Submit the study to CAA as part of the aerodrome operator's requirements under Rule 139.131.

Appendix B: Guidance on Practicability: Aerodrome Reference Code 1 & 2 Instrument Runways With 30 Seats Plus RPT (regular public transport) Operations

B.1.1 Purpose

The purpose of this appendix is to provide guidance to aerodrome operators on the requirements and expectations associated with an acceptable RESA under Rule 139.51 at aerodromes with a reference code of 1 or 2 with instrument runways. It includes direction on:

1. RESA configuration options, including conventional RESA, the use of arresting systems, and combined configurations.
2. Demonstrating practicability, including physical, environmental, operational, and economic considerations.
3. Whether the difficulties can be overcome and, if so, at what expected cost.
4. Whether the costs are proportionate to the benefits an aerodrome operator certificate holder may expect from any development of which the RESA is a part.
5. Evidence for determining practicability of a conventional RESA of at least 90m or 120m, or an equivalent safety outcome using EMAS, which may include the results of an associated cost benefit analysis (CBA) containing cost comparisons for all RESA configurations.
6. Guidance on the preparation of an aeronautical study under Rule 139.131 to support a RESA proposal, including where an operator proposes a RESA of at least 90m, a 120m RESA, or an equivalent safety outcome achieved through an engineered arresting system.

B.1.2 Scope

This guidance should be used by the certificate holder of aerodrome with a reference code 1 or 2 and an instrument runway serving aircraft with more than 30 seats engaged in regular air transport operations and where the aerodrome certificate holder proposes to construct:

1. a conventional RESA of at least 90m and/or 120m, or
2. an arresting system as an alternative to a conventional RESA, or
3. a combination of conventional RESA and an EMAS providing an equivalent stopping distance of at least 90m or 120m.

B.1.3 Applicability

This guidance is intended for use by aerodrome operators, aerodrome designers and engineers, safety managers, consultants preparing aeronautical studies, and organisations supporting RESA design, construction, or assessment. The Director may use this guidance when assessing whether a proposed RESA configuration meets the intent of the rules and provides a safety outcome evidenced in the aerodrome certificate holder’s own SMS. As a minimum the following rules are applicable and should be considered as part of any RESA proposal:

1. Rule 139.51 *Runway End Safety Area.*
2. Rule 139.53 *Aerodrome limitations.*
3. Rule 139.103 *Aerodrome maintenance.*
4. Rule 139.121 *Protection of navigation aids.*
5. Rule 139, *Appendix A.1.*
6. Rule 139.131 *Aeronautical Studies.*
7. Rule 139.75 *Safety Management Systems* (in accordance with rule 100.3).
8. Rule 121 *Appendix D.*

Note that this list is not limited to these: other rules may also apply.

B.2 RESA configurations

The RESA configuration concepts described in Appendix A.2 apply equally to this appendix, adjusted for the relevant Code 1 and 2 instrument runway lengths of 90m and 120m.

An EMAS is a system designed to decelerate an aircraft that overruns the runway, providing a stopping performance equivalent to a specified RESA length. Currently in New Zealand two aerodromes have introduced arresting bed systems, commonly referred to as EMAS in this appendix.

Examples are below:

1. 120m of conventional RESA provided at each runway end.
2. EMAS equivalent to a stopping distance of 120m constructed at each runway end.
3. 120m of conventional RESA at one runway end and at least 90m of conventional RESA at the other runway end.
4. EMAS equivalent to a stopping distance of 120m constructed at one runway end and EMAS equivalent to a stopping distance of 90m constructed at the other runway end.
5. A combination of conventional RESA plus EMAS providing equivalent stopping distance of at least 90m or 120m constructed at each runway end.
6. At least 90m of conventional RESA provided at each runway end.

B.3 Practicability and Aeronautical Study

Guidance in sections A.3, A.4 and Appendices D and E applies equally to aerodromes with a reference code of 1 or 2 and should be considered as part of the submission.

Appendix C: Guidance on Practicability: Aerodrome Reference Code 1 & 2 With Non-Instrument Runways

C.1.1 Purpose

This appendix provides guidance to aerodrome operators on meeting RESA requirements under Rule 139.51 for code 1 or 2 non-instrument runways. A RESA (if practicable) is only required where such runways serve regular passenger transport by aircraft with more than 30 seats. It includes direction on:

1. RESA configuration options (conventional, arresting systems, or combinations).
2. Demonstrating practicability (physical, environmental, operational, and economic factors).
3. Assessing whether difficulties can be overcome and at what cost.
4. Determining whether costs are proportionate to expected benefits.
5. Evidence expectations when proposing a 30m RESA.
6. Preparation of an aeronautical study under Rule 139.131 to support the certificate holders view that provision of 30m RESA is not practicable.

C.1.2 Scope and configurations

This guidance applies to aerodrome certificate holders for code 1 or 2 non-instrument runways serving aircraft with more than 30 seats in regular air transport, where they propose:

1. A 30m conventional RESA.
2. An arresting system as an alternative.
3. A combination of conventional RESA and an arresting system providing an equivalent 30m stopping distance.
4. No RESA provision.

C.1.3 Applicability

This guidance is intended for aerodrome operators, designers, engineers, safety managers, consultants, and organisations involved in RESA design or assessment. The Director may use it to assess whether a proposed RESA meets rule requirements and achieves an acceptable safety outcome within the operator’s SMS.

Relevant rules include (but are not limited to):

1. Rule 139.51 *Runway End Safety Area.*
2. Rule 139.53 *Aerodrome limitations.*
3. Rule 139.103 *Aerodrome maintenance.*
4. Rule 139.121 *Protection of navigation aids.*
5. Rule 139 *Appendix A.1.*

6. Rule 139.131 *Aeronautical studies.*

7. Rule 139.75 *Safety management systems.*

8. Rule 121 Appendix D.

C.2 Practicability and Aeronautical Study

Guidance in Sections A.3, A.4, and Appendices D and E applies equally to code 1 and 2 non-instrument runways and should be considered in any RESA submission.

Appendix D: Guidance on Practicability: Cost Benefit Expectations When Proposing a RESA

D.1.1 Minimum requirements for financial and operational evidence

A generalised or raw budget estimate for the capital and operational costs associated with sections A.2 and A.3 of this appendix, or other associated implementation challenges, is likely to be insufficient. To satisfy the test of "practicability", an aerodrome operator should provide comprehensive, itemised, and granular financial documentation.

A high-level financial summary will not be accepted as valid evidence when attempting to demonstrate that a specific runway configuration or land acquisition strategy is not practicable. It is recommended that each identified physical, geographical, or logistical challenge should be treated as a distinct project line item. The financial costs associated with meeting each specific challenge should be individually evidenced. The use of general contingencies or lumped sums should be avoided.

Aerodrome operators should be aware that when assessing financial information, CAA needs enough clarity and evidence to ensure the proposal is realistic, affordable, and safe. The more precise and well-supported the numbers are, the smoother the assessment will be.

Below is the standard expected for all aerodrome operators.

D.1.2 Financial Data Standards

The financial data should give CAA assurance that the proposal is grounded in real, current, and independently verified information. Aerodrome operators should follow these steps:

1. **Specificity:** Provide a clear breakdown of each cost component. Avoid broad averages or "ballpark" figures. Show exactly how each cost will be incurred, who incurs the cost, and at what stage of the project they will take place.
2. **Currency**: Use current-year market prices. If prices fluctuate seasonally or due to supply-chain factors, note this and provide the most recent verified figures.
3. **Independent Evidence**: Support the numbers with official documentation, such as:
   a) Reports from independent property valuers or quantity surveyors.
   b) Engineering assessments.
   c) Supplier or contractor quotes.
   d) Cost data from comparable local projects. These documents help demonstrate that the proposal is credible and financially sound.

D.1.3 Land and Property Costs

If the RESA or runway extension requires land acquisition or changes to existing land use, provide the following:

- **Independent Land Valuations:** Submit official valuations for all land parcels required to achieve a compliant RESA configuration. These valuations must come from a qualified, independent valuer.
- **Legal and Regulatory Costs:** Include realistic estimates for:

  - Resource consent applications
  - Environmental impact assessments
  - Land-use zoning changes
  - Legal fees and administrative charges These costs often take longer and cost more than expected, so transparency helps avoid delays later.

- **Easements and Obstruction Management:** If expanding the aerodrome boundary affects existing easements or creates new obstacle limitation surface issues, provide the costs to modify, relocate, or compensate affected parties.

D.1.4 Building and Site Preparation Costs

Preparing the physical site is often the most complex part of RESA development. Operators should Include the following:

- **Earthworks and Structural Support:** Provide detailed costings for excavation, fill, compaction, grading, and any retaining or support walls required to achieve compliant slopes.
- **Complex Terrain Solutions:** If the runway end is near water, cliffs, steep terrain, or unstable ground, include engineering quotes for:
  - Land reclamation.
  - Cliff-stabilisation or erosion control.
  - Pile-driven foundations or ground-strengthening works These are high-risk, high-cost items, so independent engineering input is essential.
- **Drainage and Stormwater Management:** Include the cost of installing or upgrading drainage systems to ensure the RESA remains stable, dry, and safe during heavy rainfall.

D.1.5 EMAS

For proposals such as EMAS, include the following:

- **Equipment Costs:** Provide the full cost of the system, including international shipping, customs duties, and local transport.
- **Foundation Construction**: Include the cost of the concrete foundation required to support the arresting bed.
- **Manufacturer Services:** Include fees for:
  - Factory supervision.
  - On-site installation oversight.
  - System testing.
  - Technical commissioning.

D1.6 Long-Term Operational Expenditure (OpEx)

CAA needs assurance that aerodrome operators can sustainably maintain the RESA or arresting system over its full life cycle. Therefore, the following steps must be taken:

- **Routine Maintenance:** Provide annual cost estimates for:
    - Surface inspections.
    - Vegetation control.
    - Ground compaction checks.
    - Minor repairs.
- **Environmental Protection:** Include costs for protective coatings, sealants, or treatments that prevent UV, water, or salt damage.
- **Emergency Replacement Funds**: For EMAS or similar systems, include the cost of replacing arresting blocks after an overrun event. This demonstrates financial preparedness for rare but high-impact incidents.

D.1.7 Options and expected costs for physical constraints or other difficulties

A Cost Benefit Analysis (CBA) may be required to establish evidence of the expected costs needed to overcome constraints and provide a clear threshold of practicability. There is no fixed dollar value or universal benchmark, rather, the decision depends on the relationship between cost, the level of risk reduction achieved and ultimately the ability of the certificate holder to meet the costs.

A CBA allows aerodrome operators and regulators to clearly understand not only what is technically possible, but what is reasonable to implement, given the operational context, physical constraints, and the need to achieve an appropriate balance between safety and cost.

Benefits proportionate to costs for the certificate holder

The CBA should identify and assess the benefits, with particular emphasis on safety outcomes. Operational benefits, such as increased payload, improved reliability, or greater airline use, should be quantified where possible (for example, additional passengers per year or increased revenue). However, a critical element in aviation CBAs is the treatment of safety benefits, which often involve low-probability, high-consequence events.

These benefits can be evaluated through risk modelling, historical data, or scenario analysis to estimate how each option reduces the likelihood or severity of runway excursions. Even where precise monetary values are difficult to assign, the analysis should clearly articulate the relative safety improvement between options.

A key step in completing the CBA is to bring costs and benefits together in a comparative framework, typically using metrics such as Net Present Value (NPV) or Benefit–Cost Ratio (BCR). This involves discounting future costs and benefits to present values to allow a fair comparison over the project life. However, in an aviation safety context, these financial metrics should not be used in isolation. They must be interpreted alongside qualitative safety considerations, ensuring that decisions are not driven solely by economic efficiency but reflect the overarching requirement to maintain a compliant facility and acceptable level of safety.

The final and most critical stage is to apply the findings to a risk judgement articulated in the certificate holder's SMS, such as ALARP, determining whether the cost of further safety improvement would be grossly disproportionate to the benefit achieved. This is where the CBA directly informs the safety case. For example, if constructing RESA to 240m provides only marginal additional risk reduction but requires substantial additional cost and engineering complexity, the analysis may support a conclusion that 240m RESA is not practicable. Conversely, if the additional cost delivers a significant safety improvement at a proportionate cost, then it strengthens the case for full implementation.

Throughout the process, it is essential that the CBA remains transparent and well-documented, clearly setting out all assumptions, methodologies, and limitations. This ensures that the analysis can be reviewed, challenged, and updated as new information becomes available. A well-executed CBA does not simply produce a numerical result, it provides a clear, evidence-based narrative that explains why a particular option represents the most appropriate balance between cost, operational benefit, and safety. In doing so, it becomes a cornerstone of a defensible and regulatorily robust safety case.

Example 1

A credible scenario for applying a CBA to a RESA is at a regional aerodrome proposing to extend its runway by approximately 150 metres. The driver for this extension may be the introduction of a larger aircraft type or, more commonly, to enable existing aircraft (such as ATR turboprops) to operate without payload restrictions. In this context, the extension improves take-off performance margins, allowing aircraft to depart at or near full capacity rather than leaving seats empty to meet performance limits. While the operational benefit appears straightforward (more passengers), the associated requirement to provide an acceptable RESA introduces additional cost, complexity, and land-use implications, which should be justified through a structured CBA.

The starting point of the CBA is to clearly identify and quantify the primary operational benefits arising from the runway extension. For example, if removing weight restrictions allows an additional 10–12 passengers per flight, the annual uplift in passenger numbers can be estimated based on flight frequency and load factors.

This increase can then be translated into the possibility of increased landing fees, direct airline revenue, based on average ticket prices, providing a measurable and recurring financial benefit. Beyond airline revenue, the CBA should also consider secondary or downstream economic benefits, such as increased passenger spending within the terminal (food and beverage outlets, retail) and greater use of services such as rental cars, parking, and local tourism activity.

Against these benefits, the CBA must set out the full cost of the runway extension and associated RESA provision. This includes not only the physical extension works but also the cost of achieving compliant or practicable RESA dimensions. These costs should be presented transparently and compared across the proposed options, or alternative measures like EMAS where appropriate.

A critical function of the CBA in this scenario is to integrate safety benefits into the decision-making process. While increased passenger numbers and revenue are relatively easy to quantify, the safety benefits of RESA—primarily the reduction in severity of runway excursion events—should also be considered.

This involves assessing how each option contributes to lowering risk, particularly for low-probability but high-consequence events. For instance, a longer RESA provides additional stopping distance and reduces the likelihood of aircraft damage or injury in the event of an overrun. Even if the probability of such an event is low, the consequences can be severe, and the CBA should reflect this through risk-based reasoning or indicative economic values of avoided accidents.

The CBA also plays a central role in assessing whether the cost of achieving 240m RESA compliance is proportionate to the benefits obtained, both operational and safety related.

In some cases, the nominal benefit of constructing a 240m RESA instead of a 90m RESA may be relatively modest compared to the substantial additional cost required.

In such circumstances, the CBA should support a risk-based judgement, examining whether the additional investment is justified or whether it would be considered grossly disproportionate. Conversely, if the additional safety benefit is significant and the cost increase is moderate, the CBA would support 240m as the reasonably practicable outcome.

Importantly, the CBA should not be viewed as a purely financial exercise but as part of a broader safety and regulatory justification. It provides a clear narrative that links the operational need (increased payload), the economic benefit (additional passengers and spending), and the safety requirement (RESA provision) into a coherent argument.

This narrative is essential when engaging with CAA and stakeholders, demonstrating that the aerodrome certificate holder has systematically evaluated all relevant factors and selected an option that achieves an appropriate balance between cost, safety, and operational efficiency.

In summary, when building RESA as part of a runway extension at a regional aerodrome, a CBA enables decision-makers to fully understand the trade-offs involved. It quantifies the economic gains from increased passenger capacity, captures other benefits to the operator/ proposer, and weighs these against the often-substantial costs of infrastructure and safety improvements. Most importantly, it provides the evidence needed to demonstrate that the chosen solution delivers a level of safety that is aligned to the risk and reasonably practicable in the circumstances, ensuring both regulatory compliance and responsible investment.

Appendix E – Guidance on Practicability: Checklist

1. Regulatory & Certification Context

☐ Aerodrome holds valid Part 139 certificate.

☐ Aerodrome serves regular air transport passenger service (RAPTS) aircraft with more than 30 seats.

☐ SMS is referenced and compliant with Rule 139.75 / AC100-1.

☐ Correct regulatory references included.

☐ Rule 139.51 (RESA).

☐ Rule 139.131 (Aeronautical study).

☐ Annex 14 (90m minimum / 240m if practicable).

☐ Clear statement of study objective (for example, 90m, 240 m, EMAS, combination, or not practicable case).

☐ ALARP principle explicitly identified.

2. SMS Integration & Governance

☐ Study clearly linked to operator's SMS.

Relevant SMS elements identified:

☐ Hazard identification.

☐ Risk assessment.

☐ Safety assurance.

☐ Safety performance monitoring.

☐ Evidence of formal governance.

☐ Runway Safety Team involvement.

☐ Safety committee review.

☐ Stakeholder engagement - ANSP, operators, RFS.

☐ SMS change management process applied.

☐ Risk matrix and tolerability criteria align with certificate holder's SMS.

3. Operational Context & System Description

☐ Runway characteristics described (length, code, usage).

☐ Aircraft types and traffic volumes included.

☐ Declared distances provided.

☐ Existing RESA configuration clearly defined.

Constraints identified and evidence-based:

☐ Physical/terrain (A.3.1).

☐ Land/boundary (A.3.2).

☐ Environmental/cultural (A.3.3).

☐ Infrastructure (A.3.4).

Supporting data included:

☐ Local safety occurrence data.

☐ Global runway excursion data.

☐ Meteorological factors.

☐ RFS accessibility considerations.

4. Practicability Assessment (240m RESA)

4.1 Engineering Feasibility

☐ Engineering challenges clearly described.

☐ Technical solutions identified (even if rejected).

☐ Constructability assessment provided.

4.2 Financial Evidence (CRITICAL SECTION)

Where applicable costs are provided:

☐ Itemized (no lump sums).

☐ Specific and traceable.

☐ Based on current market rates.

☐ Independent evidence.

☐ Quantity surveyor report

☐ Contractor/supplier quotes.

☐ Engineering cost estimates.

☐ Comparable project data.

Cost categories addressed:

☐ Land acquisition.

☐ Earthworks & structures.

☐ Drainage & ground improvement.

☐ Infrastructure relocation.

☐ Environmental mitigation.

☐ Land/property costs.

☐ Independent valuation reports.

☐ Legal and consent costs included.

☐ Easements/obstruction impacts assessed.

☐ EMAS (if applicable).

☐ Equipment cost.

☐ Shipping/logistics.

☐ Foundation construction.

☐ Manufacturer services.

☐ Operational expenditure (OpEx).

☐ Maintenance costs.

☐ Environmental protection.

☐ Replacement (post-event EMAS).

☐ Conclusion clearly justifies:

☐ Why 240 m graded RESA is or is NOT practicable.

5. Hazard Identification

Primary hazards identified:

☐ Landing overrun.

☐ Rejected take-off overrun.

☐ Landing undershoot.

Secondary hazards identified:

☐ Terrain / drop-offs.

☐ Water / flood risk.

☐ Obstacles / non-frangible structures.

☐ Emergency response limitations.

Multiple data sources used:

☐ Local reporting.

☐ Industry data.

☐ Expert judgement.

☐ Airline Operator input.

☐ Hazards consistent with SMS hazard register.

6. Safety Risk Assessment

☐ Risk assessment methodology aligned with SMS.

☐ Likelihood and severity clearly justified.

Scenarios assessed and compared:

☐ For 240m RESA.

☐ For 90m RESA.

☐ For EMAS solution.

☐ For Combined RESA and EMAS.

☐ Proposed configuration.

Risk levels clearly presented:

☐ Pre-mitigation.

☐ Post-mitigation.

☐ Risk acceptance aligns with SMS tolerability criteria.

7. Mitigation Measures & ALARP

Infrastructure mitigations:

☐ Graded RESA.

☐ EMAS.

☐ Obstacle removal.

☐ Frangible structures.

Operational mitigations:

☐ Aircraft restrictions.

☐ Weight or performance limits.

☐Tailwind limits.

☐ Runway condition requirements.

Procedural mitigations:

☐ AIP amendments.

☐ Pilot briefing requirements.

☐ RFS access improvements.

ALARP demonstration includes:

☐ Consideration of further risk reduction options.

☐ Cost vs benefit reasoning.

☐ Justification for stopping point.

8. Safety Performance Requirements

☐ Safety Performance Indicators (SPIs) defined.

☐ Safety Performance Targets (SPTs) defined.

Monitoring framework established:

☐ Data collection method.

☐ Reporting frequency.

☐ Responsibility assigned.

Review triggers defined:

☐ Traffic increase.

☐ New aircraft types.

☐ Incident/accident occurrence.

☐ Infrastructure changes.

9. Documentation & Submission Quality

☐ Study is complete, structured, and traceable.

☐ All assumptions clearly stated and justified.

☐ Supporting documents included and referenced.

Evidence completeness:

☐ Hazard identification record.

☐ Risk register extract.

☐ Cost evidence documentation.

☐ Engineering assessments.

☐ Environmental reports.

☐ Clear audit trail from: **Hazard → Risk → Mitigation → Residual Risk → Decision.**

☐ Submission complies with Rule 139.131 requirements.

Appendix F: Sample Aeronautical Study Considerations

A basic aerodrome aeronautical study would consider matters like, but not limited to, the elements below:

Scenario:

An operator of a commercial flight training flying organisation is considering a start-up or expanded operation on an aerodrome.

The aerodrome operator considers as part of its review of the impact on this possible new operation that it should conducted an aerodrome airspace review.

Aeronautical study elements may include the following elements:

- Modelling several levels of aircraft operations covering a range of options for the fleet size from the initial start up fleet size to the expected "final/optimum" size of the fleet.
- Modelling several local aerodrome operational factors, including:
  - Runway/taxiway design - note the taxiway design has a major influence of the runway and hence airspace capacity.
  - Location of the flight line apron in relation to the runways and taxiways and other facilities for example, fuel, maintenance, and so on.
  - Location of navigational aids in the adjacent and regional airspace required for IFR training for example, VOR, ILS, NDB.
  - Location of controlled airspace both locally and in the region.
  - Location of suitable areas of airspace for general handling (VFR) training.
  - Location of other aerodromes in the region suitable for cross country operations.
  - Local and regional meteorological conditions and seasonal patterns.
  - Location of suitable aircraft maintenance support services.
  - The current level (baseline) of aerodrome operations, for example, airline and local operations.
  - Aerodrome air traffic density, for example, circuit training, and so on. Various modelling tools are available.
  - Aerodrome air traffic complexity, for example, Crosswind runway, IFR approaches, and so on.
- The Bow Tie methodology to determine the risk scenario. (See Chapter 3, Risk).