Advisory Circular

AC139-19

Revision 0

31 August 2026

Runway End Safety Areas and Engineered Material Arresting Systems

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 and related Civil Aviation Transport Instrument.

Consideration will be given to other methods of compliance that are 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 the requirements for Runway End Safety Areas (RESA) and/or Engineered Material Arresting Systems (EMAS). It provides guidance on how to assess the practicability of a RESA or EMAS, and on expected content for an aeronautical study considering a RESA or EMAS.

Related Rules

This AC relates to Civil Aviation Rule Parts 139.20, 139.51, 139.131, Appendix A.1 to Part 139, and the corresponding Civil Aviation Transport Instrument (CATI 139.51).

Change Notice

Initial issue

Version History

History Log

Revision No.	Effective Date	Summary of Changes
0	31 August 2026	Initial issue.

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Introduction

1. This AC provides guidance on the requirements and expectations associated with a Runway End Safety Area (RESA) and Engineered Material Arresting System (EMAS) under Civil Aviation Rule 139.51 at aerodromes. The guidance provides direction on: RESA configuration options, EMAS design and standards, preparing an aeronautical study, practicability factors, and Safety Management Systems (SMS) alignment.

2. This guidance is intended for use by certificate holders, aerodrome designers and engineers, safety managers, consultants preparing aeronautical studies, and organisations supporting RESA and EMAS design, construction, or assessment.

3. The Director of Civil Aviation (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 SMS. See Appendix A and the checklist in Appendix B for more details.

RESA requirements

4. A RESA is a cleared, graded, and obstacle-free area 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. A RESA provision can be paved or unpaved.

5. RESA requirements differ by aerodrome code and operations – refer to Rule 131.51 Appendix A.1 and Table 1 (in this AC) for more details. In general:

   - **Aerodrome reference code 3 and 4:** must have a RESA of at least 240m. If that is not practicable, then the RESA must be at least 90m.

   - **Aerodrome reference 1 and 2 instrument runways with 30 seats plus regular public transport operations:** must have a RESA of at least 120m. If that is not practicable, then the RESA must be at least 90m.

   - **Aerodrome reference 1 and 2 with non-instrument runways:** a RESA of at least 30m is only required where the runways serve regular passenger transport by aircraft with more than 30 seats. Otherwise, no RESA is required.

Aircraft Arresting Systems

6. Where it is not practicable to provide a graded RESA that meets the rule requirements, the Director may agree to a reduction in declared RESA distances if the aerodrome installs an arresting system.

7. An Aircraft Arresting System (AAS) is a system designed to decelerate an aircraft overrunning the runway. Under Rule 139.51 Appendix A.1, if an arresting system is installed, the length of RESA may be reduced based on the design specification of the system. An AAS can provide predictable and effective performance in arresting aircraft overruns, independent of contaminants or the weather.

8. One such AAS design is based on the use of engineered materials that will crush under the weight of an aircraft, thereby absorbing energy. This design, known as EMAS, is

already in use in New Zealand. Other types of arresting systems include the cable/ hook-wire arresting system commonly installed at military airfields and on naval platforms.

9. When there is a significant change that may affect the safety of aerodrome operations, such as RESA or EMAS, an aeronautical study is recommended to evidence which RESA length, or its equivalent with EMAS, is practicable. Refer to Rule 139.131 and Appendix A of this AC.

Table 1: RESA requirements by aerodrome reference code

	Aerodrome reference code 3 & 4	Aerodrome reference code 1 and 2 instrument runways with 30 seats plus RPT operations	Aerodrome reference code 1 & 2 with non-instrument runways
RESA required	Yes.	Yes.	Only where runways serve regular passenger transport with more than 30 seats.
Required configuration	• If practicable, a RESA that extends to a distance of at least 240m from the end of the runway strip or the use of an EMAS that provides the equivalent to 240m. If this is not practicable, then a distance of at least 90m from the end of the runway strip or the use of an EMAS that provides the equivalent to 90m.	• An equivalent stopping distance of at least 120m. If that is not practicable, then the distance must be at least 90m, or the use of an EMAS that provides the equivalent to 90m.	• If RESA is required, an equivalent stopping distance of at least 30m.
Examples of compliance	• At least 240m of RESA provided at each runway end. • RESA with EMAS equivalent to a stopping distance of at least 240m constructed at each runway end. • At least 240m of RESA at one runway end and at least 90m of RESA at the other runway end. • RESA with EMAS equivalent to a stopping distance of at least 240m constructed at one runway end and RESA with EMAS equivalent to a stopping distance of at least 90m constructed at the other runway end.	• At least 120m of RESA provided at each runway end. • EMAS equivalent to a stopping distance of at least 120m constructed at each runway end. • At least 120m of RESA at one runway end and at least 90m of RESA at the other runway end. • EMAS equivalent to a stopping distance of at least 120m constructed at one runway end and EMAS equivalent to a stopping distance of	• At least 30m RESA. • An arresting system as an alternative. • A combination of RESA and an arresting system providing an equivalent 30m stopping distance. • If the aerodrome does not serve regular passenger transport with more than 30 seats, no RESA provision.

	• A combination of RESA plus EMAS providing equivalent stopping distance of at least 90m or at least 240m constructed at each runway end. • At least 90m of RESA provided at each runway end. • RESA with EMAS equivalent to a stopping distance of at least 90m constructed at each runway end.	at least 90m constructed at the other runway end. • A combination of RESA plus EMAS providing equivalent stopping distance of at least 90m or 120m constructed at each runway end. • At least 90m of RESA provided at each runway end. • EMAS equivalent to a stopping distance of at least 90m constructed at each runway end.	

Abbreviations and Definitions

10. These terms below are in addition to aviation-specific definitions in Part 1, Definitions and Abbreviations, which operators should also consult.

Abbreviations	
Aircraft Arresting System	AAS
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
Maximum Landing Weight	MLW
Maximum Take-Off weight	MTOW
Net Present Value	NPV
Obstacle Limitation Systems	OLS
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	
As low as reasonably practicable	While not defined in civil aviation legislation, CAA's interpretation is drawn from the Health and Safety at Work Act 2015, section 22, *Meaning of reasonably practicable*: "…that which is, or was, at a particular time, reasonably able to be done (…) taking into account and weighing up all relevant matters…"
Critical aircraft	For the purposes of EMAS, aircraft regularly using the associated runway that impose the greatest demand on the EMAS.
Design aircraft	The combination of aircraft types which are or will be operating regularly on the runway.
Exit speed	The speed of the nose gear of the aircraft as it passes the physical end of the runway (or stopway if provided).
Graded area	An area prepared to designed levels and slopes, free of hazardous irregularities and obstacles. It provides a safe surface that reduces the consequences of aircraft overruns or undershoots and supports emergency response operations.
Service road	A road that allows emergency vehicles to circumnavigate the EMAS facility without driving over the EMAS.
Setback	The distance between runway end or stopway and the beginning of the EMAS arrestor bed.

Process for acceptance of EMAS

Compliance with Transport Instrument

11. CAA has not developed AAS design standards specific to New Zealand. Civil Aviation Rule 139.51 requires that those installing an AAS must comply with the approved design standards in the transport instrument, CATI 139.51.

12. ***Note:*** *A transport instrument is secondary legislation. Once created, transport instruments form part of the rule that provides for them. Compliance with the transport instrument is mandatory. This means that a breach of CATI: 139.51 is a breach of the corresponding section of Part 139, and offences and penalties may be imposed as set out in relevant Regulations.*

Approved Design Standards

13. At present, any AAS used in New Zealand must comply with FAA Advisory Circular 150/5220-22B: Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns.

14. As the only approved AAS in CATI 139.51 is EMAS, this guidance material focuses solely on that approach. CAA will consider proposals for other arresting systems when new technology is introduced to New Zealand.

15. Before installing an EMAS, an aerodrome operator should demonstrate that the proposed design is approved under CATI 139.51 and that the associated risks have been assessed and are appropriately mitigated.

16. To fulfil these criteria an aerodrome operator should:

    - review the risks associated with the introduction of the EMAS through an aeronautical study, and
    - provide the Director with detailed design reports of the proposed EMAS solution and the aeronautical study.

17. ***Note 1*****:** *Guidance on aeronautical studies can be found in AC139-15, Aeronautical Studies for Aerodrome Operators. Further RESA and EMAS-specific information for the aeronautical standards can be found in Appendix 1 of this guidance.*

18. ***Note 2:*** *The following guidance may also be useful to reference when installing an EMAS: FAA Advisory Circular 150/5300-13: Airport Design**.***

EMAS design and standards

Concept and Operation

19. EMAS is designed to slow down the aircraft in the event of an overrun by exerting predictable forces on the landing gear. These forces are designed to not be excessive. This avoids injuries to passengers and crew, and major structural damage to the aircraft.

20. EMAS is a passive system that requires no external means to initiate or trigger the operation of arresting an aircraft. It is designed to be entered preferably straight ahead with the unrestricted use of wheel brakes and/ or thrust reversers. It does not require any special actions or procedures of the flight crew; however, they should have a basic knowledge of the system to prevent them undertaking evasive manoeuvres that could cause the aircraft to avoid entering the EMAS.

21. EMAS is not intended to meet the definition of a stopway and its availability should not be used for flight planning purposes.

Location and Dimensions

22. An EMAS is located beyond the end of the runway and centred on the extended runway centreline. It will usually begin at a setback distance from the end of the runway to avoid damage due to jet blast and undershoots. This distance will vary depending on the available area and the EMAS materials.

23. The EMAS should be placed as far from the runway end as practicable. Such placement decreases the possibility of damage to the system from short overruns or undershoots and results in a more economical system by considering the deceleration capabilities of the existing runway safety area.

24. To reduce the probability of an aircraft undershoot into an EMAS, a setback distance of at least 60 m from the threshold or runway end is recommended. However, this separation may be reduced if, after an aeronautical study, it is determined doing so is the best alternative for both overrun and undershoot protection.

25. The calculation of the setback distance balances the risk objectives of:

- providing enough area for arresting purposes
- providing enough separation to protect the bed from jet blast, and
- providing separation from the threshold to reduce the probability of undershoot in the EMAS.

26. EMAS functional width should not be less than the runway width. Where possible, this width is provided throughout the whole length of the bed.

27. The aerodrome operator should assess the relevance of each risk objective as part of the aeronautical study, considering the operating conditions such as:

- use of the runway
- types of approach
- weather conditions

- fleet mix
- incidents and accidents
- the relative position of the clearway to any proposed EMAS, and
- any other runway safety issues.

28. When considering the location of an EMAS, impact on the performance of any air navigation facilities at the aerodrome should also be considered with input from the facility operator.

Design and Arresting Performance

29. The EMAS should provide a stopping distance equivalent to the applicable distances in Rule 139 Appendix A.1 for the design aircraft exiting the runway end at a speed of 70 knots.

30. Aerodrome operators should engage with users regarding the selection of the design aircraft and optimising the EMAS design. While the critical aircraft is generally the heaviest or largest aircraft that regularly uses the runway, this may not always be the case. The EMAS performance is also influenced by landing gear configuration, tyre pressure, and the centre of gravity.

31. The operational maximum take-off weight (MTOW) is generally used in selecting the design aircraft. However, in some cases, an aircraft operating below MTOW will require a longer arrester bed. Where practicable, the design should consider both the aircraft that places the greatest demand on the system and the range of aircraft that operate regularly on the runway. In some instances, a combination of design aircraft may provide a more effective outcome than a single critical aircraft. Aerodrome-specific factors, including available RESA and air cargo operations, should also be considered.

32. The EMAS design methodology should be supported by analytical validation and, where appropriate, laboratory or onsite testing to confirm system performance. Testing may involve either an aircraft traversing a test bed or a single wheel carrying an equivalent load. The design should consider relevant aircraft characteristics including gear loads, gear configuration, tyre contact pressure, weight, centre of gravity, and speed.

33. Where practicable, EMAS should be designed to decelerate the design aircraft entering the arrester bed at 70 knots. This should be achieved for both MTOW and 80 per cent maximum landing weight (MLW). The system should not impose loads that exceed aircraft design limits. It should also avoid loads likely to cause major structural damage or excessive forces on occupants. Where available distance is insufficient, the design should maximise deceleration within the available distance, using a minimum design exit speed of 40 knots.

34. The design method for EMAS excludes the use of reverse thrust of the aircraft and assumes a runway and setback braking friction coefficient of 0.25. Within the arrester bed, a braking coefficient (0.00) should be assumed, unless the manufacturer provides field or laboratory test data demonstrating a minimum achievable braking friction coefficient. The arrester bed length should include an appropriate margin to account for calculation error.

35. The RESA requirements in Rule 139 Appendix A must be applied on both sides of the runway. Service roads, set up at both sides and at the end of the EMAS, are intended for maintenance and emergency access. These roads are provided with adequate width to allow access for rescue and firefighting service (RFS) vehicles, can support the passage of fully loaded RFS vehicles, and are graded to avoid water accumulation.

36. If an ILS (Instrument Landing System) is present at the aerodrome, the EMAS installation should be as symmetric about the centreline as possible to avoid unwanted interference or influence on the radio navigation systems.

Undershoots

37. The EMAS should be designed so that it does not cause more control problems or damage to aircraft during an undershoot when compared to touching down in a RESA.

38. Approximately 50 per cent of undershoots occur in the first 60 metres before the runway threshold, and the ratio of undershoots/overruns is reported to be 1:4. This information should be considered in the safety assessment, to find the best solution for enhancing runway safety.

Recovery of aircraft following an overrun

39. Aerodrome operators should include in their exposition appropriate plans for recovery of aircraft following an overrun event. They should also develop a process to assess the serviceability of the EMAS following any damage to it.

Operations with a compromised EMAS

40. When an EMAS is damaged due to an overrun or determined to be less than fully serviceable, a NOTAM should be issued to alert airport users of the reduced performance of the EMAS.

41. The aerodrome operators should assess the performance of the EMAS and, in consultation with aircraft operators, determine what, if any, operational procedures or limitations should be introduced to mitigate the risks associated with the reduced performance.

Resources

ICAO

Appendix 5, Doc 9157, Part 1, *Runways.* Available from the ICAO Store.

EASA

EASA_REP_RESEA_2011_12. Study on models and methodology for safety assessment of Runway End Safety Areas (RESA)

FAA

- FAA AC 150/5300-13B: Airport Design- Change 1 AC 150/5300-13B, Airport Design, March 31, 2022 Consolidated to include Change 1, August 16, 2024 (errata updates as of 4/3/2025)
- FAA AC 150/5220-22B: Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns AC 150/5220-22B - Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns

Other resources

ACRP Report 50 – Improved Models for Risk Assessment of Runway Safety Areas
Health and Safety at Work Act 2015 | New Zealand Legislation

Appendix A: Runway End Safety Area (RESA) – Guidance on Practicability and Inclusion in Aeronautical Studies

Introduction

1. The purpose of these appendices is to provide guidance on the requirements and expectations associated with a RESA under Civil Aviation Rule 139.51 at aerodromes, for inclusion in aeronautical studies. They give direction on:

   - RESA configuration options, including RESA, arresting systems, and combined configurations (RESA plus EMAS).
   - Demonstrating practicability, considering physical, environmental, operational, and economic considerations. This includes:
     - whether the difficulties can be overcome and, if so, at what expected cost; and
     - whether the costs are proportionate to the benefits an aerodrome operator certificate holder may expect from any RESA development.

2. As a minimum the following rules are applicable and should be considered as part of any RESA proposal (others may also apply):

   - Rule 139.51 Runway End Safety Area.
   - Rule 139.53 Aerodrome limitations.
   - Rule 139.75 Safety Management Systems (in accordance with Rule 100.3).
   - Rule 139.103 Aerodrome maintenance.
   - Rule 139.121 Protection of navigation aids.
   - Rule 139.131 Aeronautical Studies.
   - Rule 139 Appendix A.1.
   - Rule 121 Appendix D.

Engineered Material Arresting System (EMAS)

3. An EMAS is a system designed to decelerate an aircraft that overruns the runway, providing a stopping performance equivalent to a specified RESA length. As of August 2026, two airports in New Zealand have adopted an EMAS.

4. Where a proposed configuration would displace an existing operational or safety feature at the runway end, the certificate holder's safety assessment should identify the effect and take it into account.

5. Aerodromes can use a combination of RESA and EMAS to fulfil their RESA requirements under Rule 139.51. See Table 1 for more information on how this may work.

Preparing an aeronautical study under Rule 139.131 – SMS Alignment

6. All aerodrome operator certificate holders operate under an SMS. Under Civil Aviation Rule Part 100 *Safety Management*, the SMS should be aligned to the complexity of the aerodrome's operations and infrastructure, producing documented and traceable safety risk management outputs. 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 set out in Table 2.

7. Aerodrome operators should consider the following:

   - Annex 14 RESA requirements.
   - Rule 139 RESA requirements.
   - Rule Part 100/ ICAO Annex 19 obligations for formal safety risk management (if not meeting recommended practices).

8. Any RESA-related aeronautical study submitted to CAA should also demonstrate clear integration with:

   - ICAO Annex 19 – Safety Management (State and service-provider SMS obligations).
   - 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).

9. ***Note:*** *In any safety risk assessment, it is recommended to consider the ratio of undershoots to overruns, currently reported to be 1:4. Approaches aided by navigation aids providing vertical guidance should also be considered as a risk mitigation measure.*

Preparing an aeronautical study under Rule 139.131 – practicability constraints

10. Aerodromes are often located in challenging terrain. This can be a barrier to achieving the required RESA length. Other practicability factors to consider include land availability, environmental and cultural concerns, and existing infrastructure.

11. Evidence of relevant constraints should be provided in any RESA proposal prepared under Rule 139.131. These require a detailed, evidence-based explanation of why the required RESA length may not be physically achievable.

12. 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 set out in Table 2 below. Where applicable, their impact on the development of a RESA should form part of the aeronautical study.

Table 2: Practicability factors to consider: Physical or other difficulties that may affect or constrain the site

Typography/ terrain	Land availability and constraints	Environmental and cultural concerns	Existing aerodrome infrastructure
Steep coastal escarpments may require large retaining structures, coastal protection works, or land reclamation in areas exposed to wave action, storm surge, and erosion. **River terraces and floodplains** may require extensive cut-and-fill operations, flood protection, or ground stabilisation. **Mountainous or hilly terrain** – earthworks in such terrain can be technically complex, requiring slope stabilisation, retaining walls, or large volumes of imported fill. **Abrupt or minor elevation changes** – localised gullies, ridgelines, or man-made embankments can create sudden elevation changes that make it difficult to construct a level RESA platform without major earthworks. **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. **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.	**Adjacent land that is privately owned**, used for farming, industrial activity, or residential housing. **Land that is subject to long-term leases**, easements, or covenants that restrict modification. **Expansion**, whether for RESA or runway lengthening or both (this is likely to require compulsory acquisition processes). Some aerodromes may border **public reserves, parks, or conservation land** where further development of the aerodrome facility is restricted.	**Wetlands, estuaries, and dune systems** may be protected under resource management legislation or regional plans. **Habitats for protected species** (for example, migratory birds or native reptiles) may restrict earthworks or require extensive mitigation. **Culturally significant sites**, including wāhi tapu sites (such as burial area or battlefield) or archaeological areas, may prevent excavation or land modification. **Waterways** may require setbacks, stormwater controls, or erosion protection.	**Consider existing infrastructure**, such as: • Approach lighting systems. • Perimeter roads. • Security fencing. • Drainage channels and stormwater systems. • Utility services (power, water, telecoms). • State highways. • Easements, e.g. electricity, water, gas. • Navigation aids, including ILS localisers or glidepath antennas. • Impacts to existing obstacles and Obstacle Limitation Surfaces (OLS) survey results.

Preparing an aeronautical study under Rule 139.131 – Cost-benefit analysis and financial evidence expectations

13. A Cost Benefit Analysis (CBA) may be used 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: the decision depends on the relationship between cost and the level of risk reduction achieved.

14. A CBA allows aerodrome operators, other stakeholders, and regulators to clearly understand not only what is technically possible, but what is practicable given the operational context, physical constraints, and the costs to overcome constraints and achieve a required RESA length.

15. The CBA should 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.

Benefits proportionate to costs for the certificate holder

16. A well-executed CBA provides a clear, evidence-based narrative that explains why a particular option represents the most appropriate balance between cost, operational benefit, and safety. 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.

17. 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).

18. However, in an aviation context, these financial metrics should be interpreted alongside qualitative safety considerations. 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.

19. 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.

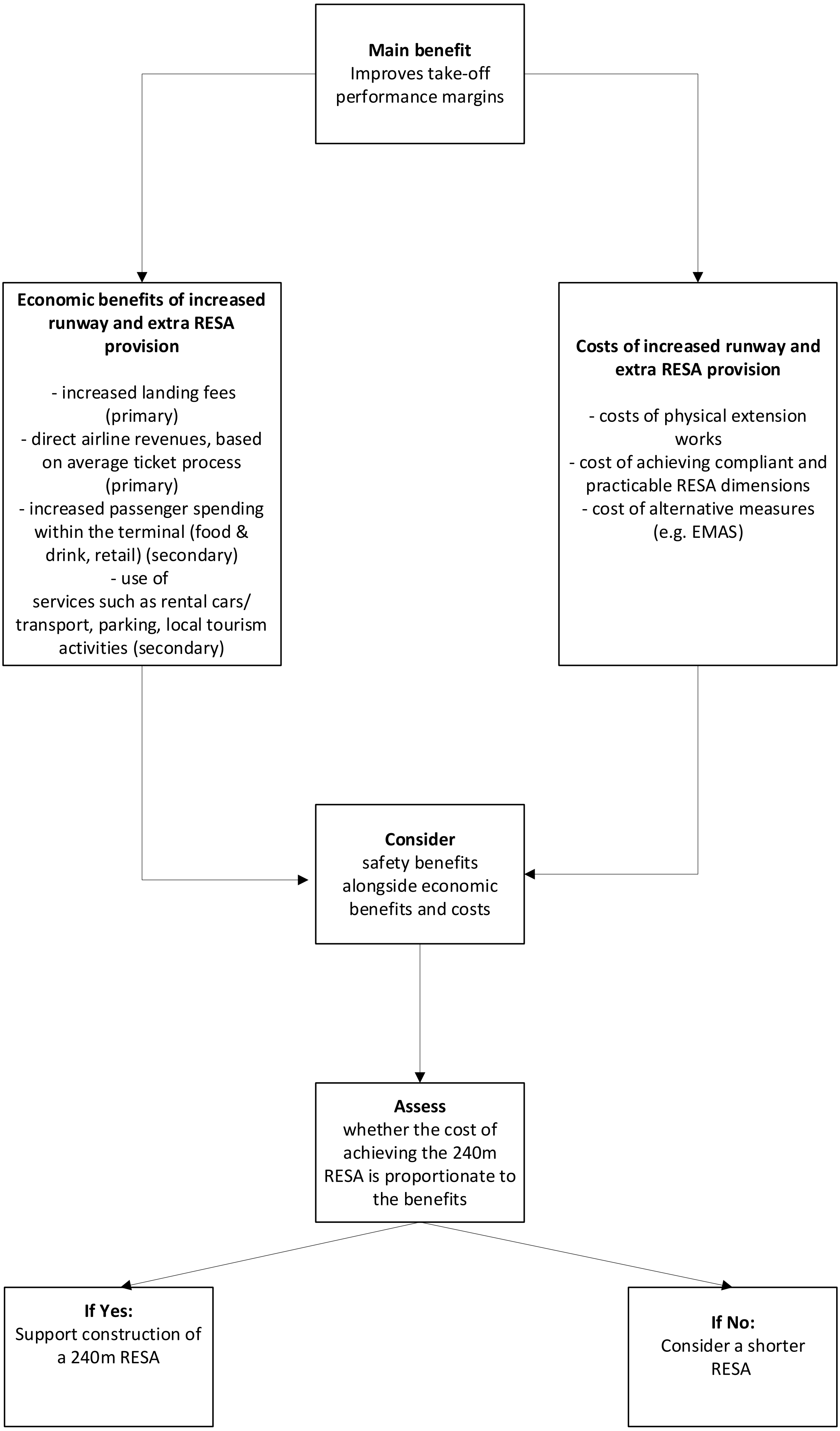
20. The final and most critical stage is to apply the findings to a risk judgement articulated in the certificate holder's SMS, such as ALARP, determining whether the cost of further safety improvement would be clearly disproportionate to the benefit achieved.

21. For example, if constructing a RESA to 240m provides only marginal additional risk reduction but requires substantial additional cost and engineering complexity, the analysis may support a conclusion that a 240m RESA is not practicable. However, if the additional cost delivers a significant safety improvement at a proportionate cost, then it should be undertaken.

22. 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.

Cost benefit analysis example: a regional aerodrome proposing to extend its runway by approximately 150 m

23. 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. See Figure 1, below.


Main benefit
Improves take-off performance margins
Economic benefits of increased runway and extra RESA provision
- increased landing fees (primary)
- direct airline revenues, based on average ticket process (primary)
- increased passenger spending within the terminal (food & drink, retail) (secondary)
- use of services such as rental cars/ transport, parking, local tourism activities (secondary)
Costs of increased runway and extra RESA provision
- costs of physical extension works
- cost of achieving compliant and practicable RESA dimensions
- cost of alternative measures (e.g. EMAS)
Consider
safety benefits alongside economic benefits and costs
Assess
whether the cost of achieving the 240m RESA is proportionate to the benefits
If Yes:
Support construction of a 240m RESA
If No:
Consider a shorter RESA

Financial and operational evidence

24. 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.

25. 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.

26. 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. CAA needs assurance that aerodrome operators can sustainably maintain the RESA or arresting system over its full life cycle. The financial data should give CAA assurance that the proposal is grounded in real, current, and independently verified information.

27. See Table 3 for the standard financial and operational advice expected of all aerodrome operators, to be included in the aeronautical study.

Preparing an aeronautical study under Rule 139.131 – submission documentation

28. The study should include a complete, traceable record of all data sources, including evidence of the practicability test.

29. See Table 4 for an example of a regulatory-aligned outline of expected content, which should include evidence of:

- any operational context
- hazard identification
- safety risk assessment, safety performance requirements, and SMS integration
- mitigation evaluation, including ALARP demonstration.

Table 3: Requirements for financial and operational evidence

Financial data standards	Land and property costs (if the RESA or runway extension requires land acquisition/changes to existing land use)	Building and preparation costs	For EMAS proposals	Long term operational expenditure (OpEx)
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. **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. **Independent Evidence**: Support the numbers with official documentation, such as: • reports from independent property valuers or quantity surveyors • engineering assessments • supplier or contractor quotes • cost data from comparable local projects. These documents help demonstrate that the proposal is credible and financially sound.	**Independent Land Valuations:** Submit official valuations for all land parcels required to achieve a compliant RESA configuration. These valuations should 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.	**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.	**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.	**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.

Table 4: Suggested contents of an aeronautical study

Operational context	Hazard identification	Safety risk assessment	Safety performance requirements	SMS integration	Mitigation measures and ALARP demonstration
Describe the runway(s), declared distances, traffic mix, aircraft types, and operational environment. **Identify physical constraints** preventing at least 240m provision of RESA. **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.	**Identify primary hazards, such as:** • landing overrun • rejected take-off overrun • landing undershoots. **Identify secondary hazards, such as:** • 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.	**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 SARPs RESA (baseline). • Rule 139.51 – at least 90m and 240m if practicable. • Use of EMAS and combination of EMAS and RESA as per section A.2 of this appendix. **Identify the proposed RESA** and any mitigations. Ensure the analysis follows Doc 9859's structured	**Provide RESA related safety performance indicators** (SPIs) and safety performance targets (SPTs) that align with the desired outputs of the aerodrome operators own SMS. **Consider setting safety outcomes** or use your 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).	**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 a collaborative risk review process** involving the Runway Safety Team, aerodrome safety committee, and relevant stakeholders - ANSP, operators, RFS. **Demonstrate** that the study is produced under the aerodrome's SMS change management process, (refer AC100-1).	**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.

		methodology for risk estimation and evaluation.			

Appendix B – Guidance on Practicability: Checklist to support preparation and review of a RESA-related aeronautical study

Regulatory & Certification Context

☐ Aerodrome holds valid Part 139 certificate.

☐ Aerodrome serves regular air transport passenger service 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 (90 m minimum / 240 m if practicable).

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

☐ ALARP principle explicitly identified.

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.

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.

☐ Land/boundary.

☐ Environmental/cultural.

☐ Infrastructure.

Supporting data included:

☐ Local safety occurrence data.

☐ Global runway excursion data.

☐ Meteorological factors.

☐ RFS accessibility considerations.

Practicability Assessment (240 m RESA only)

Engineering Feasibility

☐ Engineering challenges clearly described.

☐ Technical solutions identified (even if rejected).

☐ Constructability assessment provided.

Financial Evidence

Where applicable costs are provided:

☐ Itemised (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.

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.

Safety Risk Assessment

☐ Risk assessment methodology aligned with SMS.

☐ Likelihood and severity clearly justified.

Scenarios assessed and compared:

☐ For 240 m RESA.

☐ For 90 m 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.

Mitigation Measures & ALARP

Infrastructure mitigations:

☐ 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.

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.

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 C– Other EMAS system considerations

Table 5 – Other considerations for the EMAS system and Aerodrome operator's maintenance responsibilities

The EMAS system should:	The EMAS system should not:	The Aerodrome operator should:	Maintenance responsibilities
be frangible and mounted as low as possible with ramps provided to avoid a vertical surface, wherever feasible. ***Note:*** *EMAS is composed of material with the necessary protection to achieve this requirement during its service life.* have sufficient mechanical strength to avoid damage from personnel walking on the bed during routine maintenance. use materials that do not generate or worsen fire hazards for incoming aircraft, and that are non-sparking, non-flammable, do not promote combustion, or emit toxic or malodorous fumes in a fire environment after installation.	stop the movement of RFS vehicles during an emergency. ***Note:*** *The arrester bed may be damaged during normal vehicle access.* impede crew and passenger evacuation (adequate slopes or steps may be provided around the perimeter). impede disabled aircraft removal cause visual or electromagnetic interference with air navigation aids. cause any operational impact to the performance of air navigation aids.	ensure the bed, including its surrounding areas, is designed to prevent water from accumulating and allow ice and snow removal. ***Note****: During snow and ice removal aerodrome operators need to be careful not to cause damage to the EMAS bed.* ensure the design avoids water pooling in front of localiser antennae. minimise any effects on ILS radiated signals. ensure compatibility with approach lighting systems and radio altimeter operating areas. promote awareness through information and instructions	Establish an EMAS maintenance programme including preventive and corrective actions, as appropriate. Required by Rule 139.103 and by complying with CATI 139.51. Prepare the maintenance programme before EMAS installation. Maintain records demonstrating that inspections, maintenance activities, and service-level tests have been performed. Ensure maintenance personnel are appropriately trained and competent.

allow movement of rescue and firefighting services (RFS) vehicles during emergencies by providing adequate slopes or steps for access from the front and sides. not impede crew and passenger evacuation. adequate slopes or steps may be provided around the perimeter. be compatible with meteorological and environmental conditions including water, temperature, snow, ice, hail, salt, UV radiation, de-icing and anti-icing chemicals, fuels, hydraulic fluids, lubricants, paint, and herbicides. be designed for repair and restoration to original specifications following an overrun or other physical damage event.	have reflecting surfaces that could cause dazzle. increase wildlife hazards.	provided to runway safety teams and the pilot community. exercise care during snow and ice removal activities to avoid damage to the EMAS bed.	In the maintenance programme, include: • periodic service-level testing to assess system condition and determine repair or replacement requirements before the end of service life. • procedures and contractual arrangements for repair works, including availability of materials. • arrangements for material production and supply. • repair methodologies and quality control to maintain the level required of the system. Define repair periods appropriate to the aerodrome's operational and safety requirements. Refer AC139-5, *Operational safety during works on aerodromes* and AC139-13, *Runway Surface Friction Characteristics and Friction Testing.*