P.2019/73

<u>THE STATES OF DELIBERATION</u>
<u>of the</u>
<u>ISLAND OF GUERNSEY</u>

STATES' TRADING SUPERVISORY BOARD

REVIEW OF A POTENTIAL GUERNSEY AIRPORT RUNWAY EXTENSION

The States are asked to decide: -

Whether, after consideration of the policy letter entitled 'Review of a Potential Guernsey Airport Runway Extension' of the States' Trading Supervisory Board dated 6th August 2019, they are of the opinion:-

1. To approve that no further work is carried out to assess the option to extend the airport useable runway within the current airport boundary by reducing the Runway End Safety Area, at the eastern end of the runway, in accordance with the Director of Civil Aviation's formal advice.

2. To rescind Resolutions 1 and 2 of the States, following a Requete 2019/65 at Article XV, of 26th October 2018 in relation to investigating a potential solution to extend the operational length of the runway and providing the States with estimates for commissioning all the requirements

The above Propositions have been submitted to Her Majesty's Procureur for advice on any legal or constitutional implications in accordance with Rule 4(1) of the Rules of Procedure of the States of Deliberation and their Committees.

THE STATES OF DELIBERATION
of the
ISLAND OF GUERNSEY

STATES' TRADING SUPERVISORY BOARD

REVIEW OF A POTENTIAL GUERNSEY AIRPORT RUNWAY EXTENSION

The Presiding Officer
States of Guernsey
Royal Court House
St Peter Port

6th August, 2019

Dear Sir

1 Executive Summary

1.1 In accordance with its mandate, the States' Trading Supervisory Board (STSB) has been directed by the States to report back on the outcomes, following an investigation into the potential to extend the runway within existing airport boundaries. Specifically, the STSB was directed by the States Assembly to investigate the feasibility of re-designating a section of paved runway surface, currently classified as part of the Runway End Safety Area (RESA), to instead form part of the 'declared distance' of usable runway for both aircraft take-offs and landings.

1.2 This direction followed a Requête and the subsequent Resolutions agreed by the States, on the 26th October 2018. The STSB has duly commissioned a review to investigate the feasibility of this option and carried out a risk assessment. Having completed the review, the STSB has also consulted with the Director of Civil Aviation (DCA), as also directed.

1.3 The DCA is the regulator for the Guernsey Airport Aerodrome. As such, he has considered the proposal and the subsequent review and has written to the General Manager, Ports, with his conclusions as the regulator in this matter (see Appendix 1). He confirms in that letter that he could not support the current proposals and that he:

> "… should not be sanctioning any erosion in available safety margins for purely commercial reasons…"

1.4 The States are being asked to decide whether, after consideration of this policy letter they are of the opinion that: firstly, no further work is carried out to assess the option to extend the airport useable runway within the current airport boundary by reducing the Runway End Safety Area, at the eastern end of the runway, in accordance with the Director of Civil Aviation's formal advice; and, secondly, to rescind Resolution 2 of the States on Article XV of Billet d'État No. XXIII of 26th October 2018[1].

2 Introduction

2.1 This Policy Letter fulfils the Resolutions of a Requête[2] approved by the States Assembly in October 2018. The Resolutions directed the STSB to investigate a potential solution to extending the operational length of the Guernsey Airport Runway and to report back to the States Assembly on the feasibility of doing so.

2.2 The Resolutions required an investigation into whether it would be feasible to re-designate a section of paved surface, currently classified as part of the Runway End Safety Area (RESA), to instead form part of the 'declared distance' of useable runway for both take-off and landing. The end result of this re-designation would effectively extend the runway declared distance by approximately 108m, through a reduction in the length of the RESA from its current length of 198m to 90m at the eastern end.

2.3 The rationale identified within the Requête, was to test whether there would be political appetite to pursue this option, utilising existing airport infrastructure, for:

"..*maximum operational benefit in the pursuit of lower air fares and improving air links*.."

The declared landing distance available (LDA) for Guernsey Airport's runway is currently 1,463 metres. This does present some operational limitations on the operation of larger aircraft. For example, an Airbus A320 typically operated by airlines such as EasyJet and British Airways would require a runway length closer to 1,570m in order to operate with commercially viable payloads. As such, the operators of this aircraft type could not operate into Guernsey Airport without incurring payload restrictions.

2.4 Specifically, the resolutions of the Requête directed that the STSB firstly consult with the DCA to determine if:

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[1] Resolution 2 required that, if there is evidence to suggest that is possible, that STSB return to the States with the details needed to commission the runway extension.

[2] Requete, 2019/65, 27th June 2018 and Resolutions on Article XV of Billet d'État No. XXIII, 26th October 2018

(a) A 90 metres “undershoot” RESA is acceptable for landing on runway 27

(b) A 90 metres “overrun” RESA is acceptable on runway 09

AND

(c) To identify any safety enhancements, including Engineered Material Arresting Systems (EMAS), which would be required to enable the commissioning of 107 metres of the starter strip/paved RESA or to mitigate the reduction in the length of the RESA from 197 metres to 90 metres.

Secondly, following that consultation, if the evidence suggested that the commissioning of the 107 metres was feasible, the resolutions directed the STSB to return to the States giving indicative costs estimates for commissioning all the requirements.

2.5 Resolution 1(c) included the identification of safety enhancements, including the use of EMAS, to investigate whether this would enable the reduction of the RESA and thereby the extension of the declared distance of useable runway. This is further examined in sections 4 and 5.

2.6 Arresting systems such as EMAS have been used fairly extensively in the US and occasionally in Europe, to improve RESA safety, often **as a mitigation measure**, particularly where there is limited potential for a sufficient length of land-based RESA to stop aircraft in the event of a runway excursion. An EMAS solution has in some cases, effectively resulted in the reduction in the length of the overall land used to accommodate a traditional RESA design.

3 Current Situation

3.1 Under the International Civil Aviation Organisation (ICAO) Aerodrome Reference Code, Guernsey Airport’s runway is classified as a 3C runway. The recommended length of a RESA for this Category of runway is currently 240m, with an additional ‘Runway Strip’ of 60m. The mandated minimum RESA is 90m.

3.2 Currently the RESA at the Eastern end of the runway (‘09’) is 198m, whilst the Western end of the runway (‘27’) is 240m. The 198m RESA at the Eastern end was increased from 90m as part of the Guernsey Airport Pavements Project and a safety case was produced and approved by the UK Civil Aviation Authority (CAA) as part of the design approvals for this project. The safety case laid out reasoning why the improved RESA could not achieve a full 240m recommended length. Figure 1 below, describes the current aerodrome layout at the eastern end of the runway, which has been the subject of a review in order to fulfil the requirements of the first elements of the Requête.

3.3 From a regulatory perspective, an Aviation Permit is issued to the Aerodrome Accountable Manager by the DCA. The DCA uses the CAA to provide specialist advice on matters of aerodrome standards and licensing, with that regulator undertaking audits, on behalf of the DCA, in accordance with current aviation regulatory standards.

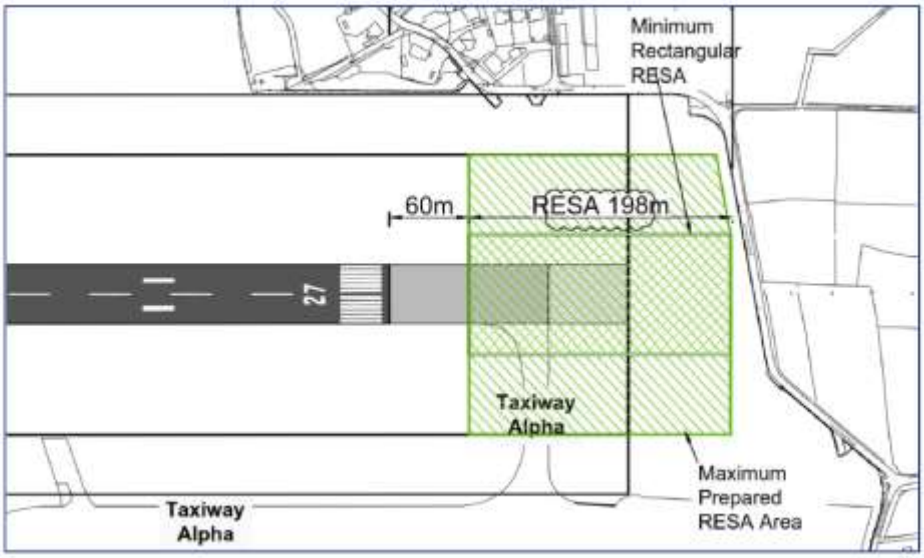

Figure 1 Eastern End of the Guernsey Airport Runway '27'.

4 External RESA Risk Assessment Report

4.1 In February 2019, Guernsey Airport instructed Jacobs UK Ltd to undertake an assessment to understand the risks associated with reducing the length of the eastern RESA. The report is attached as Appendix 1, RESA Risk Assessment Report, May 2019.

4.2 The main purpose of the risk assessment report ("the Report") was to consider and evaluate the potential risks of several options to increase the declared distance of the runway, by (a) reducing the length of the RESA to the minimum mandated length of 90m, or (b) through the introduction of EMAS technology to reduce the physical area of land of RESA whilst achieving an improvement on the 90m reduced RESA length. This assessment included consideration of the likelihood and severity of a runway undershoot or overrun event that would result from the proposed changes. At the same time, the Report evaluated the risks of the current RESA length at the Eastern end of 198m.

4.3 Jacobs reviewed the historical records of the type and frequency of aircraft movements and the overrun incidents at Guernsey Airport to establish the baseline level of risk of recurrence periods for overruns against a benchmark for a hypothetical UK average airport. Slight adjustments were applied to account for slightly higher risks for local weather circumstances, due to the frequency of crosswinds, wind shear and fog in Guernsey. The assessment also included an estimate of the impact of the operation of larger aircraft[3] on the extended runway with a reduced RESA. The assessment was applied to the following options:

- **Option 1** proposed reducing the RESA to 90m, which Jacobs determined would increase the runway declared distance by 108m, thereby increasing the overall length of the runway to 1,571m. This option was the least preferred option, due to the probability of an uncontained overrun being greater than that on the existing 198m RESA and therefore not acceptable in terms of safety guidelines.

- **Option 2** proposed using an EMAS installation, creating a 120m length EMAS bed RESA, such technology stated as being an equivalent to a 240m traditional RESA. This option is potentially the best solution and offers the best risk assessment in safety terms. However, with the retention of the required 60 m strip end, this only provides an additional length of declared distance of 78m. This provides a total useable runway length of only 1,541m rather than the desired 1,570m extension. As such, this marginal increase in runway length was unlikely to satisfy the rationale for the extension.

- **Option 3** proposed a hybrid option *should* the States of Guernsey be willing to relax its position on industry advice. This would mean relying on the ICAO Annex 14 requirements for Aerodromes (which do not currently specifically reference EMAS). As Guernsey Airport is audited against European Union Aviation Safety Agency (EASA) standards, then this option may be more feasible as opposed to the continued adoption of the UK CAA's CAP 168 standard. This would potentially make it possible to consider the scope of a less than full length EMAS. This option was assessed on the basis of a 90m EMAS bed RESA, with declared distances increasing by 108m (as per Option 1 providing a 1,571m useable runway length). The risk profile for this option was only marginally better than Option 1.

4.4 The risk assessment conclusions show that only Option 2 is assessed as 'green' as an overall acceptable risk in comparison with the benchmark position, while Options 1 and 3 are assessed as 'amber' for an uncontained overrun risk. Effectively an 'amber' risk is less safe than the status quo.

[3] including but not limited to the Airbus A220, A320ceo, A320 neo series and Boeing 737

4.5 With regard to the current provision of a 198m RESA at the eastern end, the Report suggested that the only additional mitigation open to further improve safety would be to consider an EMAS installation in addition. Whilst the eastern end is not currently the full recommended length of 240m, it concluded that the 198m RESA was an acceptable provision. This is further supported by the evidence for compliance that was provided at the time of the runway design approvals from the CAA in 2011.

5 External Regulatory and Policy Context

5.1 The Guernsey Airport Aerodrome is regulated by the DCA who has been appointed for both the Bailiwicks of Guernsey and Jersey. The DCA utilises the CAA to carry out audits of the airport, against EASA aerodrome requirements. The CAA and EASA regulations in turn adopt ICAO international standards and operating guidelines for Aerodromes.

5.2 ICAO and EASA regulations allow a reduction in the recommended RESA length where an arresting system is installed. The view taken by the UK CAA regarding the provision of EMAS in RESAs is described in CAP 168[4] which states that:

"..*Engineering Material Arresting Systems (EMAS) may be installed at UK licensed aerodromes as an alternative where a 240m RESA cannot be achieved*.."

The CAA stated Policy on EMAS is:

"…to permit the installation of EMAS at UK licensed aerodromes as an alternative where a 240m RESA cannot be achieved.."

5.3 EMAS technology is intended as a mitigation measure to improve safety. Whilst the US Federal Aviation Authority (FAA) has used EMAS to increase declared runway distances in the US, the CAA regulations identify that EMAS should only be used to provide an equivalent level of safety for those runways not having a full RESA, in other words as a ***mitigating method*** in lieu of a non-standard RESA.

5.4 The DCA is ultimately responsible for aviation safety matters and has written to the General Manager Ports with his conclusions following the Jacobs Review (see Appendix 2). Having consulted with industry experts, the DCA (in his role as regulator) has concluded that there is no case to allow this project and that he:

[4] CAP 168, page 99, section 3.75 ' Arresting Systems'

"…should not be sanctioning any erosion in available safety margins for purely commercial reasons.."

6 Consultation

6.1 The DCA has been consulted on the initial and subsequent drafting of the Jacobs report. The DCA has also consulted with industry regulators and provided his views initially in May 2019. These were subsequently provided in a formal letter of response to the General Manager Ports, States of Guernsey, which is provided in Appendix 2, 8th July 2019.

6.2 On the 13th March 2019, a Hazard Identification Workshop was held with key stakeholders including airlines, private aircraft owners, business jet operators and airport users in Guernsey. The Workshop was arranged by Jacobs as part of its initial data gathering exercise.

7 Conclusions

7.1 Jacobs was commissioned to undertake a RESA Risk Assessment Review and report on several potential options that would see an increase in the declared landing distance of the airport runway. Each solution involved a reduction in the length of the Runway End Safety Area. It concluded that option 2, to utilise an EMAS bed RESA of 120m (instead of a 240m traditional RESA) was the best solution. This was rated as a 'green' risk in terms of an uncontained overrun incident risk. However, this option only provided a useable runway length of 1,541m which would not allow the economic benefits dependent on larger aircraft and payloads landing at Guernsey Airport. The economic benefits would be further weakened when taking into account the cost of installing and maintaining EMAS.

7.2 The General Manager, Ports (as the Accountable Manager for Guernsey Airport) endorses the view of the DCA. The DCA did not support the findings of the report, as he did not believe he should sanction any erosion in available safety margins for purely commercial reasons. He states in his letter dated 8th July 2019 that:

"… as I am responsible for air safety, unless the ICAO Recommended requirements are met or unless there is very good reason, supported by a compelling safety argument, that they cannot be met; I don't think there is any case to allow this project…"

7.3 Given the above, it is proposed that Resolution 2 of the Requête, that STSB return to the States with the details needed to commission the runway extension, is rescinded.

8 Compliance with Rule 4

8.1 In accordance with Rule 4(1), the Propositions have been submitted to Her Majesty's Procureur for advice on any legal or constitutional implications. She has advised that there is no reason in law why the Propositions should not be put into effect.

8.2 In accordance with Rule 4(4) of the Rules of Procedure of the States of Deliberation and their Committees, it is confirmed that the propositions above have the unanimous support of the STSB.

8.3 In accordance with Rule 4 (5), the Propositions relate to the duties of the STSB to ensure the efficient management, operation and maintenance of any States' unincorporated trading concerns and commercial interests which the States have resolved to include in the mandate of the Board, which includes Guernsey Airport.

8.4 The preparation and agreement of the propositions and content of the Policy Letter has involved consultation with the Director of Civil Aviation.

Yours faithfully

P T R Ferbrache
President, STSB

J C S F Smithies
Vice-President, STSB

J Kuttelwascher
Member, STSB

S J Falla, MBE
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General Manager Ports
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8th July 2019

Dear Colin

REVIEW OF POTENTIAL GUERNSEY AIRPORT RUNWAY EXTENSION
Further to my earlier letter of the 19th May 2019, I am writing to formally advise you, as the Director of Civil Aviation and as such, responsible for air safety matters in the Bailiwick of Guernsey. Thank you very much for your efforts so far in undertaking a review of the potential to extend the declared distance of useable runway at Guernsey Airport Runway, by reducing the designated safety area (i.e. the Runway End Safety Area (RESA) at the eastern end.
I have carefully reviewed the RESA Risk Assessment Report from Jacobs and taken expert advice on the proposal from the Air Safety Support International (ASSI) UK Safety Adviser for the Overseas Territories. My response to the proposal is below:

- The Development proposal does not offer any safety gain whatsoever. It concentrates purely on commercial objectives to operate with higher payloads/larger aircraft within the existing airport boundaries.

- As the regulator, I should not be sanctioning any erosion in available safety margins for purely commercial reasons.

- The project is counter to the Department for Transport's policy for the UK (all elements including the Crown Dependencies) which must comply with the International Civil Aviation Organisations (ICAOs) Standard and Recommended Practices (SARPS) and Appendix 14, with regard to the maintenance of a RESA. It is also counter to the European Aviation Safety Agency EASA's Guidance Material for Aerodromes Design[1].

[1] CS-ADR-DSN, Issue 4, 8th December 2017

- The Guernsey Airport Runway has a Code 3 designation and therefore should be meeting a 240m RESA (Recommended Practice), a 90m RESA is a ***minimum*** requirement.

- The Civil Aviation Authority's (CAA's) Policy on Engineered Materials Arresting Systems (EMAS) is to permit the installation of EMAS at UK licensed aerodromes as an alternative where a 240m RESA ***cannot be achieved***. Guidance is also provided on this matter in the CAA's Licensing of Aerodromes CAP 168, Chapter 3 'Arresting Systems'.

- The proposed mitigation of EMAS is not used in the spirit for which it was intended. The Federal Aviation Administration have pioneered the guidance on EMAS, and it clearly states that the main purpose of EMAS is to mitigate against overruns only when it is not practicable to achieve the full standard RESA. It then gives the following reasons where it is not practicable, none of which are valid reasons for the use of EMAS here in Guernsey:

    - Lack of available land;
    - Obstacles such as bodies of water, highways, railroads, and populated areas;
    - Severe drop-off terrain.

As I am responsible for air safety, unless the ICAO recommended requirements are met or unless there is a very good reason, supported by a compelling safety argument, that they cannot be met; I don't think there is any case to allow this project.

Yours Faithfully,

D.C. Lazarus

Dominic Lazarus
Director of Civil Aviation

Guernsey Airport RESA Risk Assessment

States of Guernsey

RESA Risk Assessment Report

B2357100-001 | 1.2

May 2019

Source: Google Earth Pro

Guernsey Airport RESA Risk Assessment

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1.1	May 2019	Final Issue	RV	BV	AP
1.2	May 2019	Final Issue	RV	BV	AP

Contents

Glossary

Abbreviation	Definition
AIP	Aeronautical Information Publication
ASDA	Accelerate and Stop Distance Available
CAA	Civil Aviation Authority
EASA	European Aviation Safety Agency
EMAS	Engineered Material Arresting System
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
LDA	Landing Distance Available
LDR	Landing Distance Required
MTOW	Maximum Take-off Weight
NATS	National Air Traffic Services
RESA	Runway End Safety Area
ROAD	Runway Overrun Accident Database
RVR	Runway Visual Range
TORR	Take-Off Run Required
TORA	Take-Off Run Available

1. Introduction

Jacobs was instructed by Guernsey Airport in February 2019 to undertake an assessment to understand the risk associated with the eastern Runway End Safety Area (RESA) provision at Guernsey Airport, in the context of possible changes in runway declared distances. The study evaluates the risks associated with a reduction in the current eastern RESA back to the minimum mandated requirement, and the subsequent likelihood and severity of a runway undershoot or overrun event, noting that the proposed changes will result in:

- A 90 metres ‘undershoot’ RESA for landings on Runway 27
- A 90 metres ‘overrun’ RESA on Runway 09

The scope of the risk assessment includes consideration of the impact of the introduction of larger aircraft including, but not limited to, the Airbus A220, A320ceo, A320neo series and Boeing 737 series aircraft particularly in relation to the proposed changes to the eastern RESA as described above.

Furthermore, the work is to review and recommend any further safety improvements, including Engineered Material Arresting Systems (EMAS), which should be considered to mitigate the proposed reduction in the eastern end RESA and introduction of larger aircraft operations at Guernsey Airport.

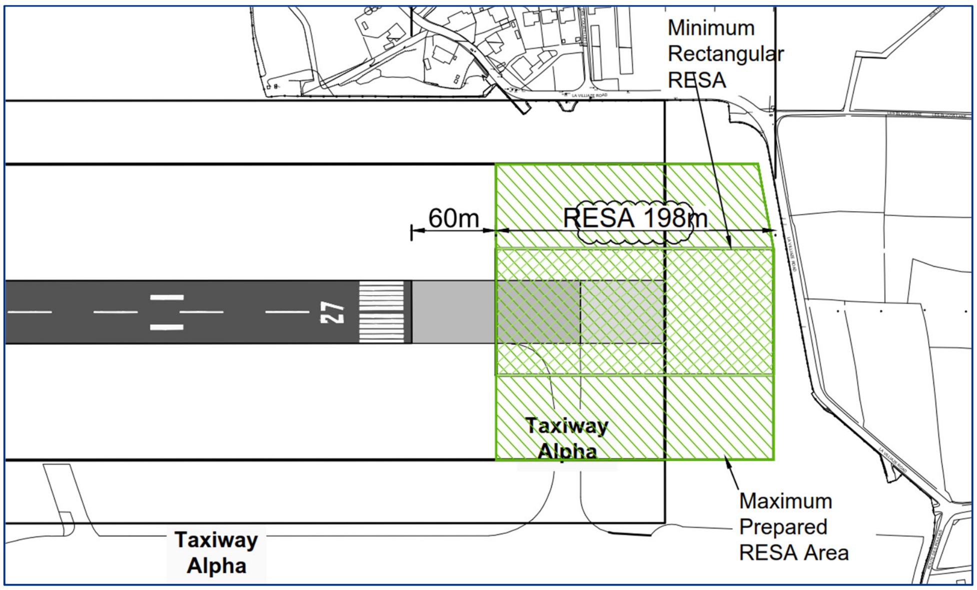
After this introduction, Section 2 of this report summarises the data collected for the risk assessment, which includes the notes from a workshop attended by airport staff and stakeholders in March 2019. Section 3 describes the overrun risk assessment whilst Section 4 deals with the risk assessment for undershoots. The conclusions of the report are brought together in Section 5.

The data sources used for the quantitative statistical analysis variously utilise the words crash, incident and accident with little or no consistency of application. In this report, these are all taken as referencing an event that would have been captured by the relevant source database as an overrun or undershoot, without intending to highlight the difference in severity that they respectively represent.

2. Data Collection

2.1 Aerodrome Layout

This risk assessment study considers the eastern RESA provision of Guernsey Airport shown below in Figure 2.1. The full aerodrome layout is shown in Figure 2.2.



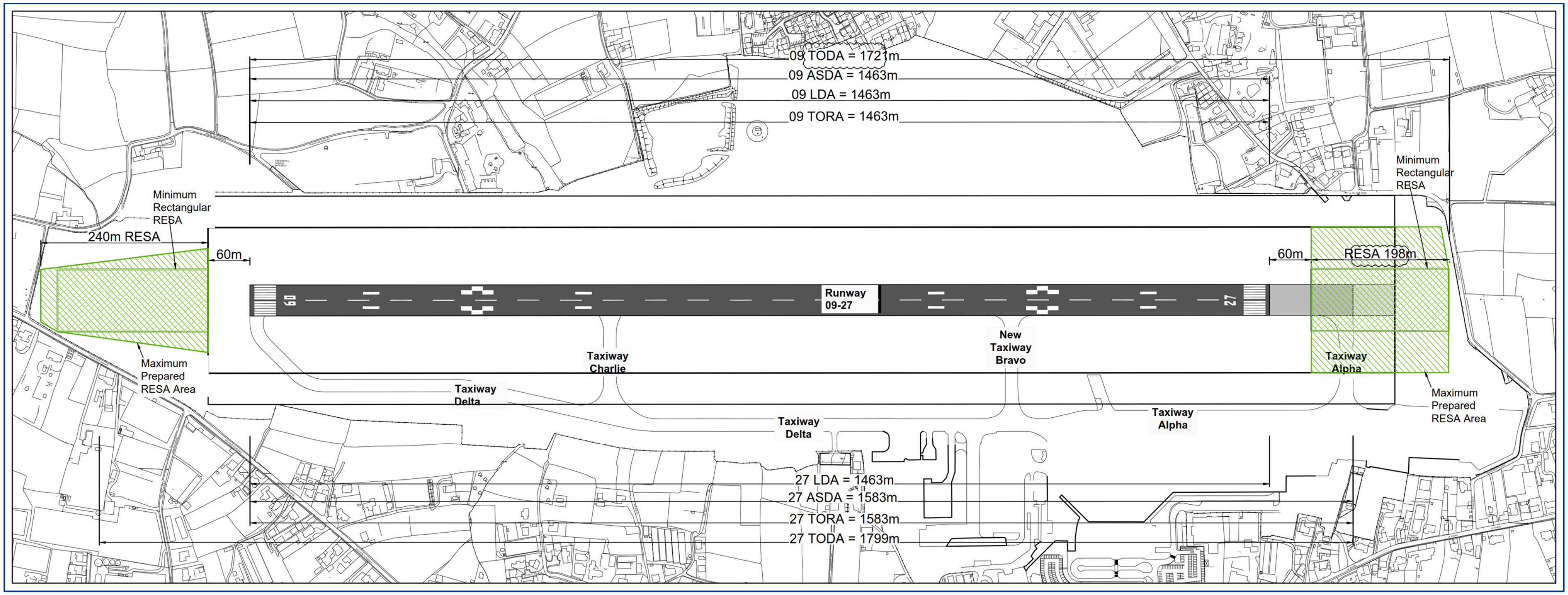
Drawing provided by Guernsey Airport

Figure 2.1: Existing Eastern RESA Area

The existing declared distances as provided in the UK AIP are shown in Table 2-1.

Table 2-1: Extract from UK AIP showing Existing Declared Distances

EGJB AD 2.13 DECLARED DISTANCES					
Runway Designator	TORA	TODA	ASDA	LDA	Remarks
1	2	3	4	5	6
09	1,463 m	1,721 m	1,463 m	1,463 m	
27	1,583 m	1,799 m	1,583 m	1,463 m	
09	955 m	1,213 m	955 m		Take-off from Taxiway C intersection
27	1,102 m	1,318 m	1,102 m		Take-off from Taxiway B intersection



Drawing provided by Guernsey Airport

Figure 2.2: Guernsey Airport Aerodrome Layout

Guernsey Airport wish to consider a reduction in the eastern RESA back to the minimum required length provision of 90m as this would allow an increase in the declared distances to the eastern edge of the end of the full-strength paved runway. This would be applied to those declared distances which are currently at 1463m: namely Runway 09 TORA, ASDA and LDA and Runway 27 LDA. Close inspection of the available layout data, checked by use of measurements in Google Earth Pro, confirms that the existing RESA ends at the ILS aerial foundations, and being 198m long, the change in declared distances to leave the mandatory minimum RESA length of 90m would be limited to an increase of 108m.

The topography of the runway is shown in Figure 2.3 as an extract from the Type A chart. The slight up gradient for take-off and landing on Runway 09 towards the eastern RESA is marginally beneficial in assisting in deceleration of a landing or an aborted take-off. The overall runway gradient is 1:153 or 0.65%. The disbenefit of the gradient on take-off performance would have to be taken into account in the take-off performance calculation by airlines and hence is not of concern to the risk of overrun. The longitudinally flat portion at the eastern end of the runway means that no allowance needs to be made for the effect of longitudinal gradient on the deceleration of an overrun into the RESA.

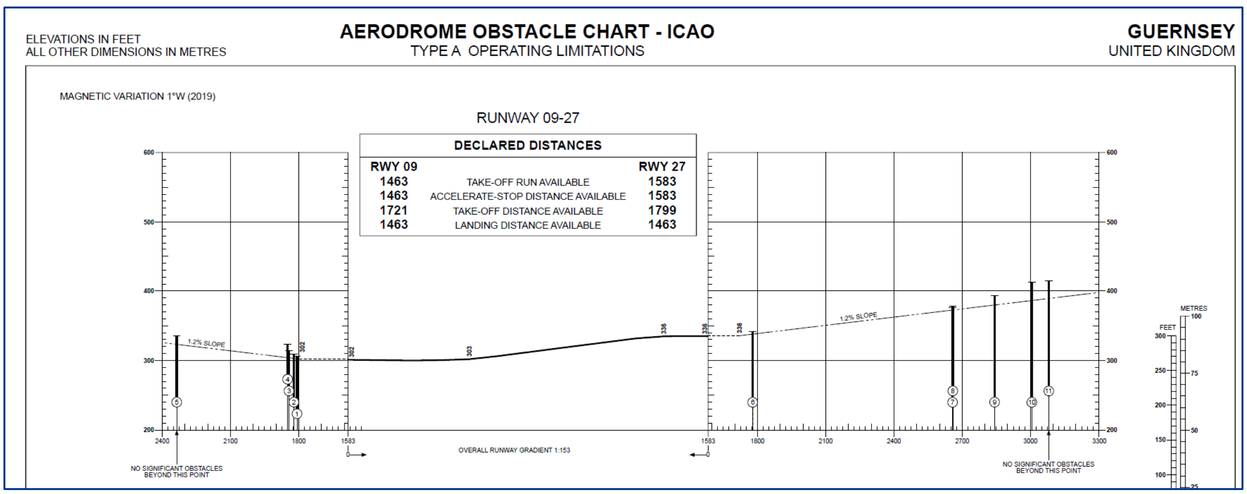
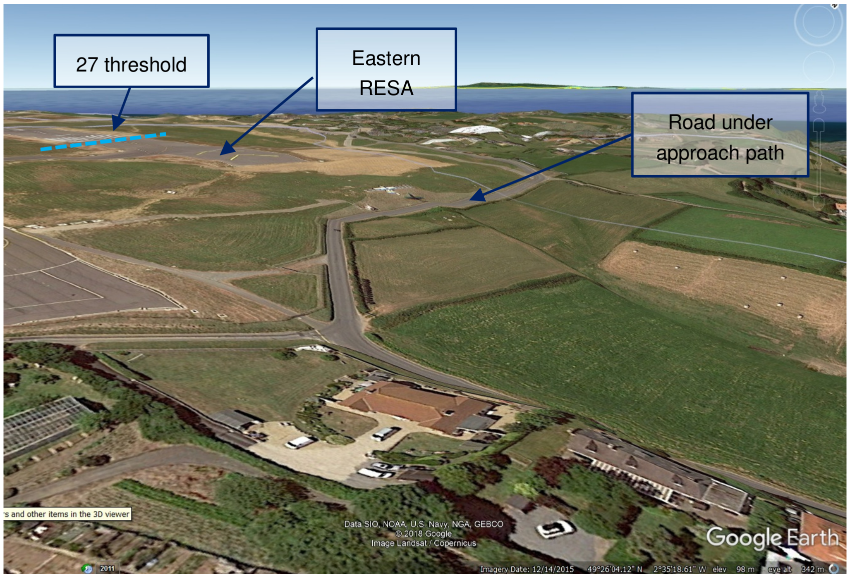


Figure 2.3: Extract from Type A Chart for Guernsey Airport

The topography to the east of the airport has been reviewed both by reference to ground level information available in Google Earth Pro and by visual inspection during a site visit by Jacobs on 12th and 13th March 2019. There is an earthworks slope after the aerodrome boundary down to a public road which is some 4m below the level of the eastern RESA. To the east, the ground level then continues down into a valley, the centreline of which is roughly on the extended runway centreline. A 3D view of the area with vertical scale exaggerated by a factor of 3 is shown in Figure 2.4.



Vertical scale exaggerated by factor 3
Source: Google Earth Pro

Figure 2.4: 3D View of Ground Beyond the East End of the Runway

2.2 Special Features at Guernsey Airport

Guernsey Airport provided a written summary of any special features of aircraft operations at the airport that might impact the risk assessment. The written response is attached as Appendix A.

The key feature is that given the exposed nature of the island, the exposed location of the airport and the geographical position, there is a high propensity to low RVR conditions and windier conditions but relatively little impact of snow and ice. It is also noted that the runway is wider than the requirement for the current traffic and that there is a good standard of implementation of nav aids, landing aids and aerodrome lighting. Friction levels on the grooved runway surface are good.

2.3 Air Traffic Movements

Detailed records of air traffic movements have been provided for the years of 2017 and 2018. As there has been a trend of declining volume of air traffic at Guernsey over the last five years (as reported through the CAA website) the risk assessment uses the most current data of 2018. The consideration of the impact of larger aircraft is assessed as an additional 5 daily rotations, which is 10 movements per day or 3,650 per year. The analysis of the air traffic movements is discussed further in Section 3.4.2.

2.4 Overrun History

The overrun history for the runway at Guernsey is of interest as it can support or challenge the results of the quantitative assessment of overrun risk.

Information on runway overruns has been provided for the period since 1999 by Guernsey Airport and has been extended by Jacobs review of published AAIB reports since 1960 and the Aviation Safety Network database. The asphalt surfaced runway 09/27 is understood to have been commissioned in 1960 and prior to that date the airport operated off grass runways. Therefore, any overrun incidents prior to 1960 have not been included.

From the available data there have been just three overrun incidents recorded in the 59-year period from 1960 to 2019. These are:

1. 7th Dec 1997. An F27 landed on Rwy 27 in strong crosswinds. Due to the need for differential braking the aircraft deceleration was impaired and the aircraft overshot the runway end. Directional stability had not been maintained and the aircraft veered off to the left, that is to the south, shortly before the end of the runway. The crash location at the end of the incident was within a 90m minimum RESA length but is treated as an uncontained overrun since it is located outside the width of the RESA at approximately 95m from runway centreline.

2. 8th March 2006. An HS748 landing on Rwy 27 overran by 145m. This location is contained within a 90m RESA plus 60m runway strip end.

3. 17th May 2006. Dornier 328 Jet landing on Rwy 09 overran by 25m. This location is contained within the runway strip end and hence within a zero RESA provision.

These historical records are assessed as follows. Within the 59-year period since the runway was commissioned there have been only two overruns which went beyond the runway strip end into a RESA area. They were both on runway 27, there having been none into the RESA on runway 09. It is also noted that all three incidents were landing overruns, there having been no overruns from aborted take-offs. This suggests a recurrence period of 1 every 30 years for an overrun past the runway strip end. Of these overrun incidents, only one was uncontained within the RESA width, suggesting a 1 in 60-year recurrence period.

These recurrence periods are of the same order of magnitude as calculated by Jacobs as benchmarks for a hypothetical UK average airport. That benchmark calculation suggested 1 in 13 years for an overrun beyond a runway strip end, and 1 in 71 years for an overrun that is not contained by a full 90m length RESA. This supports the view that the overrun history at Guernsey does not suggest that the airport is significantly more or less likely to experience overruns than at the benchmark average airport. It is concluded that the overrun history does not, in itself, suggest a need to increase nor to decrease overall overrun crash rates used in the quantitative modelling.

However, input from pilots at the workshop session held on 13th March 2019 included their view that, although not “High Risk”, the frequency of crosswinds, wind shear and fog made operations at Guernsey a slightly higher risk than at airports that do not suffer similar weather.

2.5 Hazard Identification Workshop 13th March 2019

A Hazard Identification workshop was held at Guernsey Airport on 13th March 2019. It was well attended by a wide group of stakeholders. In addition to general discussion about the methodology being used for the risk assessment, and agreement that an uncontained overrun to the east would be considered “Catastrophic” in aviation terms as likely to be involving hull loss and multiple loss of life, a discussion of issues that may contribute towards an overrun situation was held in a structured way by using the Flight Safety Foundations check list. Comments that arose during that discussion, together with an attendance list of the stakeholders is attached as Appendix B.

A key point arising from the discussion was that, although not “High Risk”, the frequency of crosswinds, wind shear and fog informed a consensus view that operations at Guernsey should be considered to be at a slightly higher risk than at airports that do not suffer similar weather. The overrun history does not in itself support the view that the overrun risk is higher at Guernsey, and there are several positive safety indicators in the provision of a wider runway than required, with a grooved surface with good friction and CAT I precision approach infrastructure with a good standard of AGL provision, including enhanced runway centreline lighting (lights spaced at 15 metres instead of the standard 30 metres) and alternating light colour change as the runway end is approached. However, in response to the views held at the workshop the landing overrun risk assessment described in this report has used risk factors increased by a nominal 1.10 factor.

2.6 Previous RESA Reports at Guernsey Airport

Two documents have been provided related to consideration of the RESA provision as part of the runway reconfiguration and overlay project completed in 2014. One report is from Mott MacDonald and considered a range of RESA options for the development. The other document is the CAP791 submission for the 2014 runway development demonstrating compliance with the regulatory requirements.

The Mott MacDonald report of January 2011 considered a range of options and reviewed each for regulatory compliance. Although risk statistics were discussed at a high level the report does state that statistical analysis of the risks involved was not part of the scope of the report. The report may have assisted in defining the preferred option that was subsequently commissioned in 2014, but does not provide a quantitative statement on the risk of uncontained overruns.

The CAP791 compliance matrix does discuss RESA risk issues for the runway layout as now commissioned. In particular it provides the following statements.

> *A RESA Risk Assessment would be conducted in the event of any operational changes. For clarity the following are key factors for current operational conditions:*
>
> *Prior to these works being carried out the existing RESA available is 83m for aircraft approaching rwy27 and 78m for 09 end.*
>
> *Current and expected aircraft types do not require more than 1200m of runway for takeoff or landing.*
>
> *New runway pavement length is 1583m.*
>
> *Only 1463m of that is to be declared as LDA for both 27 and 09.*
>
> *Aircraft approaching 27 or departing 09 will be provided with 197m of RESA of which 60m x 45m is runway quality surfacing and 60m x 45m is hard paved blast pad of equivalent standard. Additionally the 60m runway strip has runway quality surfacing of width 45m.*
>
> *Aircraft departing 27 do not require utilising this RESA at this end and therefore the runway quality surface is available as a full width starter extension.*
>
> *RESA at west end is 240m*
>
> *09 is the less dominant used runway*
>
> *The gradient of the runway is uphill from 09 to 27. The effects of this raise will assist in braking aircraft.*
>
> *The runway surface and blast pad will be grooved Marshall Asphalt across the entire length, including the starter extension area to ensure the friction levels remain consistent over the whole surface.*
>
> *The aerodrome will keep the ILS system currently CAT 1 compliant.*
>
> *An annual review of the air traffic movements will be conducted to determine if any significant changes to aircraft types have occurred since the previous review to ensure the 197m is still acceptable.*
>
> *In January 2011, an independent review of the CURRENT design chosen, and an EMAS (FAA compliant specification 2. 180m RESA with EMAS) provided RESA shows that EMAS would be in the region of £6m more, and only provide 120m of undershoot RESA albeit with EMAS in place.*

In evaluating the nature of how RESA risk was considered at that time, it would appear that the eastern RESA was accepted as tolerable at 198m due to the above qualitative considerations. In contrast, the subject of this report by Jacobs is to provide a quantitative assessment of the risk of uncontained overruns.

2.7 Eastern RESA Options for Quantitative Risk Assessment

As a base case, the probability of an uncontained overrun beyond the limits of the current eastern RESA provision has been analysed. A further three options, labelled as Options 1, 2 and 3 have then been similarly analysed. All are shown as a comparison against benchmarks for a hypothetical average UK airport produced using the same analysis methodology. As an EASA certified airport, Guernsey Airport is certified in accordance with the requirements and procedures set out in EU 139/2014. The certification basis as an acceptable means of compliance (AMC) is compliance with the Certification Specification as issued by EASA. For aerodrome design that is CS-ADR-DSN Issue 4.0. The States of Guernsey DCA utilise the UK CAA to carry out audits of the airport. Although these audits are made against the EASA requirements, the view taken by the UK CAA regarding the provision of EMAS in RESA's is indicated in UK CAP 168. Accordingly, all three documents, ICAO Annex 14, EASA CS-ADR-DSN and UK CAP 168 have been referred to in the discussion of the three options below.

2.7.1 Option 1

Option 1 is the provision of a minimum 90m length eastern RESA, retaining the same 210m width of RESA quality land as currently provided. Since this arrangement allows a 108m increase in declared distances, this arrangement is also analysed with a future traffic scenario of an additional 5 rotations per day, being 5 landings and 5 departures of larger aircraft such as the Airbus A220, A320ceo, A320neo series and Boeing 737 series aircraft. A comparison with the benchmarks will inform decision making on the acceptability of these scenarios. However, it is clear that the probability of an uncontained overrun will be greater than with the existing longer RESA. Therefore, the likely improvement in containing overruns by the provision of an Engineered Material Arresting System (EMAS) is considered in Options 2 and 3.

2.7.2 Option 2

Both ICAO Annex 14 and EASA Certification Specification CS-ADR-DSN Issue 4.0 allow a reduction in the recommended RESA length where an arresting system is installed based on the design specification of the system. The UK CAA in CAP 168 further indicates their view on this matter by stating that where declared distances are to be increased by the provision of EMAS, then a full length EMAS is required to be equivalent to a full 240m of conventional grass RESA plus 60m strip end, all designed in accordance with the FAA performance specification and guideline material. Option 2 is therefore the provision of a full length EMAS to the FAA guidelines.

The FAA guidelines are given in AC 15/5220-22B where a number of charts for planning purposes are provided. In all cases, the full EMAS bed that is equivalent to a conventional full RESA is contained within a 600 foot minimum length which, to metric dimensions, can be taken as equivalent to 180m. The most appropriate chart for the range of possible future aircraft named in the scope document for this report is that for the B737-400. For this case an EMAS bed of 400 feet length (120m) is the full design requirement to contain an overrun exiting the runway at 70 Knots. That is located after a stand-off length of 200 feet (60m) which will conveniently match a 60m strip end and a 120m RESA with EMAS bed for the central runway width portion. Thus Option 2, requiring a 120m RESA length can only deliver an increase in declared distances of 78m.

Since the 120m of EMAS is considered by the FAA guidelines to be equivalent to a full RESA of 240m length, it is straightforward in the Jacobs methodology to assess the probability of an uncontained overrun for this case.

2.7.3 Option 3

It is recognised that a key driver for this project has been the provision of increased declared distances, and it may be that the 78m increase provided by Option 2 is not enough for commercially viable operations by the named larger aircraft. Notwithstanding the view expressed by the UK CAA in CAP 168 regarding the need for a full length EMAS if declared distances are to be increased, it is recognised that the regulatory position in Guernsey is different to that within the UK, whereby it is understood that the overriding legal requirement is to follow ICAO Annex 14 requirements. The UK CAA is used as a competent authority to advise and, in the course of this advice, carries out audits which nowadays are to EASA standards and not to the UK CAP 168. Therefore, there may be some scope to consider the provision of less than a full length EMAS RESA if the risk assessment results are tolerable and acceptable for Guernsey Airport.

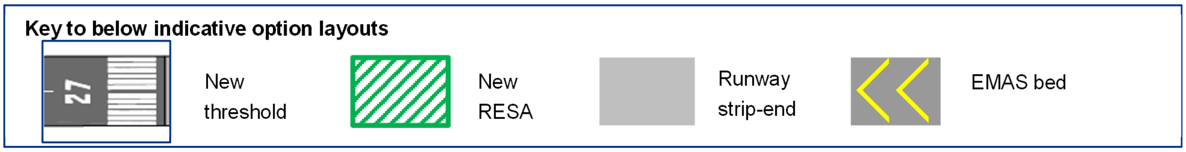
Accordingly, Option 3 is, like for Option 1, the implementation of a 90m RESA with declared distances increasing by 108m, but in this case with an EMAS bed for the 90m length of the RESA, as usual at runway width. The direct equivalence of Option 2 to a 240m RESA length has allowed a calculation of the average deceleration rates as an aircraft passes through the full length of the overrun area. These deceleration rates applied to the 90m EMAS RESA of Option 3, allow a calculation of the equivalent length of grass RESA provided by the 90m EMAS bed. Allowing for the fact that an aircraft must be brought to a halt before its nose moves past the end of the RESA, the calculation shows that the 90m EMAS length is equivalent to 160m of conventional grass RESA.

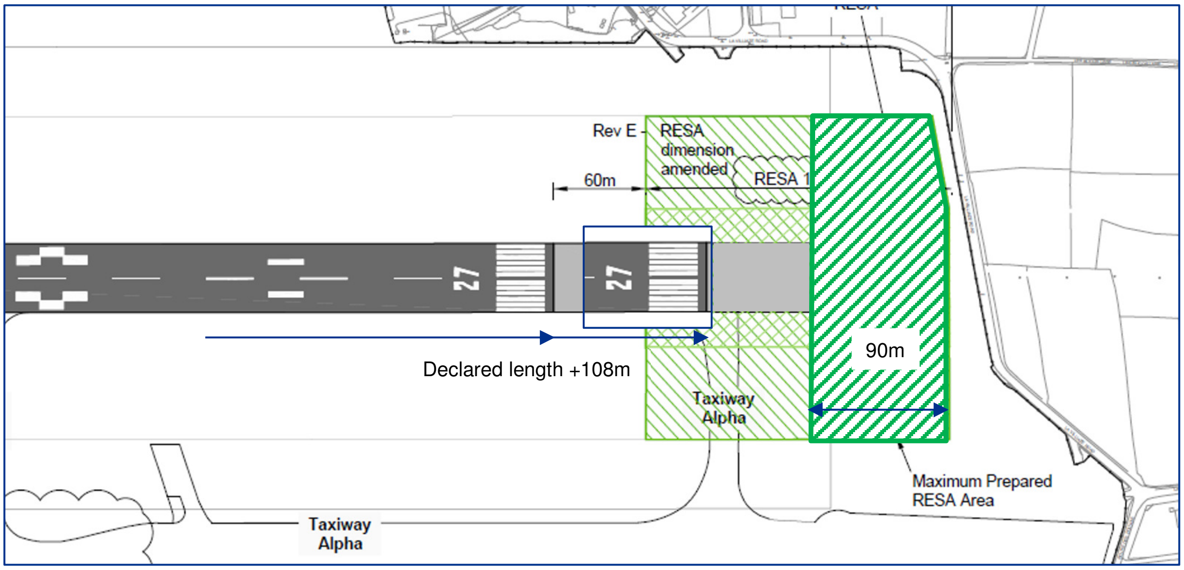
In all EMAS cases it must be noted that it is the FAA planning guidelines that are being used, and that the FAA require that a final design is done by the EMAS manufacturer of the chosen EMAS system for the selected design aircraft. Consequently, there could be some change in the eventual implementation, but the options selected are considered reasonably representative for planning purposes.

To summarise, the options selected for risk assessment analysis are:

- **Base Case** RESA and traffic as existing situation.
- **Option 1** Reduce RESA to 90m. Analysed for 2018 traffic
    - **Option 1+** As for Option 1 but with additional 5 rotations, 10 movements per day of larger aircraft (typical of the A320-family) now able to use the 108m longer declared distances.
- **Option 2** Augment the reduced RESA with a fully compliant length of EMAS. To be compliant, this requires a 120m length of EMAS bed with a stand-off of 60m from the runway end. This means that only 78m of increased declared distance is possible. Analysed for 2018 traffic.
    - **Option 2+** As for Option 2 but with additional flights as in Option 1+
- **Option 3** Augment the reduced 90m RESA with a 90m length of EMAS. This would be non-compliant with the UK CAA approach to installation of EMAS when done in order to increase declared distances, but is provided here to see what the result would be when compatible with a 108m increase in declared distances. Analysed for 2018 traffic.
    - **Option 3+** As for Option 3 but with additional flights as in Option 1+

Sketches of the option layouts are shown overleaf in Figure 2.5, Figure 2.6 and Figure 2.7.





Do not scale from sketch

Figure 2.5: Option 1 - 90m RESA

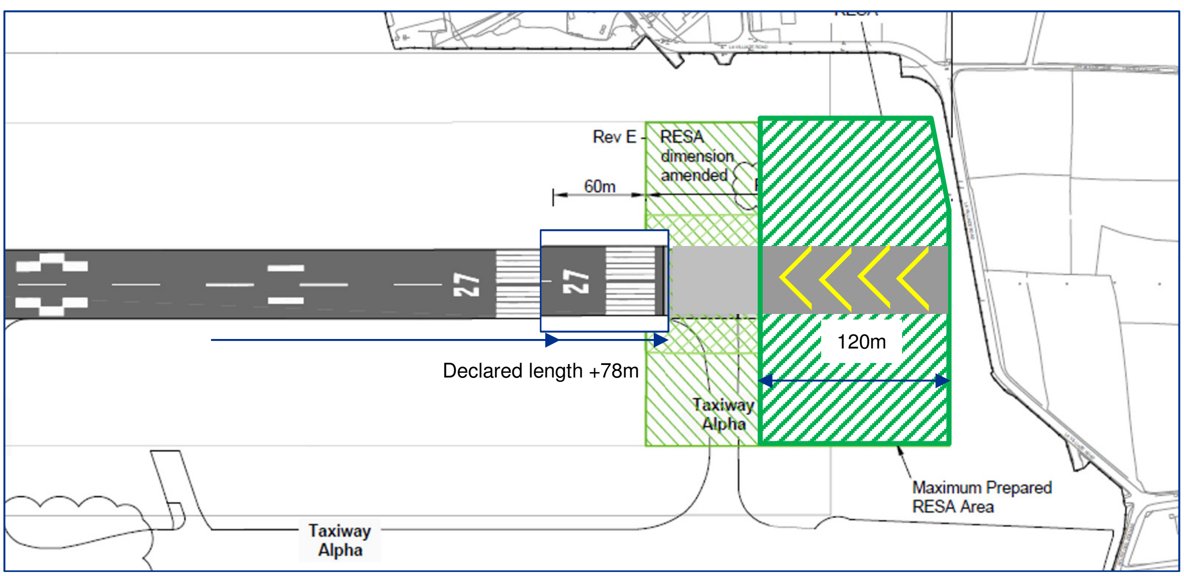


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Figure 2.6: Option 2 - Fully Compliant EMAS bed

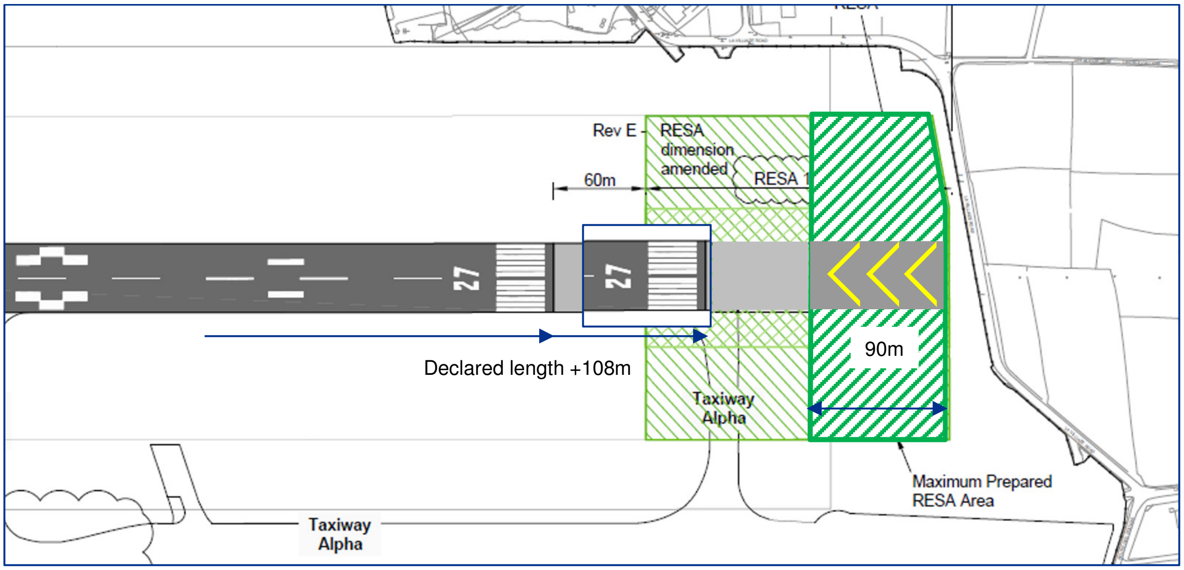

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Figure 2.7: Option 3 - 90m EMAS bed

3. Overrun RESA Risk Assessment

This section of the report examines the risk associated with overrun RESA provision at Guernsey Airport.

3.1 Methodology

In order to determine the probability of an uncontained overrun for various RESA dimensions the following steps have been followed:

- Determine a baseline of accident probabilities (crash rates) based on incidents occurring at similar airports (Section 3.2). A variety of sources including the ROAD[1] database of overrun incidents (held by Loughborough University), and data from the CAA[2] have been used to determine the baseline probabilities and probability density function
- Generate a hypothetical average UK airport against which the risk levels at Guernsey Airport have been compared (Section 3.3)
- Correction of the average crash rates to reflect Guernsey Airport's characteristics (Section 3.4)
- Application of the probability density function around the area covered by the RESA. Different RESA layouts have been analysed against the current and future aircraft mix and aircraft movements (Section 3.5)
- Express the likelihood of an event occurring both as an individual risk and as an incident of 1 in a number of years for a given level of traffic (Section 3.5).

3.2 Accident Probabilities - Baseline

The baseline overrun rates described in this section are used firstly to calculate probabilities for an average UK airport, in Section 3.3, and then for Guernsey Airport in Section 3.4.

3.2.1 Average crash rates in UK (ROAD, CAA and NATS databases)

3.2.1.1 Aircraft above 5700 kg MTOW

According to the CAA (1998) over the 21-year period (1976-1996) the overrun rate to civilian registered fixed wing aircraft over 5700 kg was 1.69 landing overruns per million landings and 0.403 take-off overruns per million take-offs. These are average rates over the whole of the UK.

3.2.1.2 Aircraft below 5700 kg MTOW

In their Public Safety Zone calculations, NATS uses a crash rate for piston engine aircraft of 3.3 crashes per million aircraft movements (NATS, 1997). This compares to a crash rate of 3 per million movements calculated for aircraft below 5700 kg MTOW by Slater (1993). It is noted that these are for all crashes, not just overruns.

Calculations from the Loughborough Overrun Database (Kirkland, 2001) suggest overrun rates for UK jet and turboprop non-air transport flights of 2.5 landing overruns per million landings and 0.7 take-off overruns per million take-offs. These figures total to 1.6 per million movements and are thus supported by being a comparable order of magnitude with the NATS figures but, as expected, is less as being only for overrun crashes, and will therefore be used in this study.

[1] The Runway Overrun Accident Database (ROAD) was developed by Loughborough University, UK © all rights reserved.
[2] Risks from Aeroplanes Overrunning Aerodrome Runways, CAA, October 1998

3.3 Accident Probabilities – Hypothetical Average UK Airport

The number of aircraft movements used to determine the average yearly movements at a UK airport has been computed using data supplied by all relevant UK reporting airports. Average yearly aircraft movements are 46,831 for the year 2017. This data has been used to calculate average UK incident rates per year.

Annual movement figures and incident rates for the hypothetical airport are shown in Table 3-1 and Table 3-2.

It has been assumed that there is one runway (two operational directions) for which the landing, take-off and accelerate stop distances are equal and are used equally by aircraft. It has also been assumed that half of the movements are of aircraft greater than 5700 kg MTOW and half less than 5700 kg. The ratio of runway length to that required by a particular operation is also average and therefore the average UK incident rates given by the CAA in 'Risks from Aeroplanes Overrunning Aerodrome Runways' can be assumed.

Table 3-1: Hypothetical Average UK Airport movements

	2017
Aircraft Movements	46,831

Table 3-2: Hypothetical Average UK Airport Incident Rates

		Accidents per million take-offs or landings	Movements (rounded values)	Incidents per year
Overrun area 1	Takeoff overrun > 5700 kg	0.403	5854	0.002
	Takeoff overrun < 5700 kg	0.700	5854	0.004
	Landing overrun > 5700 kg	1.691	5854	0.010
	Landing overrun < 5700 kg	2.500	5854	0.015
		Sub-total	**23,416**	**0.031**
Overrun area 2	Takeoff overrun > 5700 kg	0.403	5854	0.002
	Takeoff overrun < 5700 kg	0.700	5854	0.004
	Landing overrun > 5700 kg	1.691	5854	0.010
	Landing overrun < 5700 kg	2.500	5854	0.015
		Sub-total	**23,416**	**0.031**
		TOTAL	**46,831**	**0.062**

Table 3-3: Occurrence Period for Average UK Airport

	Occurrence Period in Years
90 x 90 RESA	71
150 x 240 RESA	210

By applying this incident rate to the probability density function modelled from the ROAD data and considering the current traffic, the probability of an incident occurring outside of a 90m x 90m RESA is 0.014 per year or one incident in 71 years. The probability of an incident occurring outside of a 240m x 150m RESA is 0.005 per year or one incident in 210 years. A pictorial representation of these benchmarks is shown in the graphic in Figure 3.1 together with a RAG traffic light colour range.

Figure 3.1 also shows Jacobs' proposed use of a benchmark risk to an individual movement of 10^{-7}. This is based on the same value as used in the ICAO CRM (Collision Risk Model). Given the order of magnitude nature of reporting risk probabilities and the inherent lack of precision in the assumptions required to enable the analysis, it is considered inappropriate to suggest that RAG changes from red to green at the single value of 1×10^{-7}. Consequently, an Amber zone is shown between 1×10^{-7} and 2×10^{-7}.

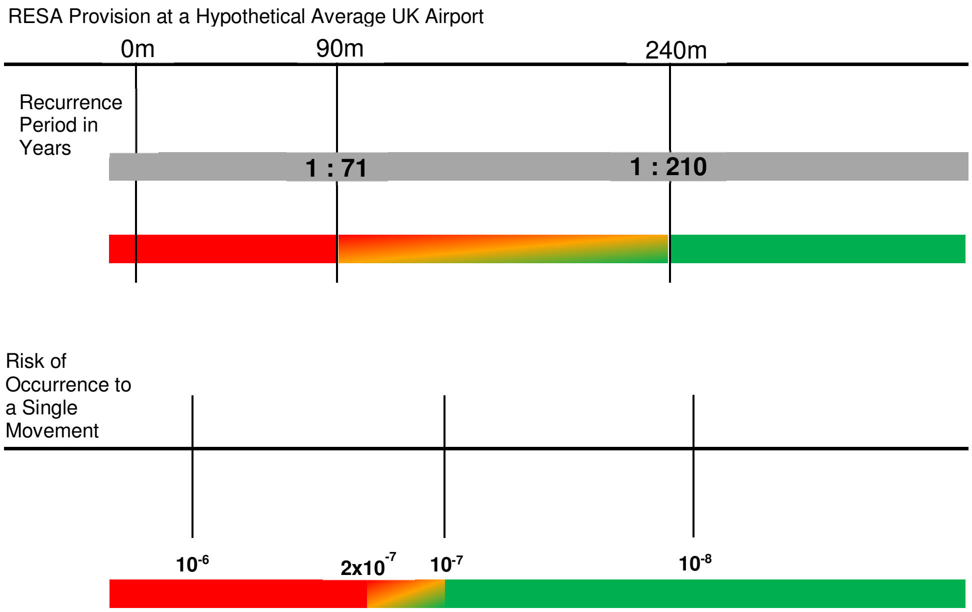


Figure 3.1: RESA Provision and Related Risk of Occurrence – Current Traffic

3.4 Guernsey Airport Overrun - Analysis

3.4.1 Current and Future Traffic

Guernsey Airport has provided data showing an annual total of aircraft movements of 38,323 and 36,533 in the years 2017 and 2018 respectively. Checking aviation statistics on the UK CAA website it can be seen that there has been a gradual decline in ATM's at Guernsey Airport over the last 5 years. The Base Case analysis will be carried out on the most recent, 2018 data.

Of the 36,533 aircraft movements in 2018, over 99% have been identified by their aircraft type and allocated into four fixed wing categories plus helicopters as described below. The remaining few unknown types were then allocated by proportion to each of the five categories.

Future traffic has been assessed on the basis of an additional 5 daily rotations of a small commercial airliner, typical of the A320 family, giving an additional 3,650 annual movements.

Table 3-4: Traffic Data and Runway Utilisation at Guernsey Airport

Year	Movements Considered	Runway Split % 27 : 09
2018	36,533	53% : 47%
2018 (excluding helicopters)	35,539	
Future additional traffic	+3,650	

The prevailing winds coming from the south west mean that Runway 27 is the dominant runway in use, however, there is not a significant difference in usage between Runways 27 and 09.

It is understood that using Runway 09 with a small tailwind component, to facilitate departures into Jersey and Europe when the wind strength and direction do not dictate the use of Runway 27, is actively discouraged due to the impact this practice has been shown to have on controller and pilot workload. Therefore, the similar runway usage between 27 and 09 is assumed to be reflective of the wind conditions that occur at Guernsey Airport.

3.4.2 Aircraft Types Analysed

The aircraft types operating at Guernsey Airport were separated into three main categories based on the take-off run required (TORR) and excess runway length available:

- Large Commercial and Large Business Aircraft - TORR more than 1,000m (maximum of 46% excess take-off run available on full length)
- Small Commercial, Other Business and Large Light Aircraft - TORR between 500m and 1,000m
- Small Light Aircraft - TORR 500m or less (91% excess take-off run available from Taxiway C intersection)

Helicopter movements were excluded.

For the purpose of modelling the risk, aircraft in the middle category were further disaggregated on the basis of MTOW (more or less than 5,700 kg) to identify the following four categories utilised in the analysis:

- Group 1: Large Commercial and Large Business Aircraft (more than 5,700 kg)
- Group 2: Small Commercial and Medium Business Aircraft (more than 5,700 kg)
- Group 3: Small Business & Large Light Aircraft (less than 5,700 kg)
- Group 4: Small Light Aircraft (less than 5,700 kg).

Average crash rates suggested by CAA, 2000 and Kirkland, 2001 (see references in Section 6) were applied to each of these four categories. These crash rates were then revised by applying factors that consider the landing and take-off percentage of runway length usage.

3.4.3 Revised crash rates for overrun applied at Guernsey Airport

The possibility of a reduction in the likelihood of crashes has been considered for take-off and landing operations. Suitable reduction factors to be applied to the crash rates mentioned in Section 3.2 were analysed based on the runway length utilisation (TORR vs. TORA) using data from the ROAD, which shows a significant reduction in probability of an overrun incident when the excess runway length available is more than 80% of the length required.

Table 3-5: Declared Distances at Guernsey Airport

Declared Distance (m)	Runway 09	Runway 27
TORA	1,463	1,583
LDA	1,463	1,463

Take-Off

The take-off overrun probability is expressed as a function of the excess distance available between the required take-off run (TORR) and the end of the available take-off run. Where aircraft have significantly more runway available than required, then the risk of overrun may be reduced, as these aircraft do not contribute significantly to the crash risk. It was determined that reduction parameters would apply for those aircraft for which excess take-off run available corresponds to an excess distance of at least 80%.

It is understood that all aircraft are permitted the full runway length if desired, but that an intersection departure is facilitated if requested by the pilot. Since an intersection departure is a possibility for both Group 3 aircraft (Small Business Aircraft and Large Light Aircraft) and Group 4 aircraft (Small Light Aircraft), these aircraft have been assessed based on an intersection departure from Taxiway Charlie, although it is accepted that, in practice, the business aircraft within Group 3 would typically use the full length.

For the purposes of this assessment, the aircraft in Group 3 would not, therefore, have a significant excess of runway available, and therefore a risk reduction factor has not been applied to this group for take-off overrun risk, giving a more conservative estimate of the risk.

Group 4 aircraft departing from Taxiway Charlie would still have a significant excess of runway available and, therefore, a risk reduction factor has been applied to Group 4.

Table 3-6: Take-Off Overrun Risk Reduction Factors – Runway 09

A/C Group	Definition	Average TORR + Standard Deviation (m)	Take-off Run Excess (m)	Take-off Run Excess as % of TORR	Risk Reduction Factor
Group 1	Large Commercial and Large Business Aircraft	1,754	-291	-17%	1.00
Group 2	Small Commercial and Medium Business Aircraft	1,055	408	39%	1.00
Group 3	Small Business Aircraft and Large Light Aircraft	832	123	15%	1.00
Group 4	Small Light Aircraft	450	505	112%	0.05

Note: The negative take-off run excess for Group 1 reflects that these types may be performance limited for take-off at Guernsey

Landing

Likewise, risk reduction factors have been considered for landing overruns as a function of the excess distance available between the required landing run and the end of the available landing run. It was determined that reduction factors would apply for those aircraft for which excess distance available corresponds to an excess distance of at least 80%.

Table 3-7: Landing Overrun Risk Reduction Factors – Runway 09

A/C Group	Definition	Average LDR + Standard Deviation (m)	Landing Distance Excess (m)	Landing Distance Excess as % of LDR	Risk Reduction Factor
Group 1	Large Commercial and Large Business Aircraft	1,636	-172	-11%	1.00
Group 2	Small Commercial and Medium Business Aircraft	977	486	50%	1.00
Group 3	Small Business Aircraft and Large Light Aircraft	762	701	92%	0.1
Group 4	Small Light Aircraft	502	961	192%	0.05

Note: The negative landing distance excess for Group 1 reflects that these types may be performance limited for landing at Guernsey

Combined Overrun Crash Rates

Table 3-8 and Table 3-9 display the take-off and landing overrun probabilities obtained by applying the reduced crash rates to the traffic present at Guernsey Airport (current and with additional flights). In the Hazard Identification workshop, it was identified that Guernsey Airport's characteristics make landing a higher risk than at other airports in the UK. Therefore, the crash risk for landing has been assessed with a 1.1 multiplier to reflect the higher risk.

Table 3-8: Crash Rates for the Overrun Analysis – Current Traffic

							Application of Crash Rates			
			Runway 27 movements		Runway 09 movements		Runway 27 Overrun		Runway 09 Overrun	
A/C Group		Annual Movements	Take-off	Landing	Take-off	Landing	Take-off	Landing	Take-off	Landing
1	LCBA	18,232	4,831	4,831	4,284	4,284	1.95E-03	8.99E-03	1.73E-03	7.97E-03
2	MCBA	5,919	1,569	1,569	1,391	1,391	6.32E-04	2.92E-03	5.61E-04	2.59E-03
3	SBA	4,052	1,074	1,074	952	952	7.52E-04	2.95E-04	6.67E-04	2.62E-04
4	Light Aircraft	7,336	1,944	1,944	1,724	1,724	6.80E-05	2.67E-04	6.03E-05	2.37E-04
	Total	*35,539*	*9,418*	*9,418*	*8,352*	*8,352*	*3.40E-03*	*1.25E-02*	*3.01E-03*	*1.11E-02*

Table 3-9: Crash Rates for the Overrun Analysis – Future Traffic

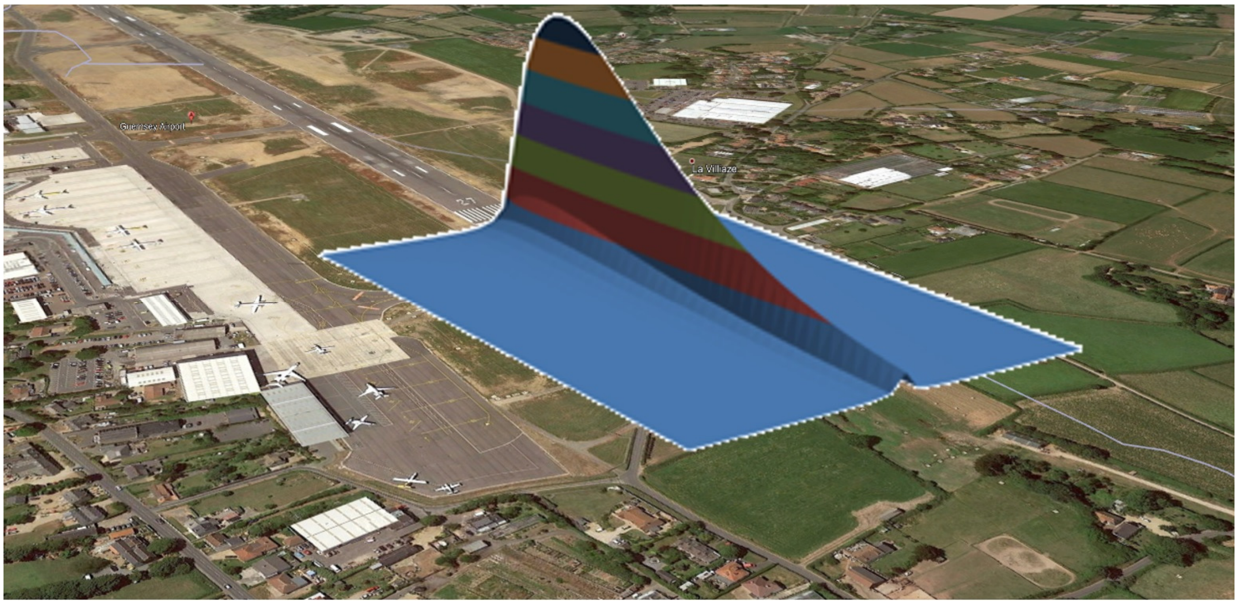
							Application of Crash Rates			
			Runway 27 movements		Runway 09 movements		Runway 27 Overrun		Runway 09 Overrun	
A/C Group		Annual Movements	Take-off	Landing	Take-off	Landing	Take-off	Landing	Take-off	Landing
1	LCBA	18,232	4,831	4,831	4,284	4,284	1.95E-03	8.99E-03	1.73E-03	7.97E-03
2	MCBA	5,919	1,569	1,569	1,391	1,391	6.32E-04	2.92E-03	5.61E-04	2.59E-03
3	SBA	4,052	1,074	1,074	952	952	7.52E-04	2.95E-04	6.67E-04	2.62E-04
4	Light Aircraft	7,336	1,944	1,944	1,724	1,724	6.80E-05	2.67E-04	6.03E-05	2.37E-04
5	A320-type	**3,650**	**967**	**967**	**858**	**858**	**6.63E-04**	**2.56E-03**	**5.88E-04**	**2.27E-03**
	Total	*39,189*	*10,385*	*10,385*	*9,209*	*9,209*	*4.06E-03*	*1.50E-02*	*3.60E-03*	*1.33E-02*

The probability density function modelled from the ROAD data allows an airport specific spatial distribution of overrun locations to be developed. By applying the above crash rates to the probability density function, the likelihood of incidents occurring outside the provided RESA has been calculated.

3.5 Guernsey Airport Overrun Results

3.5.1 Spatial Distribution of Accident Probability

As an example of the nature of the spatial distribution, Figure 3.2 shows the Base Case superimposed as a 3D image on a Google Earth image of the runway end. The 3D image of probability covers a length of 400m and a width of 300m. Note how the probability is highest on the extended centreline of the runway and close to the threshold.



Source: Google Earth + Jacobs Analysis

Figure 3.2: Overrun location probability contours for existing Base Case overlaid on east end of runway

3.5.2 Review of Results

The following tables and graphs illustrate the output of the overrun analysis: they contain the likelihood of an overrun incident outside of the provided RESA. The results are shown in a RAG setting. Red would mean that the result clearly has a more frequent occurrence than the benchmark for a 90m RESA, whilst Green similarly means that the result clearly has a less frequent occurrence than the benchmark for a 240m RESA.

An Amber result means that, for a recurrence period, it is better than the benchmark figure for a 90m RESA but not as good as that for a 240m RESA. The benchmark for the risk to an individual movement is $1x10^{-7}$ but is given an amber zone between that and $2x10^{-7}$. Note that the individual risk is given as an average for the aircraft fleet. It is a weighted average taking into account both the numbers of movements and the crash risk factors applied to each group of aircraft types.

Some aircraft movements will be at a higher individual risk and some at a lower risk. An individual movement will in fact experience a different risk profile depending on the specific aircraft, its weight and performance and the weather conditions at the time of the movement.

The results are discussed in Section 5 of the report.

Table 3-10: Runway 09 Uncontained Overrun Risk

Option		Existing traffic		+ Future traffic	
		Recurrence Period (years)	Incidents per Movement	Recurrence Period (years)	Incidents per Movement
Base	Existing situation with 198m RESA	365	7.72E-08	N/A	N/A
Option 1	Reduce RESA to 90m allowing declared distances to increase by 108m	163	1.73E-07	135	1.89E-07
Option 2	Full EMAS bed in a 120m RESA. Equivalent to a 240m RESA but declared distances increased by only 78m	373	7.55E-08	310	8.22E-08
Option 3	Reduced EMAS length of 90m in a 90m RESA. Declared distances increased by 108m	239	1.18E-07	199	1.28E-07

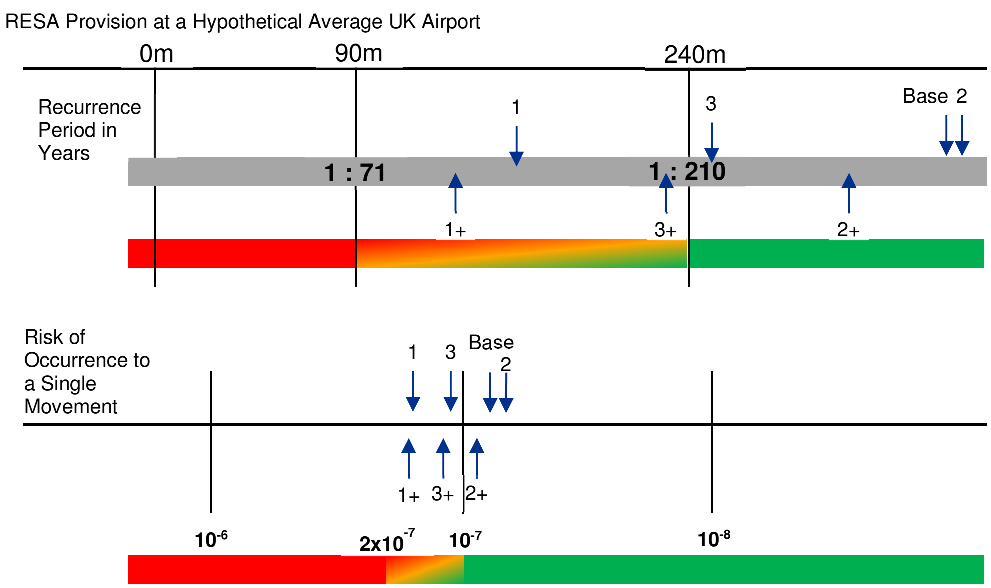


Figure 3.3: Runway 09 Uncontained Overrun Results

4. Undershoot RESA Risk Assessment

A runway undershoot differs significantly from a runway overrun. When an overrun occurs, it can be reasonably expected that it is obvious to the Accident and Incident Investigators and the incident will be so labelled in any reports. Consequently, the databases available of runway overrun accidents and incidents will be quite accurate in providing a full record of incidents and accidents that must be considered to be part of the statistical record of overruns.

In the case of undershoots, since these accidents are from flight on arrival, great care must be exercised in considering which of these accidents are to be deemed undershoots and would be relevant to a RESA assessment. The data sets of arrival accidents which are available to allow analysis of accidents from arriving aircraft whilst still in flight show a great spread of data, including accidents at several kilometres downwind of the aerodrome and at several kilometres to the side of the runway centrelines.

An example of such a data set is shown below in Figure 4.1. This is based on an FAA study of arrival accidents for GA aircraft and includes accident locations at over 7Km before the landing threshold and up to 4km to the side of the runway centreline.

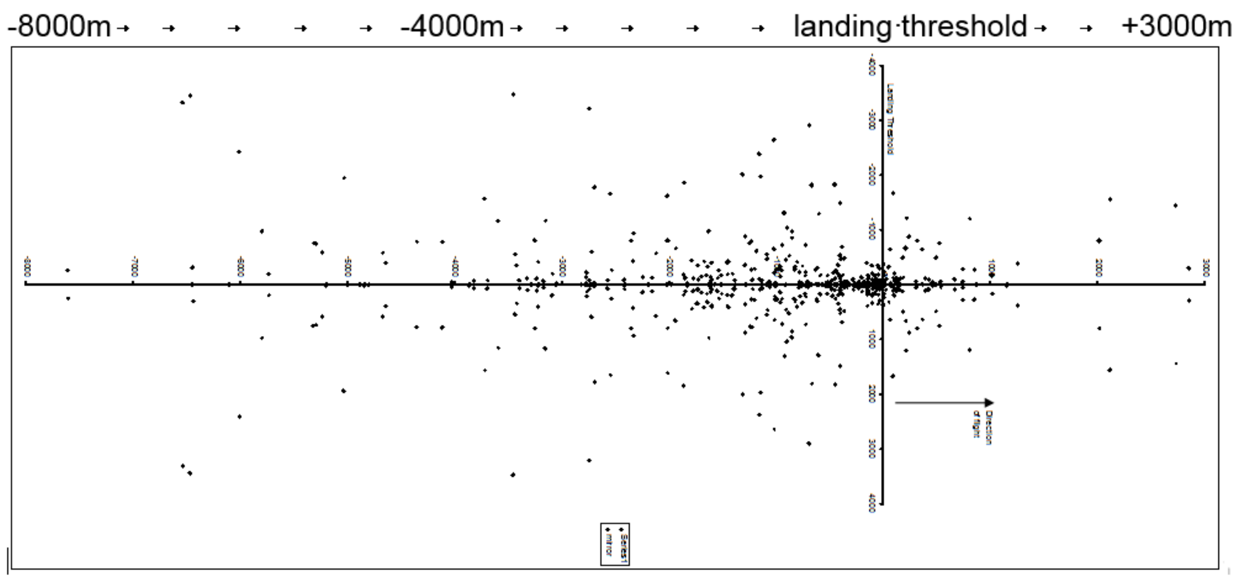


Figure 4.1: GA Arrival Accidents from FAA study

Another example is provided by the probability density function developed by NATS, 1997 in their study of public safety zones. This is shown graphically in Figure 4.2 for the 1000m before the landing threshold.

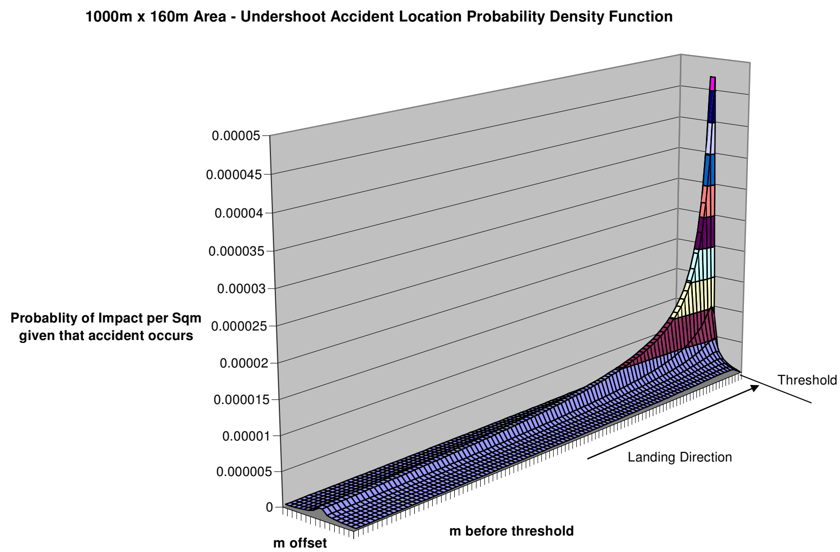


Figure 4.2: Illustration of Arrival accident from flight probability over a 1000m by 160m area before the threshold

Both of these data sets illustrate that an appreciable number of the arrival accidents occur well downwind of the aerodrome. These are before the aircraft is over the land area and infrastructure that the airport operator can reasonably be expected to control and improve by the provision of RESA areas.

Nevertheless, integration of the probability density functions provided by NATS indicates that the highest accident probability locations are contained within the ICAO RESA. The shape of the accident location probability density function is shown in Figure 4.3.

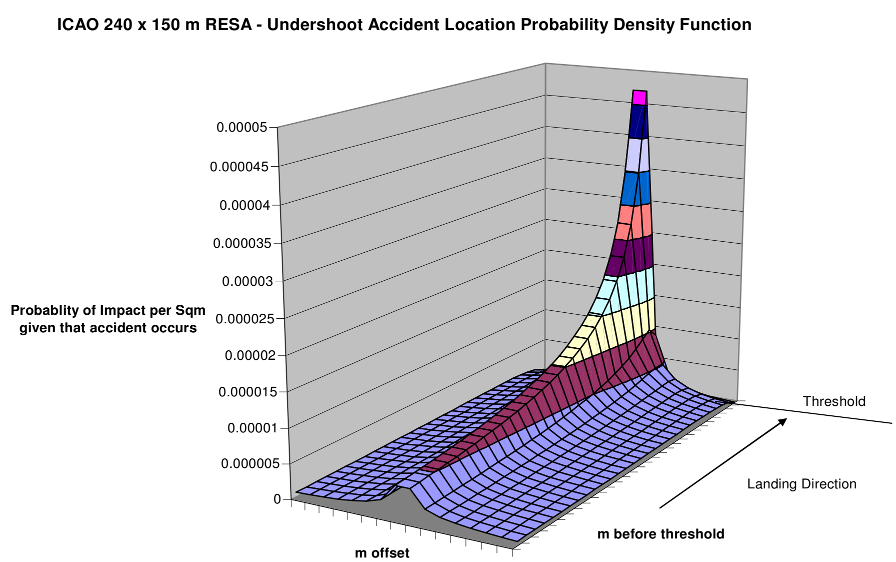


Figure 4.3: Accident Probability within ICAO RESA

Consequently, the method used is based on a presumption that if the aerodrome infrastructure provided full ICAO recommended RESA dimensions of at least 240m long by 150m wide, then the infrastructure is deemed to have provided industry standard and appropriate protection for runway undershoots.

It is recognised that additional protection both to and from the undershoot incident is provided by obstacle limitation and development limitation by aerodrome safeguarding surfaces and by the application of a Public Safety Zone. However, this report is concerned solely with the risk assessment of the provision of RESAs.

An undershoot accident of relevance is thus defined as one that could have been ameliorated by better provision of RESAs if these are less than the ICAO recommended 240m by 150m RESA. It is thus assessed as the risk of such an accident occurring within the ICAO RESA of 240m by 150m but outside of the actual provided RESA if smaller. No benefit is obtained from the EMAS for an undershoot as all that is considered is whether an aircraft reaches the physical extent of the RESA.

A calculation of the portion of crash rates from arriving flight located between the provided RESA and the full ICAO RESA (240m L x 150m W) has been carried out using the probability density function.

4.1 Methodology

The method used is as follows:

- Calculate the crash risk of an airport vicinity arriving accident per million movements, using average First World crash rates (NATS, 1997) for various aircraft categories. In the Hazard Identification workshop, it was considered that Guernsey Airport's characteristics make landing a slightly higher risk than at other comparable airports. Therefore, the crash risk has been assessed with a 1.1 multiplier to reflect the higher risk
- Apply these to the spectrum of aircraft types using Guernsey Airport and, using estimates of annual movements by each category, calculate a weighted crash rate
- From NATS, 52% of these crashes are landing crashes from arrival flight excluding landing overruns, and after application of runway utilisation, the crash rate for each undershoot can be calculated
- The pre-threshold crash location probability density function is integrated, both for the full 240m by 150m ICAO RESA and for the actual shape of the undershoot RESA provided. The difference multiplied by the crash rate for each undershoot provides the individual risk that an undershoot incident will occur within a RESA area that should perhaps have been provided but outside of that which has been provided
- This is then taken as the key risk parameter which measures the risks related to the non-provision of sufficient RESA and can be expressed both as an individual risk and as an incident of 1 in a number of years for a given level of traffic.

4.2 Guernsey Airport Undershoot - Analysis

4.2.1 Current and Future Traffic

The utilisation of the two runways for landing operations is as in Table 4-1.

Table 4-1: Traffic Data and Runway Usage at Guernsey Airport

Year	Movements Considered	Runway Split % 27 : 09
2018	36,533	53% : 47%
2018 (excluding helicopters)	35,539	
Future additional traffic	+3,650	

4.2.2 Aircraft Types Analysed

For the undershoot analysis the aircraft types operating at Guernsey Airport were separated into ten categories as outlined in the document 'Third Party Risk Near Airports and Public Safety Zones Policy'[3]:

- Class I Jets
- Class II – IV Jets
- Eastern Jets
- Executive Jets
- Turboprops T1
- Turboprops T2
- Turboprops (unclassified)
- Piston-Engine
- Other non-commercial
- Miscellaneous

4.2.3 Crash rates for undershoot applied at Guernsey Airport

The weighted crash rates proposed indicate an overall rate of 1.228 per million movements for the current traffic at Guernsey Airport as shown in Table 4-2.

Table 4-2: Calculation of Crash Rate for Undershoot – Current Traffic

Aircraft class	Crash rate per million movements of aircraft class	Annual movements	Proportion of movements	Weighted crash rate per million movements
Class I jets	1.114	0	0.00%	0
Class II-IV jets	0.148	2,545	7.16%	0.012
Eastern jets	0.930	0	0.00%	0
Executive jets	2.230	2,362	6.65%	0.163
Turboprops T1	0.270	19,431	54.68%	0.162
Turboprops T2	0.733	79	0.22%	0.002
Turboprops (unclassified)	0.733	2,042	5.75%	0.046
Piston-engine	3.000	8,852	24.91%	0.822
Other non-commercial	3.000	0	0.00%	0
Miscellaneous	3.000	228	0.64%	0.021
	TOTAL	*35,539*	100.00%	1.228

The proportion of the crash rate from arriving flights is then applied (NATS, 1997) shown below in Table 4-3.

Table 4-3. Crash Rates from Arriving Flight on each Runway – Current Traffic

Runway	Utilisation (%)	Proportion of crashes that are from arriving flight* (%)	Crash rate per million used in analysis
09	47	52	0.3002
27	53	52	0.3385

***Note: excluding landing overruns.**

[3] Third Party Risk Near Airports and Public Safety Zones Policy, A. W. EVANS, P. B. FOOT, S. M. MASON, I. G. PARKER, K. SLATER, June 1997

In the future scenario, the additional flights of modern A320-family equivalent aircraft change the mix of aircraft operating at Guernsey Airport and reduce the resulting crash rate to 1.129 per million movements as shown in Table 4-4 with the resulting arrival crash rate shown in Table 4-5.

However, it must be noted that it is assumed that the relocation of the Runway 27 glidepath antenna necessary for Options 1,2 and 3, will continue to provide the same quality of signal to support CAT 1 precision approaches and the use of the same crash rates with respect to undershoot risk. There have been previous reports of some significant perturbations, possibly due to the difficult ground plane topography on the approach that can give rise to unstable approaches. A formal assessment of this effect should be sought from the navaid providers during the next design stage if an option involving a relocated 27 landing threshold becomes the preferred option.

Table 4-4: Calculation of Crash Rate for Undershoot – Future Traffic

Aircraft class	Crash rate per million movements of aircraft class	Annual movements	Proportion of movements	Weighted crash rate per million movements
Class I jets	1.114	0	0.00%	0
Class II-IV jets	0.148	6,195	15.81%	0.026
Eastern jets	0.930	0	0.00%	0
Executive jets	2.230	2,362	6.03%	0.148
Turboprops T1	0.270	19,431	49.58%	0.147
Turboprops T2	0.733	79	0.20%	0.002
Turboprops (unclassified)	0.733	2,042	5.21%	0.042
Piston-engine	3.000	8,852	22.59%	0.745
Other non-commercial	3.000	0	0.00%	0
Miscellaneous	3.000	228	0.58%	0.019
	TOTAL	*39,189*	100.00%	1.129

Table 4-5: Crash Rates from Arriving Flight on each Runway – Future Traffic

Runway	Utilisation (%)	Proportion of crashes that are from arriving flight*	Crash rate per million used in analysis
09	47	52%	0.2759
27	53	52%	0.3112

***Note: excluding landing overruns**

The results in Table 4-6 provide the likelihood that an undershoot incident is located outside of the existing or option RESA but inside the area defined by the ICAO standard RESA of 240m x 150m.

Table 4-6: Runway 27 Undershoot Risk Results

Option	Existing traffic		+ Future traffic	
	Recurrence Period (years)	Incidents per Movement	Recurrence Period (years)	Incidents per Movement
Base	7,938	3.54E-09	N/A	N/A
Option 1	1,762	1.60E-08	1,738	1.47E-08
Option 2	2,332	1.21E-08	2,301	1.11E-08
Option 3	1,762	1.60E-08	1,738	1.47E-08

5. Conclusions

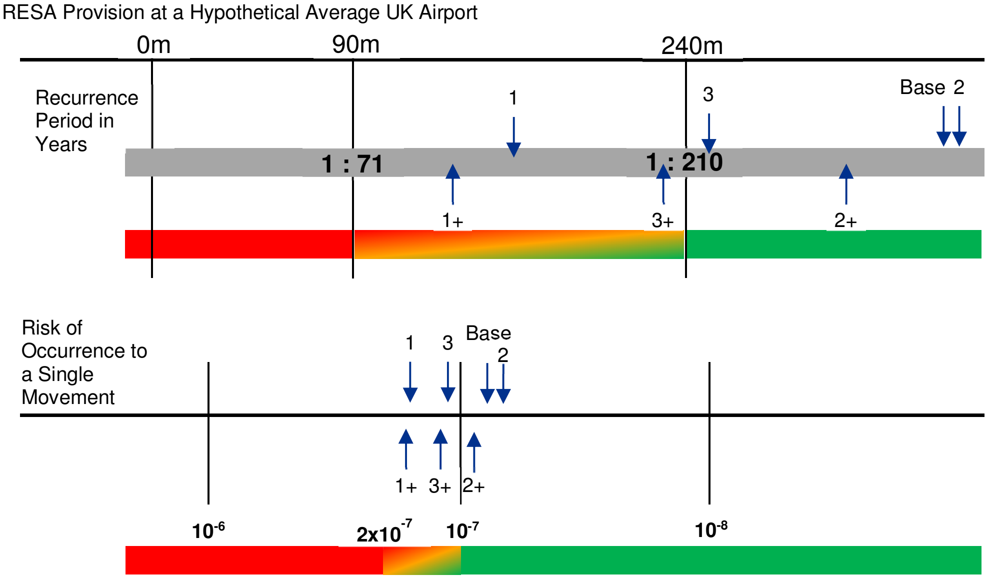
In view of the current provision of a wider runway than the minimum required, good friction on a recently overlaid and grooved runway surface, CAT 1 precision approach and a good standard of AGL lighting including alternating light colours towards the runway ends, the only realistic additional mitigation to improve the RESA provision is consideration of EMAS installations.

It is noted that the probability of an undershoot location that would have been within a 240m by 150m RESA but is outside of the provided RESA is very low for all cases. The probability is an order of magnitude smaller than for landing or aborted take-off overruns. Tolerability and acceptability of the RESA provision are therefore dominated by the results for overruns. The overrun analysis results given in Section 3 are repeated here for ease of reference.

Runway 09 Uncontained Overrun Risk

Option		Existing traffic		+ Future traffic	
		Recurrence Period (years)	Incidents per Movement	Recurrence Period (years)	Incidents per Movement
Base	**Existing situation with 198m RESA**	365	7.72E-08	N/A	N/A
Option 1	**Reduce RESA to 90m allowing declared distances to increase by 108m**	163	1.73E-07	135	1.89E-07
Option 2	**Full EMAS bed in a 120m RESA. Equivalent to a 240m RESA but declared distances increased by only 78m**	373	7.55E-08	310	8.22E-08
Option 3	**Reduced EMAS length of 90m in a 90m RESA. Declared distances increased by 108m**	239	1.18E-07	199	1.28E-07

RESA Provision at a Hypothetical Average UK Airport



The risk of an uncontained overrun for the Base Case which analysed the existing situation is within both of the Jacobs benchmarks. This result is mutually supportive of and with the qualitative arguments put forward in the CAP 791 compliance matrix for the 2014 runway development for acceptance of the 198m RESA provision.

For Options 1, 2 and 3, the probability of an uncontained overrun is marginally greater with the future larger aircraft traffic than with existing 2018 air traffic, but within the constraints of the accuracy of the statistical analysis the change is not significant enough to justify different decisions on the implementation of a changed RESA / Runway configuration on that ground alone.

Option 2, a full 120m length EMAS RESA, whether with the existing traffic or with the forecast additional larger aircraft, is also within both the Jacobs benchmarks. This is not surprising as it is planned by the FAA guidelines to be equivalent to a full 240m RESA. It shows slightly lower probabilities of an uncontained overrun than for the Base Case because the EMAS bed protects out to a 240m length equivalent for the width of the runway, which more than compensates for the loss of the width of the RESA over the reduced RESA length. It must be noted that Option 2 would only allow a 78m increase in declared distance but has the advantage that it complies with the stance taken by the UK CAA where declared distances are to be increased.

Option 1, which would be the simplest to implement, has results which all fall within an Amber zone in the RAG marking comparison with benchmarks. The recurrence period of both Option 1 and Option 1+ are both roughly half way between the recurrence benchmarks for a 90m and a 240m RESA, but the risk to a single movement is, although Amber, close to the judgemental two-fold increase in the $1x10^{-7}$ benchmark which is taken from ICAO Collision Risk Modelling.

The benchmark of $1x10^{-7}$ is the most appropriate target benchmark for risk to an individual movement. When analysing an existing situation, it is considered inappropriate, bearing in mind the order of magnitude nature of risk assessment, the limited statistics available and the need for some judgement in the analysis, to require major capital expenditure to remedy a failure to hit a benchmark by what would be a small amount on a log scale order of magnitude basis. That is why a judgemental amber zone of up to twice the benchmark has been used. However, when assessing the tolerability and acceptability of new works, greater preference should be given to being closer to the target benchmark of $1x10^{-7}$. As noted in Section 3, the quoted result of the risk to an individual movement is an average for the aircraft fleet. Some movements, by nature of the aircraft type, performance and weather conditions will be carried out at a higher level of probability of overrun.

Consequently, from all of the above consideration, on the grounds of the probability of uncontained overrun alone, Option 1 would be the least preferred option.

Option 3 has been analysed to see what could be done if using EMAS to the best effect within a 90m RESA, thus maintaining the potential for a 108m increase in declared distance. Although 3 of the 4 results for Option 3 and Option 3+ are in Amber zones, they are very close to the benchmarks, and again, bearing in mind the limitations on accuracy of risk assessment that is generally reported in orders of magnitude, should be considered as comparable to the benchmark. It must be noted that such an EMAS installation with the purpose of increasing declared distances is contrary to the stance taken by UK CAA on such a proposal as stated in CAP 168, however, the regulatory position in Guernsey is not obliged to follow a UK CAA stance.

The final decision will necessarily be made by those in authority responsible for safety at the airport, and in agreement with the regulator. However, the Jacobs recommendations summarising the discussion above is that:

a. The Base Case of the current 198m RESA being an acceptable provision is supported as appropriate by this quantitative assessment. In so doing the work carried out both supports and is supported by the qualitative arguments put forward in the CAP 791 Compliance Matrix for the 2014 runway development.

b. Option 1, a 90m RESA with no EMAS provision would be the least preferred option on the grounds of probability of uncontained overrun alone.

c. Option 2, a 120m EMS RESA can be recommended and would be compliant with the stance taken by the UK CAA when declared distances are to be increased. However, the increase in declared distance is limited under this option to 78m which might not provide the desired improvement in aircraft performance.

d. Option 3, a 90m EMAS length in a 90m RESA would be at a lower cost than the 120m EMAS of Option 2 and would provide the desired 108m increase in declared distances. The risk assessment shows the probabilities of uncontained overruns are very close to the benchmarks and, taking into account the limits of the accuracy of the analysis, is comparable to the benchmark. However, this option is not compliant with the view taken by the UK CAA where declared distances are to be increased. It would normally only be used to improve the RESA provision at an existing land constrained location with no increase in declared distances, and it would then be compliant with the FAA guidelines for a non-standard RESA.

6. References

Kirkland, I., 2001. The risk assessment of aircraft runway overrun accidents and incidents.

CAA, 1998. Risks from Aeroplanes Overrunning Aerodrome Runways

NATS, 1997. Third Party Risk near airports and public safety zone policy.

Slater 1993. A method for estimating the risk posed to UK sited by civil aircraft accidents. CS Report 8345, Civil Aviation Authority, London, UK.

CAA, 2000. Aviation Safety Review 1990-1998.

EU 139/2014

ICAO Annex 14 Volume 1 Aerodrome Design and Operations 8th Edition July 2018

EASA CS-ADR-DSN Issue 4.0 Certification Specifications and Guidance Material for Aerodromes Design

UK CAP 168. Licensing of Aerodromes

Appendix A. Guernsey Airport Specific Operational Issues

The following response was received from Guernsey Airport following a request for identification of any special features associated with the Guernsey Airport Operation which need to be considered in connection with any proposals to reduce RESA length.

Difficult weather conditions

- Generally given the exposed nature of the island and our geographical position we do have a high propensity to RVR conditions, windier conditions and relatively little impact of snow and ice, exposed location and therefore propensity to wind.
- Guernsey Airport operates a ‘back to black’ policy for snow and ice conditions so there is no increase of runway excursion created by the rare snow and ice conditions.
- Cross wind limits are set by airline operators, in accordance with the aircraft manufacturer’s operations manuals and they ultimately will make a decision as to whether they can operate at Guernsey Airport in accordance with the published information in our AIP. The cross wind limits set by the aircraft manufacturer and/or airline operator are designed to minimise the risk of a runway excursion.
- RVR limits for approach are also set by airline operators. The worst case scenario would be a combination of - cross winds, wet runway and into RVR’s (all just on airline operators limits).
- Thunderstorms may produce difficulties with downdraughts and wind shear.

Provision and use of visual or instrument approaches

- Guernsey Airport deploys CAT1 ILS at both ends in operation with standard 200’/550m minima applied. LPV 200 to be shortly introduced, which will have very similar criteria to the ILS CAT 1 minima.
- The introduction of EVS 2 on the recently ordered Aurigny ATR 72-600 fleet is also worthwhile noting and also some of the airlines considering operating in Guernsey also having capability to carry out lower than CAT 1 operations (similar arrangements are undertaken in Jersey as part of a specific safety case signed off by the DCA). This includes the E195 which can be fitted with a HUD option (I understand G-NSEY has been fitted with the wiring to enable this modification to be fitted if required).
- Lower Than Standard (LTS) CAT 1 operations do require that the ILS operate within CATII or even CATIII course structure requirements, depending on the target RVR. This would require additional protection of the Loc and GP sensitive areas – which has not yet been deployed.

ILS precision approach categories

- CAT1 and LPV200 approaches available, historically we have had issues with perturbations on 27 approach ILS signal due terrain. Perturbations are likely to worsen at the 27 end when or if the threshold is moved further east, as the GP will be moving closer to the valley and therefore will be more exposed to the effect of the rising ground on the far side of the valley giving rise to bends. The 27GP will have to be re-commissioned with this in mind, noting that it already has a coverage weakness 8deg right - due to the tuning deemed necessary to control the perturbations.
- There is some scope for tuning our M-array but like all multi-antenna systems what you gain in one area you can lose in another. It follows the law of diminishing returns.
- Coverage of the 27 Loc will also have to be confirmed in modelling as the Loc antenna array is below the horizontal plane of the runway and the actual glideslope will have moved 100m+ further to the east as part of these proposals and so more terrain screening of the bottom coverage of the Loc beam comes into play.
- Current Air Pilot entries refer to weakness in low level coverage of the 27 GP, with the words “Pilots must not descend on RWY 27 GP until fully established on RWY 27 LOC”.
- The weakness in low level coverage is a result of the adjustments necessary on the M-Array to reduce the perturbations. This situation is likely to worsen when we move the GP further east.

Any ICAO/EASA non-compliance with runway friction levels

- None, runway friction readings provided. Runway levels compliant to ICAO standard, grooved marshall, LED runway edge lights. Under the current issue of CS–ADR-DSN — Aerodromes Design, Guernsey Airport’s aerodrome reference code is 3C.

- Code 3 runways which handle aircraft with an Outer Main Gear Wheel Span (OMGWS) of 6 m up to but not including 9 m are required to have a minimum width of 30 metres. We selected a 45 metre runway as part of the specification for the pavements project.
- By comparison, other similar sized airports have a compromise in runway width (e.g. Southampton is 37m, Southend is 36m) but still are able to handle A320 and Boeing 737 series aircraft without issue.

Lighting

- We selected LED runway edge lights (spaced at 60 metres) and enhanced runway centreline lights spaced at 15 metres instead of the mandatory 30 metre spacing to enhance guidance.
- Our approach lighting is as follows:
  - Runway 27 – Code centre-line with five cross bars. Single approach centre-line light omitted from the system at 270 metres from the Runway 27 threshold. 895 metres length in total with high light intensity.
  - Runway 09 - Code centre-line with five cross bars. Single approach centre-line lights omitted from the system at 570 and 540 metres from the Runway 09 threshold. 803 metres length in total with high light intensity.

- **Any terrain constraints on approach or take-off procedures** – Forest Road Water tower on 27 approach (as per CAP232); there may be other obstructions which become more prominent as a result of the threshold moving east and this will be subject to a wider study by our appointed CAP 232/1732 surveyor in due course and if there is a case to be considered.

- **Runway excursion history:** The runway excursion history at Guernsey since 1999 (for commercial aircraft over 5,700kg MTOW) is:

1. 8 Aug 1999, Aurigny Shorts SD360: During landing roll on Rwy 09 aircraft veered sharply to the right, departed runway & struck PAPIs. Nose & landing gear damaged. No injury to 40 POB (excursion onto CGA, not overrun or undershoot RESA)

2. 21 Apr 2001, Aurigny Saab 340: During landing roll on Rwy 09 aircraft veered to the left, departed runway. No damage or injury to POB (excursion onto CGA, not overrun or undershoot RESA)

3. 8 Mar 2006, Emerald HS748: aircraft overran runway some 145m after landing on Rwy 27. Slight damage, no injury to 2 POB (excursion onto overrun RESA)

4. 17 May 2006, Club 328 Dornier 328 Jet: aircraft overran runway some 25m after landing on Rwy 09. Threshold light damage, no injury to POB (excursion onto overrun strip end zone)

Appendix B. Hazard Identification Workshop

A Hazard Identification Workshop was held at Guernsey Airport on 13th March 2019, attended by the following representatives of the airport, regulatory body and airlines.

Name	Company	Job Title
Colin le Ray	Guernsey Airport	General Manager Ports
Peter Collivet	Pula Aviation Ltd	Pilot
Nick Brown	Pula Aviation Ltd	Pilot
Ross Coppolo	Guernsey Airport	Head of Safety & Compliance
Ash Nicholas	Guernsey Airport	Head of Aviation Services
Leah Jeffreys	Guernsey Airport	Manager, Air Traffic Control
Chris Arnold	Guernsey Airport	Chief Technical Officer
Simon Macphail	DCA	Dep. DCA & Aviation Security Regulator
Gareth Williams	Guernsey Airport	Airport Operations Manager
Nigel Moll	Aurigny	Flight Operations Director
Mark Darby	Aurigny	CEO
Rob le Page	Architect & Chartered Surveyor	Principal
Spencer Raynes	Blue Islands	Director of Flight Operations
Ben Verrall	Jacobs	Senior Consultant
Richard Verrall	Jacobs	Senior Airport Planner

Following a discussion on the risk assessment methodology, the workshop discussed issues around flight safety at Guernsey Airport, using the following tables as a discussion guide.

The workshop consensus view is that, whilst Guernsey is not high-risk, it is one of the higher risk airports pilots fly to, due to the combination of crosswind, reduced visibility and a shorter runway length than experienced at other typical airports.

B.1 Factors Affecting All Phases of Flight

Flight Phase	Contributory Factor	Comment
All Phases	Long Duty Period	Typically 1/month pilot reaches max. duty period
	Single Pilot Operation	Not on scheduled flights. GA / air taxi may have single pilot ops.
	No approach radar service or airport tower service	Approach / Tower is set up well and provides good service.
	No current local weather report	Good weather information available.
	Unfamiliar airport or unfamiliar procedures	Local issue: Wind from 210-230 causes windshear from topography and hangar turbulence. Warning issued in AIP, and on ATIS when applicable.
	Minimal or no approach lights or runway lights	09 Approach has two missing lights. Enhanced lighting provided on runway centreline.
	No visual approach-slope guidance	Approach glidepath lighting is good.
	Foreign destination - possible communication / language problems	Commercial pilots required to have good English. Proximity to France draws foreign GA pilots, may not be as good.
	Fog / reduced visibility	Frequent occurrence of reduced visibility compared to other airports. Generally not prolonged – usually either morning or evening. Can be low cloud.
	Proportion of night operations	Open 06:30 until 21:00. If med-evac aircraft operating, would be small a/c
	Wet runway	
	Contaminated runway	Braking action is good. Runway friction surveys good.
	Runway braking action	
	Runway slope	Downslope on 27 can delay touchdown
	Visual illusions e.g. sloping terrain, wet runway, whiteout / snow	Runway slope can cause appearance of a dip in middle. Mirage effect / heat haze in summer.

B.2 Factors Affecting Landing

Flight Phase	Contributory Factor	Comment
Landing – Approach / Touch down	Obstacle environment / hilly or mountainous terrain	Nothing to affect to the west. Water tower and vehicles on road to the east are noted in obstacle charts.
	Tailwind	Variation in fog density at either end of runway can affect runway choice, resulting in tailwind component. Due to slope, minor tailwind take-off on 27 can be preferable to minor headwind 09 take-off.
	Crosswind	More of an issue than other airports. Turbulence over hangars is noted in AIP
	Windshear	210-230 wind direction – windshear concern means will be noted on ATIS message. Jersey gives report if windshear issues expected.
	Non-precision approach	Generally use ILS with daytime option to use visual – night landing must use ILS. Offset VOR can destabilise approach. Some a/c GPS equipped for approach.
	Mechanical failure on aircraft	Mostly modern fleet – freight operator using late 80's / early 90's aircraft.
	Other declared emergency	Divert to Exeter for better runway length if flapless landing. Jersey is another alternative.
	Wrong weather information given	Every RVR change is advised. Generally do not have quick changes in weather.
	Airport specific procedures	Fog / wind / shorter runway to be considered when operating to Guernsey.
	Non-precision approach - especially with step-down procedure or circling procedure	N/A
	Visual Approach in darkness	Would use ILS
	Late runway change	If need to change runway is identified, then would offer inbound a/c a hold to re-brief the approach.
	No published STAR	N/A
	Cold temperature effects - true altitude lower then indicated altitude	N/A
	No GPWS / EGPWS / GCAS / TAWS	Fitted to aircraft

	No radio altimeter	Fitted to aircraft
	No wind shear warning system	By radio feedback. Embraer and large business jets have a warning system (reactive)
	Other factors	Icing conditions increases landing speed. Typically 50% of the time in winter operations. Offset VOR can destabilise approach.
Landing – Roll out / Braking	Mechanical failure on aircraft	No issue.
	Tyre burst	No issue.
	Airport specific procedures	Night closure does not affect
	Percentage of runway length critical operations	ATR a/c never. Embraer – if wet runway circa 70% of landings could be critical. Large business jets cannot use runway if wet. A/c which can land max weight on dry runway may be restricted if wet.

B.3 Factors Affecting Take-off

Flight Phase	Contributory Factor	Comment
Take-Off – Line up	Line up reduces available TODA	Join runway at 90 degrees to maximise length available
Take-Off – Acceleration	Mechanical failure on aircraft	Some but not significant
Take-Off – Lift Off	Mechanical failure on aircraft	
	Bird strike	High risk.
	Other factors that may increase the probability of an abort being required	N/A
Take-Off – Deceleration to stop	Mechanical failure on aircraft	Usually due to engine indications. One a/c type can show door warning.
	Tyre Burst	
	Percentage of runway length critical operations	70 to 80% of operations have more performance available. Intersection take-off only used by small GA. Pilot instructed to backtrack as required – a/c sequencing planned such that full length could be used.

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STATES OF DELIBERATION
of the
ISLAND OF GUERNSEY

STATES TRADING SUPERVISORY BOARD

REVIEW OF A POTENTIAL GUERNSEY AIRPORT RUNWAY EXTENSION

Dear Sir,

In accordance with Rule 4(2) of the Rules of Procedure of the States of Deliberation and their Committees, the STSB requests that the Propositions be considered at the States' meeting to be held on 25th September 2019.

It is important that the Policy Letter for the review of the potential Guernsey Airport Runway extension is considered without further delay, as Resolution 2 of the Requête directed the States' Trading Supervisory Board to return to the States by 31st March 2019 with a Policy Letter on this matter.   This is notwithstanding that I have already provided an outline briefing to the States on the outcome of the review.

Yours faithfully,

P Ferbrache

P T R Ferbrache
President
States Trading Supervisory Board

J C S F Smithies
Vice President

J Kuttelwascher
Member

S J Falla MBE
J C Hollis
Non-States Members