Design Options Report (DOR)

Stage 2 Develop and Assess

MAG East Midlands Airport

Document Details

Reference	Description
Document Title	Design Options Report (DOR)
Airport	East Midlands Airport
Issue	Version 1
Date	27 October 2023

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1. Introduction

1.1. Purpose

The East Midlands Airport (EMA) Airspace Change project is currently at Stage 2 – Develop & Assess of the CAP1616 Airspace Design process. Step 2A requires the change sponsor to develop a comprehensive list of options that address the Statement of Need (SoN) and align with the design principles developed through the two-way engagement carried out during Stage 1 of the process.

The purpose of this Design Options Report (DOR) is to describe how the comprehensive list of departure and arrivals design options has been derived, as required by Step 2A of CAP1616. The design options have been grouped together within design envelopes that illustrate the lateral limits of where routes could be developed based upon design parameters of the aircraft and constraints within the airspace. These design options form the comprehensive list and as described both in sections 6 to 18 for Departures and sections 19 to 29 for Arrivals, they have been tested with stakeholders.

This DOR presents the comprehensive list of options to be progressed to the design principle evaluation, as reported in the separate Design Principle Evaluation (DPE) document.

The DOR forms part of the suite of documents submitted to the CAA at Gateway 2 of the CAP1616 process and is intended to be read alongside these documents.

The full suite of Stage 2 submission documents is:

- The **Stage 2 Summary Document**, which draws together the key points from the Stage 2 submission and provides details of the Government's national programme of airspace change, the CAP1616 process and the progress to date of the ACP at EMA.
- **Design Options Evolution (DOE),** Appendix A to the Stage 2 Summary Document shows the evolution of the design options through Steps 2A and 2B of the CAP1616 process. The resulting shortlist of design options will be considered in the Full Options Appraisal (FOA) at Stage 3.
- This report, **Design Options Report (DOR)**, which sets out the EMA's approach to the design process and the output of that process in the form of design options for both departures and arrivals at the airport. It presents the options identified and describes how those options were refined to provide the comprehensive list of options to be progressed to the Design Principle Evaluation (DPE).
- **Design Principle Evaluation (DPE)**, which assesses how the design options have responded to the design principles established at Stage 1 of the CAP1616 process and identifies those design options that warrant further analysis at the next step.
- **Initial Options Appraisal (IOA)**, building on the results of the DPE, the IOA is the first of three option appraisals required as part of the CAP1616 process. The purpose of the IOA is to provide, at a minimum, a qualitative assessment of each design option providing stakeholders and the CAA with the relative differences between impacts, both positive and negative; and

- The **Stakeholder Engagement Report (SER)**, which explains how engagement has been used in the processes described in the other Stage 2 documents and records its outputs.

These reports, together with their supporting appendices, will be published on the CAA Airspace Change Portal www.airspacechange.caa.co.uk.

1.2. Document Overview

CAP1616 Step 2A requires the change sponsor to develop a comprehensive list of design options (to the extent that a list is possible) that address the SoN and that align with the design principles. This DOR is our response to that requirement and presents the process followed to arrive at a comprehensive list of design options for evaluation against the design principles as illustrated below:

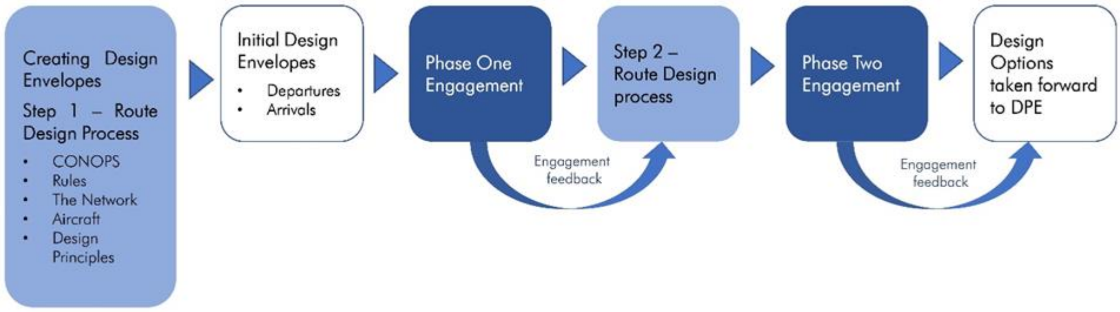

Figure 1: Design options process

This DOR first describes the background to the design work undertaken during Step 2A including the rationale that supports the design options. This includes:

- Details of the current operations at EMA (section 2.2).
- The list of design principles developed through the two-way engagement process with key stakeholders (section 1.3).
- An explanation of the interaction between the EMA Future Airspace project and the NATS en-route (NERL) Airspace (section 3).
- Details of the future operational requirements at EMA, the core assumptions, the definition of 'do nothing' and 'do minimum' scenarios, and the controlled airspace requirements (section 4).

A description of the process used to develop the design options is provided (in section 5). This section also includes a description of the development of an initial design boundary, the application of design constraints and assumptions to create design envelopes and the subsequent development of design options within those design envelopes.

Finally, a description of how we have taken account of discussions with key aviation stakeholders, including NERL, Manchester Airport (MAN) and Birmingham International Airport Ltd (BIAL) in the development of the options is set out in sections 5.9 and 5.10.

Sections 7 to 18 provide detail of the departure design options and sections 19 to 29 provide detail of the arrivals design options, taken together they form the comprehensive list of options. These sections describe each design envelope in turn, along with each design option within the relevant envelope, including the 'do minimum' option where this is located within the relevant envelope. A description of how each design envelope and the design options it contains were developed is provided, alongside a description of the characteristics of the design envelope and design options.

The design options presented in this DOR have been grouped into 'Unviable', Viable but Poor Fit (lettered options[1]) and Viable and Good Fit (numbered options[2]). The basis for these groupings is described in further detail in section 5.11 and summarised in the table below.

Classification	Criteria	Outcome
Unviable	Would not fully comply with the requirements of PANS-OPS 8168 or did not have an approved safety justification for the lack of non-compliance.	These options were not designed, due to a lack of compliance with the required standards. As a result, no such options were progressed to the DPE.
Viable but Poor Fit	A clear failure to align to one or more of the three 'must have' design principles (Keeping the Skies Safe (Safety), A Joined-up Approach (Programme) and Meeting Demand (Continuity)) with which all design options **must** comply.	These are identified as lettered options[1] and were not progressed to a full evaluation in the DPE. However, a rationale for misalignment to one or more of the three 'must have' design principles is included in both this DOR and the DPE, including the results of any trade-off analysis.
Viable and Good Fit	Expected to meet the three design principles with which all design options 'must' comply (Safety, Programme and Continuity).	These are identified as numbered options[2] and were progressed to a full evaluation in the DPE.

Table 1: Options viability – summary table

Both the Viable and Good Fit and the Viable but Poor Fit options are incorporated within the comprehensive list of options. Only the Viable and Good Fit options are progressed to a full evaluation in the DPE, although the initial evaluation of the Viable but Poor Fit options against the 'must have' design principles is included here and in the DPE. The Unviable options referred to within this DOR were not progressed to the DPE, as they did not comply with the relevant standards, address the SoN or meet the three design principles with which all design options 'must' comply.

Within the relevant departure and arrival sections of this DOR, each Viable and Good Fit option is described and illustrated by a chart showing the path of the designed track over the ground. The rationale for including the option is also provided. A detailed evaluation of the

[1] The lettered options are formed of alpha and numeric characters e.g. A8 or D12.
[2] The numbered options commence with a numeric character e.g. 1, 2, 3, and on a small number of occasions have an alpha character suffix e.g 1A.

options against the design principles is not provided; these evaluations are contained in the DPE.

Each section also contains a written description of the Viable but Poor Fit options. As these design options fail to align with at least one of the 'must have' design principles, they have not been designed and are not described to the same level of detail as the Viable and Good Fit options.

For both departures and arrivals, the design options are presented on an envelope-by-envelope basis with an analysis of all design options within each envelope. runway 09 is considered first followed by runway 27.

The full design options evolution can be found within the DOE, which forms Appendix A to the Stage 2 Summary Document.

1.3. Design Principles

CAP1616 requires a list of design principles to be created, informed by two-way engagement with stakeholders. These were developed at Stage 1 and function as a framework which underpin how the EMA design envelopes and design options were developed. The design principles are listed in Table 2:

Title	Category	Description
Keeping the skies safe	Safety (S)	Safety must take precedence over all other factors. Flight paths must be safe for airspace users, the airport, and communities on the ground.
A joined-up approach	Programme (P)	Any changes must align with the broader national airspace modernisation strategy, comply with national, international and industry regulations and legislation, and align with current and future Airspace Change Programmes in the north and south of the UK through involvement in the Future Airspace Strategy Implementation groups.
Meeting demand	Continuity (C)	New flight paths must ensure the continuation of services offered today and meet any future demand, in keeping with local and national planning policy, and the Government's policy on 'making best use' of existing runway capacity.
Limiting our footprint	Emissions (E)	Flight paths that limit and, where possible, reduce emissions should be implemented.
Sharing the load	Noise 1 (N1)	Flight paths should, where practical, be spread out to avoid concentration of aircraft activity to share any noise impacts.
Responsive flight paths	Noise 2 (N2)	Where flight paths have to overfly communities, we will consider existing noise in the local area, and will select flight paths to mitigate effects on areas with relatively low levels of ambient noise.
Limiting disturbance	Noise 3 (N3)	Flight paths should seek to limit and, where possible, reduce noise disturbance to communities – especially at night.

Title	Category	Description
Noise sensitive locations	Noise 4 (N4)	Flight paths should, where practical, avoid locations that are especially sensitive to noise.
Fit for the future	Airspace 1 (A1)	Flight paths should be designed to future proof our airspace and should not be constrained by existing arrangements.
Airspace for all	Airspace 2 (A2)	Our controlled airspace should be open to all authorised users; however, priority will be given to airport air traffic over other airspace users, except for emergency aircraft.
Enhancing technology	Technology (T)	Flight paths should be designed using the latest, widely available navigational technology and flying techniques.

Table 2: EMA Agreed Design Principles

1.4. EMA Future Airspace Project - Next Steps

1.4.1. Developing and Assessing Operating Networks

Consistent with the requirements of Step 2A of CAP1616, we have undertaken a design process to identify a comprehensive list of route options. In Step 2A, these route options have been evaluated against the design principles that we identified through stakeholder engagement in Stage 1. This work is reported separately in this document and the DPE. Those that best align with the design principles were carried forward in the process to Step 2B.

Design options carried forward to Step 2B have been subject to an initial appraisal. The findings of that appraisal are set out in the IOA and the accompanying assessment tables. The IOA has enabled us to identify a shortlist of design options.

The shortlist of design options has benefited from extensive engagement with stakeholders, including the general public. Among these stakeholders were other sponsors of airspace change including NATS as the en-route airspace provider, airlines and other airports with whom EMA may interact. Therefore, there is confidence that our shortlist and proposals are flexible enough to provide compatibility with proposals emerging from other change sponsors, in so far as they are known at this time.

We will continue to work with other change sponsors, including NATS, to ensure that, consistent with the UK's Future Airspace Strategy, we realise the benefits of modernising airspace arrangements. This will include:

- Further work to understand and resolve interdependencies and design conflicts with NATS and adjacent airports as part of the Cumulative Assessment Framework (CAF) process, particularly routes to the west, south west and south east.
- Supporting NATS in their work to create new CAS to the east of EMA.
- Detailed design work to combine individual EMA design options into networks of routes as part of the wider network system.

- Providing information to NATS to inform their development simulations for the MTMA, which will test these emerging system concepts.
- Working with NATS and other design teams involved with the FASI project to define EMA routes to and from the south.

This work will also allow us to combine our options into operating networks. Defining networks of routes that support operations to and from EMA will allow us to undertake the more detailed assessment at Stage 3 and allow us to understand the extent to which we are able to provide noise respite and relief to those that are most impacted. The introduction of PBN which, consistent with the requirements of the AMS, is integral to our proposals, will increase the accuracy with which aircraft fly and is likely therefore to lead to greater concentration on any single flight path. In exploring different combinations of routes and their role in a network, we will be guided by the Government's objective to minimise the total adverse effects on people on routes below 4,000ft.

1.4.2. Options Appraisal

The IOA that we have completed is the first of three appraisals required under CAP1616. The operating networks that result from the steps we set out at section 1.4.1 will allow us to undertake the more detailed Full Options Appraisal (FOA) required at Stage 3. This further assessment will make much greater use of quantitative data. As the FOA will consider fewer options, it will allow us to explore local factors including tranquillity and biodiversity in greater detail than has been possible to date, though this more detailed assessment will benefit from the data we have collated and reported at Stage 2.

Whilst the IOA considered the characteristics of each route option, the FOA will also consider operating networks. This assessment will require an estimate of the numbers and types of aircraft that will fly each route in a network. To facilitate this assessment, we will prepare detailed air traffic forecasts.

The assessment of operating networks will also allow greater consideration of some important factors, reflected in our design principles and for which the assessment in the IOA was limited due to routes not being developed as a system, or combined with the designs of the en-route network and adjacent airports. These include noise, emissions, capacity and safety. In defining the full range of criteria that we assess in the FOA we will be guided by CAP1616 and will take account of the information in Appendices B and E.

Our approach to the FOA and the way we will consider and collect the key information is set out in greater detail in the IOA at section 8.7.

1.4.3. Policy for the Design of Controlled Airspace Structures

On 12th October 2023, the CAA published an updated version of SARG Policy 126 (Policy for the Design of Controlled Airspace Structures), replacing the former policy statement dated 11 August 2022. This policy provides technical design criteria for controlled airspace structures and has been used to inform both the creation of the comprehensive design options, and to assess these options within the DPE and IOA process. The updated policy statement has a number of changes, including reductions to the design criteria and separation standards that ensure containment of instrument flight procedures, and which therefore may have a bearing on the design options created as part of this ACP.

The EMA Stage 2 submission including the DPE and the IOA assessed alignment of the design options with the August 2022 policy on the design of controlled airspace structures, which was in force at the time those assessments were carried out. As this policy was so recently superseded, the change sponsor has therefore undertaken a preliminary review of the updated October 2023 policy and the design options. It has concluded that, although the changes may impact a number of arrivals options and departure options, no design options would be prematurely discounted as a result of not having applied SARG Policy 126. It was concluded that the application of the up-to-date policy in substitution for the 2022 policy would not materially change any of the outcomes in the DPE and IOA. Consequently, it is unnecessary to revise the EMA Stage 2 submission.

This EMA Stage 2 Gateway submission is therefore based on the previous iteration of the SARG Policy 126, dated 11 August 2022. However, further work to confirm alignment with the new 12 October 2023 policy will be conducted within Stage 3A and beyond. Similarly, all future work will be conducted in line with this revised October 2023 policy – or any successor.

1.4.4. Controlled Airspace

As there is the potential for routes to be refined or amended, as referred to above, it would be premature to define future Controlled Airspace (CAS) requirements at this stage. As such, we will identify CAS requirements for groups of options during Stage 3. All stakeholders will be provided with an indication of the CAS requirements within our Step 3C Consultation material, and the comments received will be taken into account and considered as part of the consultation analysis activities in Step 3D. More details of this approach are provided at section 4.5.

1.4.5. RNAV Substitution of Existing Routes

The proposals being developed by MAG and other sponsors within the MTMA cluster are complex and will not be implemented for several years. Given the intention to rationalise the network of DVORs (Doppler VHF Omni-directional Range) across the UK, it will be important that aircraft are able to continue to operate safely and efficiently in the intervening period between this rationalisation and the new arrangements being introduced. EMA intend to use the CAP1781 process provided by the CAA to provide a temporary solution using RNAV (Area Navigation) substitution, which will maintain the current network of routes with no change in aircraft behaviour, pending the full implementation of this airspace change. CAP1781 allows new technology - RNAV – to be used to maintain existing departure routings (SIDs). To support this, we will work with airlines to ensure they implement any required technical changes to their systems. The CAP1781 process has begun and will run in parallel to this airspace change. We expect to conclude this separate change process in 2024.

1.4.6. Updating Stakeholders

The completion of the work required at Stage 2 has developed and refined the design options available at EMA, as well as expanding the understanding of stakeholders' views on those options. While it is not a requirement of the CAP1616 process, all stakeholders will be provided with the information submitted to the CAA at the conclusion of Stage 2 and given the opportunity to discuss the content and ask questions. This will include details of the feedback gathered at phase two of engagement, the revised route options and the assessments undertaken as part of Step 2B. This will ensure that they remain informed of the development of the Airspace Change Proposal at EMA ahead of the full public consultation exercise at Stage 3.

2. Current Operations and Future Airspace Design Principles

2.1. Overview

In 2019, EMA submitted a SoN to the CAA, setting out why an airspace change was necessary. This step was completed in July 2019 when the CAA approved the SoN, agreeing that EMA should initiate an airspace change, with a provisional assessment of 'Level 1' and an allocated reference 'ACP-2019-44'. In accordance with paragraph 108 of CAP1616, the CAA's confirmation of the level will follow once the change sponsor has completed its option development and options appraisal (Steps 2A and 2B respectively).

Further details of the SoN and the requirements it sets out are in section 5.2.

2.2. Current Operations

EMA has a single runway, orientated in an east-west direction, as shown in Figure 2 below.

Figure 2: EMA runway orientation

Aircraft take off and land into wind, and because of the UK's dominant wind direction, westerly operations are predominant. Over the last 20 years the split is approximately 75% westerly using runway 27 and 25% easterly using runway 09.

EMA serves just under five million passengers a year. In addition to this important role as a regional passenger airport, EMA is the UK's largest dedicated air-cargo airport, processing and transporting over 400,000 tonnes of cargo a year. These cargo operations play a significant part in the way that the airport operates, with a relatively high proportion of annual movements taking place between 20:00 and 04:00.

Currently, arrival and departure routes at EMA do not fully utilise the capability of modern aircraft navigation technology and techniques due to their reliance on ground based navigation aids. This was reflected in the SoN and led to the development of the design principles highlighted in section 1.3.

The number of aircraft arrivals and departures in 2020 and 2021 was significantly affected by the COVID19 pandemic with a reduced number of passenger aircraft movements and an increased number of cargo movements as shown in Figure 3. Whilst 2022 showed a return towards pre-pandemic trends, instability in the industry continued to impact operations in both passenger and cargo movements.

During 2023, passenger operations have showed a steady recovery towards pre-pandemic levels. The number of cargo movements has reduced compared to 2020 and 2021 levels. As EMA operations continue to stabilise, we expect this trend to continue albeit with some cargo growth retained, and for 2023 to be a more representative year. However, in the meantime, the calendar year of 2019 represents the last full year of (pre-pandemic) normal operations and has therefore been used as the baseline for analysis in the DPE and IOA, as it most closely reflects 'normal' operations.

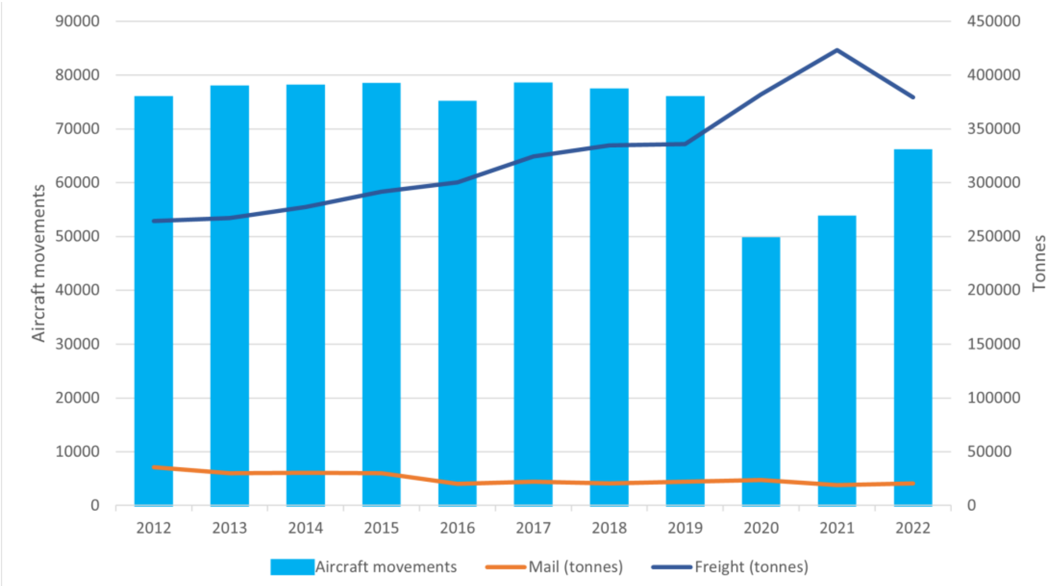

Figure 3: Annual traffic statistics 2012 to 2022

The current operation at EMA can be summarised as follows:

- Runways 09/27 are open 24 hours a day, both have certified Instrument Landing Systems (ILS) with runway 09 supporting CAT I approaches, whilst runway 27 supports CATII/IIIb approaches. This means that aircraft can land on runway 27 when visibility or cloud base is less than that permitted for landings on runway 09.
- For noise mitigation purposes the default runway entry point for departing aircraft on runway 27 is moved to the west between the hours of 22:00-07:00 (local time), thereby reducing the noise impact on communities to the east of the airport generated by the engines at the start of the take-off roll.
- Westerly is the preferred operation as it minimises the impact of aircraft noise on local communities and has fewer operational constraints on departures. It is therefore maintained until the tailwind component is above 5 knots. This is the maximum UK CAA authorised tailwind component.

- Due to the location of EMA, arriving traffic and departing traffic within the upper airspace network is managed by two NATS en-route Air Traffic Control Centres (ATCC). Traffic to/from the north is managed by the Scottish ATCC at Prestwick and traffic to/from the south being managed by London ATCC at Swanwick.

- The airport is used by a number of airlines to conduct training flights. However, these do not fly a Standard Instrument Departure (SID) and are practising the initial stages of departure and the final stages of landing with a short circuit in-between. The circuits they fly are flown at a lower altitude under the supervision of ATC. As a result, the changes being made under the ACP do not apply to training flights and will have no impact on their operation.

Further details of current operations and traffic flows can be found in section 8 of the Stage 2 Summary Document.

2.3. NATS DVOR Rationalisation Programme

The current departure and arrivals procedures at EMA rely upon a number of ground based Doppler Very High Frequency Omni Range (DVOR) navigational aids. These are part of a national network which, at the time of installation in excess of 40 years ago, were used by both commercial aircraft and general aviation as a means of navigation and position fixing. These facilities are owned and operated by NATS within their obligations as the national ATC provider.

This DVOR infrastructure is now operating significantly beyond its design life which means that either replacement or withdrawal has become necessary. As a result, the CAA has given NATS the approval to reduce this DVOR infrastructure from 46 to 19 facilities. This number was predicated on:

- The advances in commercial aircraft technology, meaning that these aircraft no longer need to use these facilities.

- The global requirement for commercial aviation, ATC and airports to transfer to procedures based on PBN, which is reflected in both the ICAO Global Air Navigation Plan (GANP) and subsequently the UK AMS.

- The continued requirement for general aviation to use a limited number of these facilities as an aid to navigation. General aviation are not subject to the requirement to transition to PBN.

At EMA, there is a reliance in current procedures upon the DVORs at Brookmans Park (BPK), Daventry (DTY), Trent (TNT) and Pole Hill (POL). Of these, BPK, DTY and TNT are all scheduled to be removed from service which is driving the need to upgrade any procedures based on these facilities to PBN standard.

Although POL is remaining, there is still a need for EMA to upgrade any procedures based upon this DVOR because of the PBN requirements within the AMS. The POL DVOR will therefore remain in use, but by general aviation only.

2.4. Departures

Most departing aircraft follow a set of routes called Standard Instrument Departures (SIDs). A SID simplifies the departure process by providing the pilot and the aircraft's flight management system with several 'waypoints', which the aircraft follow. As described in section 2.3, these SIDs are required to be upgraded to PBN, either as a result of their reliance upon DVORs that are being withdrawn or in accordance with UK and international requirements.

These requirements to upgrade to PBN are reflected in the AMS and referred to in the EMA Design Principle 'A joined-up approach' (Programme) with which the EMA design options must align.

For departures there are currently four Standard Instrument Departure (SIDs) for runway 09 and two for runway 27 which are shown in Table 3 with a diagram in Figure 4. These link each runway direction to the NATS en-route airspace network at the SID termination altitude of 6,000ft to the north and Flight Level 90 (FL90) which is an altitude of approximately 9,000ft to the south.

Departure direction	Runway 09 SID (DVOR)	Runway 27 SID (DVOR)
North and West	Trent (TNT) Pole Hill (POL) 07:00-22:00 only	Trent (TNT)
South and East	Daventry (DTY) Brookmans Park (BPK) 00:01-06:00 only	Daventry (DTY)

Table 3: Departure directions and associated SIDs

Of the SIDs listed above, the TNT, DTY and BPK DVORs are all scheduled to be removed from service, although POL will remain. In addition, the BPK SID from runway 09 is due to be withdrawn from use as part of a separate airspace change.

Departing aircraft follow the SIDs until they have reached a minimum altitude which varies according to the SID that the aircraft is on. Above this, ATC vectoring may be used to provide a route to connect to the NATS upper airspace network which results in a dispersed overflight distribution. Departures are typically transferred to the NATS en-route sectors after passing 3,000ft.

Each SID is also contained within one of six Noise Preferential Routes (NPRs) which are shown in Figure 4. These NPRs contain aircraft in a defined area until they reach a minimum altitude of between 3,000 and 6,000ft. Each NPR is 2.4 kilometres wide (1.2km each side of the SIDs) at the point where aircraft can be directed by Air Traffic Control to leave the NPR (in a process called vectoring) and follow a more direct route to their destination.

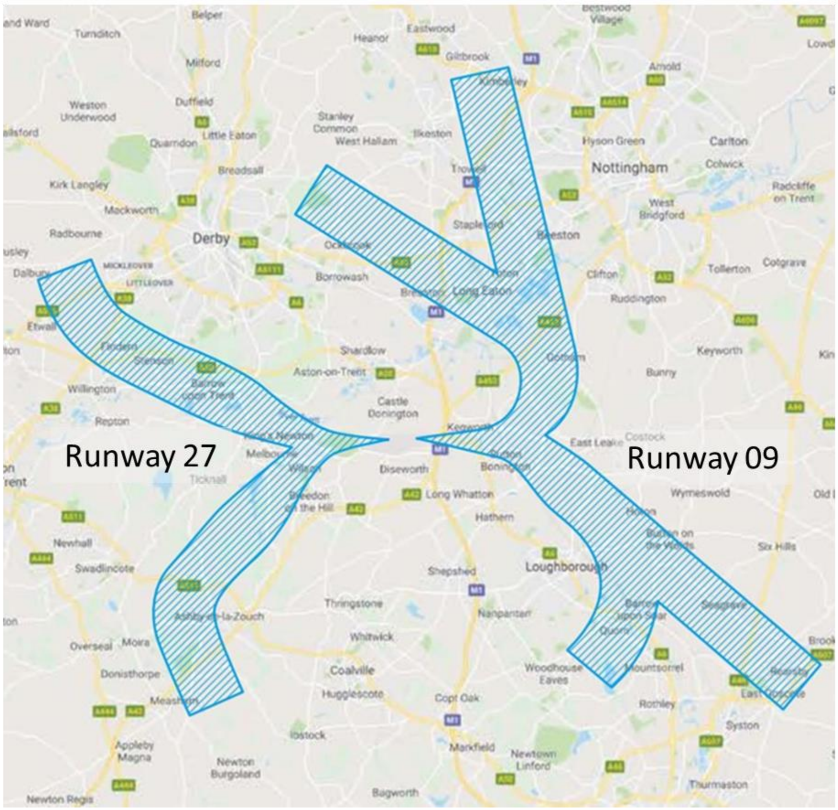

Figure 4: Existing EMA Noise Preferential Routes

The diagrams at Figure 5 and Figure 6 show the distribution of departing aircraft from runways 09 and 27 over a typical summer's day. This distribution is influenced by:

- The design of the SIDs including the location of ground based navigational aids, specifically the DVOR facilities.
- The need to connect to the NATS upper airspace network, and to be deconflicted from the flights to and from other airports including Birmingham.
- The dimensions of the Noise Preferential Routes (NPRs), which encompass the SIDs.
- The rules and regulations regarding ATC vectoring. Once aircraft reach a certain altitude, which varies between 3,000ft and 6,000ft, ATC are permitted to turn the aircraft off the SID, either to create a more direct route, or to ensure separation from other airborne traffic.

The SIDs from runway 27 are deconflicted from arrival routes, meaning that there are typically no restrictions on departures from runway 27. However, on runway 09 operations, the departures are typically subject to a restriction that requires EMA radar control to approve the release due to interactions with the arrival routes. This leads to some departures, from runway 09, having their climb stopped at an intermediate level (typically 5,000ft) until they are clear of the arrival at which point they are climbed either to the SID level or to another level that has been coordinated with the relevant NATS en-route sector.

A buffer zone also exists between EMA and Birmingham ATC primarily for deconfliction of arrival operations to runway 09 at EMA. However, the buffer zone is also relevant on those occasions when a departure from runway 27 is required to climb straight ahead and not follow the SID track for weather avoidance. In this case, the departure is required to level off at 5,000ft until coordination is effected with Scottish (Prestwick) Control.

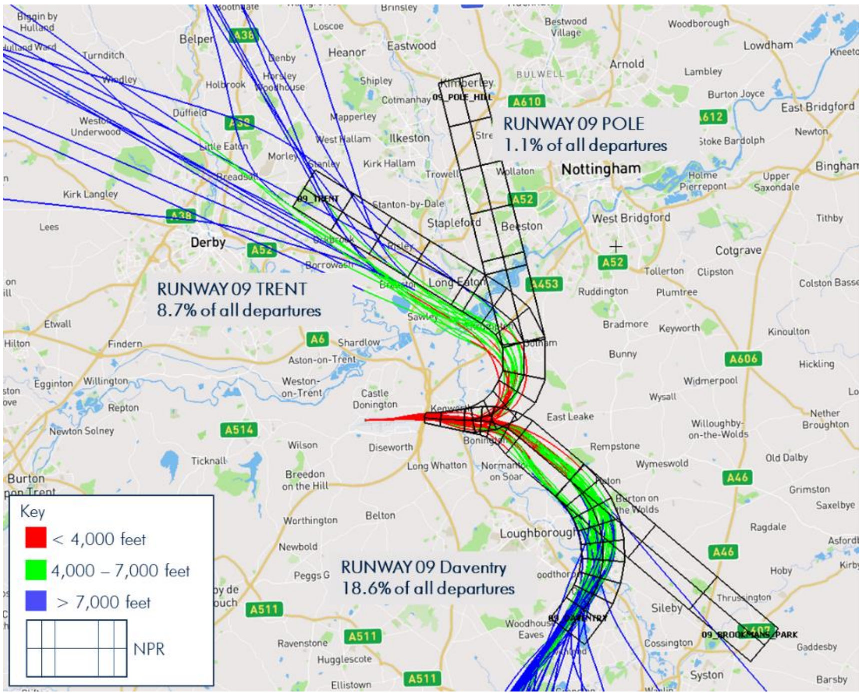

Figure 5: Typical summer's day departures from Runway 09 in 2019

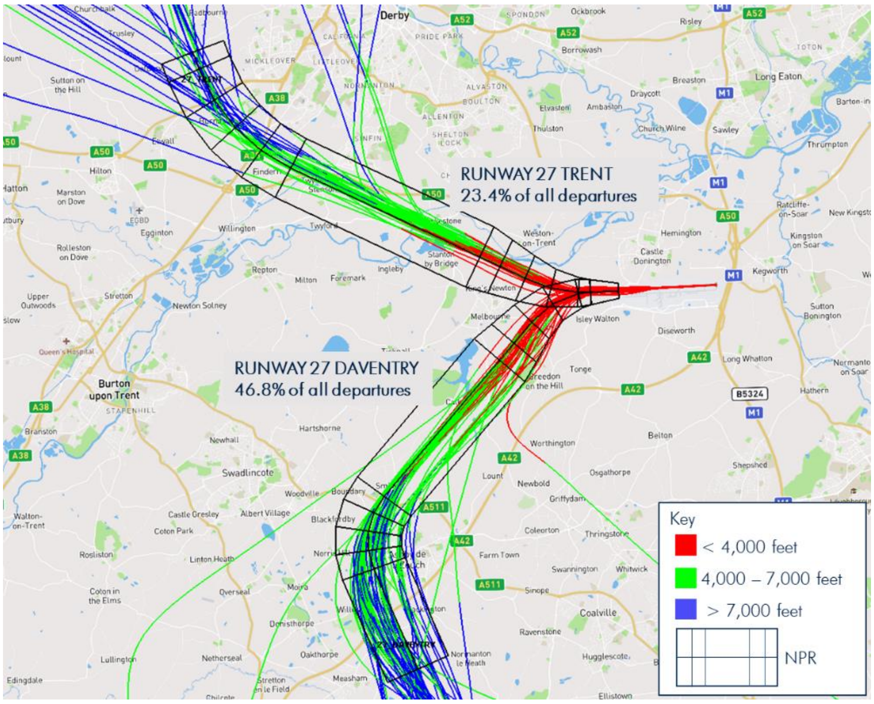

Figure 6: Typical summer's day departures from Runway 27 in 2019

2.5. Arrivals

Arriving aircraft approach UK airspace from several entry points before routing towards one of the two EMA holding stacks at ROKUP and PIGOT which are shown at Figure 7. During busy periods arriving aircraft may be held in one of these before being vectored for their final approach.

Arriving aircraft are vectored and sequenced by ATC to ensure they remain safely separated from other air traffic and to maximise capacity. This involves controlling the speed, direction, and height of the aircraft prior to them being turned on to final approach and following the Instrument Landing System (ILS). Once on the ILS, the flight path is predictable as this provides precision guidance to the aircraft which creates the concentration of tracks that can be seen on the last 6-10 miles for arriving flights.

Wherever possible aircraft will be offered a Continuous Descent Approach (CDA) by ATC which means aircraft descend on a smooth, continuous path from the two holding patterns to the runway. CDAs have an environmental benefit by reducing fuel burn and noise and EMA regularly achieves over 90% compliance for CDA's from 5,000ft.

The diagrams at Figure 7 Figure 8 and Figure 9 show the distribution of arriving aircraft for runways 09 and 27 over a typical summer's day. These show the result of ATC vectoring in creating dispersed tracks between 7,000ft and the point at which they are established on 'final approach' and follow the ILS at between 6 -10 miles from the runway.

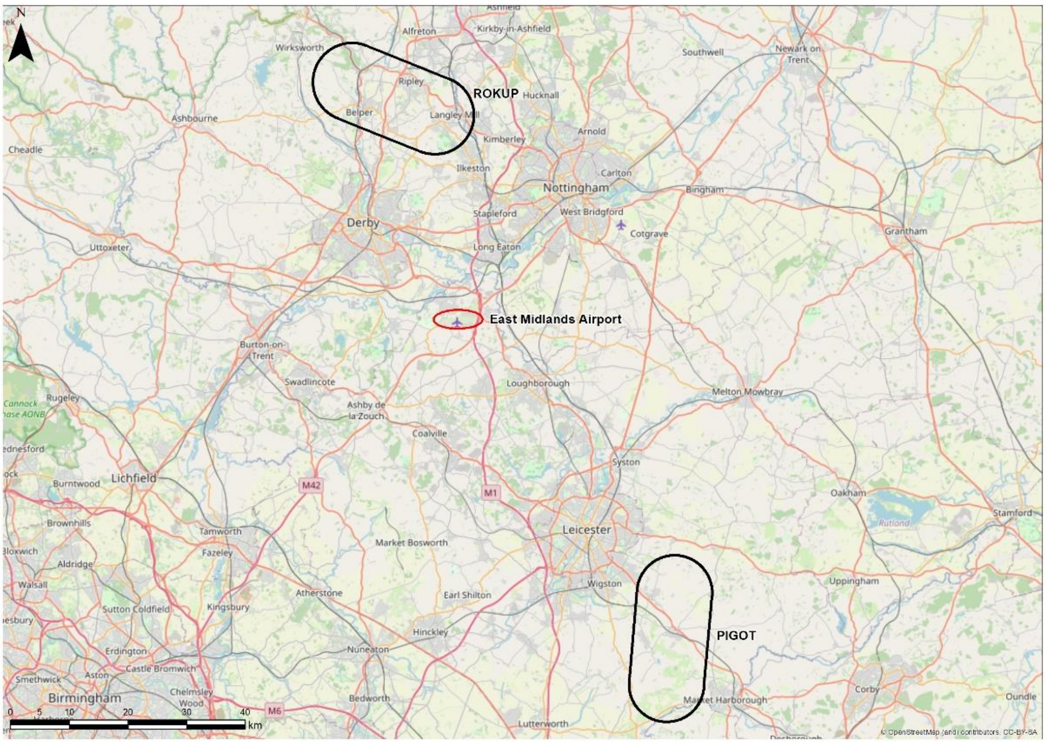

Figure 7: Location of EMA's existing holds ROKUP and PIGOT

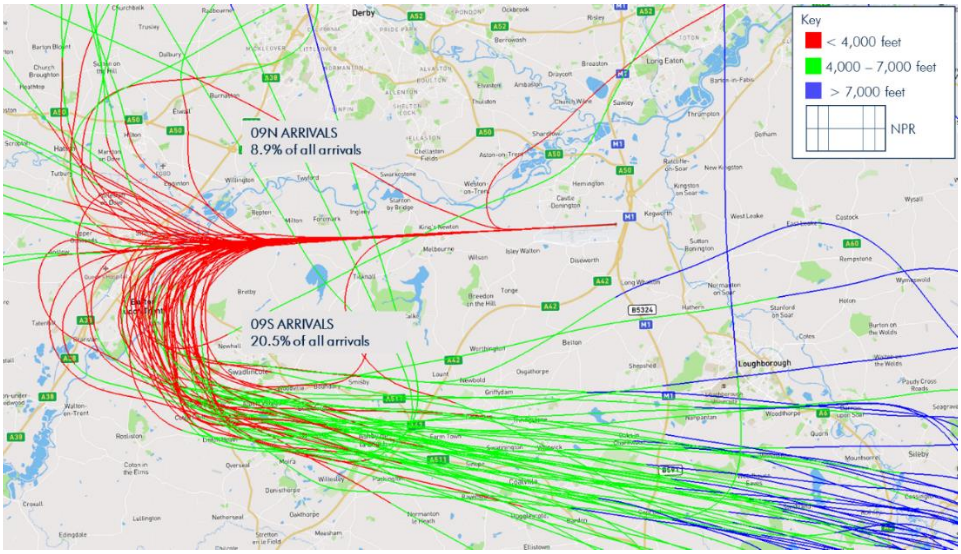

Figure 8: Typical summer's day arrivals onto Runway 09, in 2019

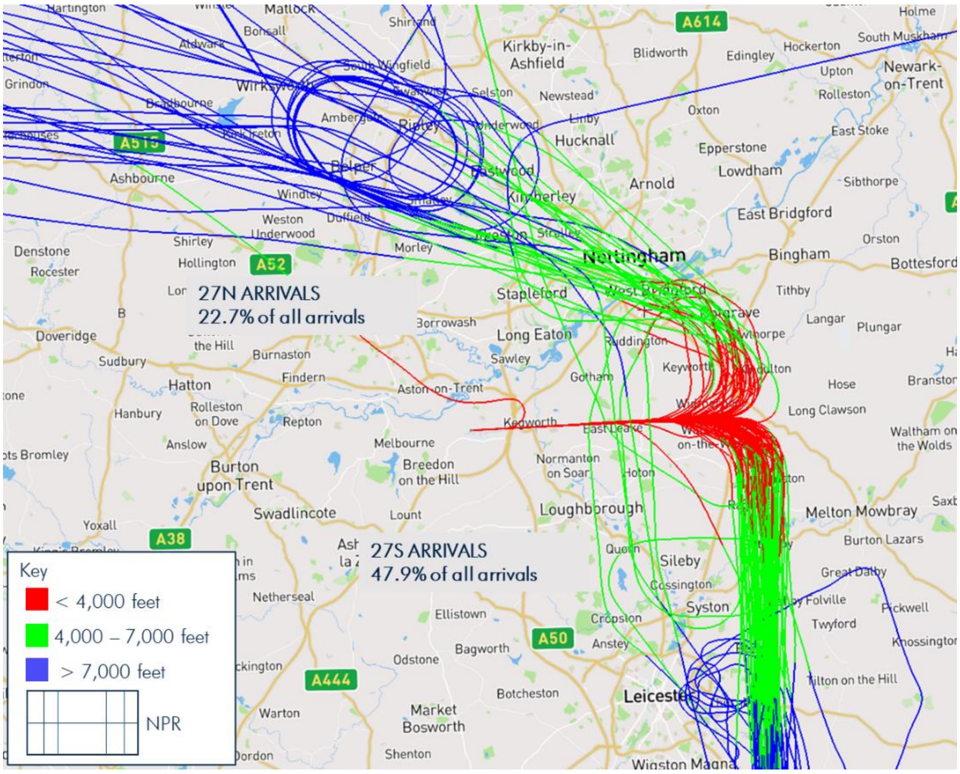

Figure 9: Typical summer's day arrivals onto Runway 27, in 2019

2.6. Alignment to CAP1711 Airspace Modernisation Strategy

The CAA published its refreshed Airspace Modernisation Strategy (AMS) on 23 January 2023, replacing the former AMS dated December 2018. The refreshed AMS pulls together the ICAO Global Air Navigation Plan, the 2018 AMS and also new requirements that the CAA has identified through stakeholder engagement.

Although the initial options design work for EMA Stage 2 was conducted against the version of the AMS (December 2018) in force at the time, EMA have assessed the refreshed 2023 AMS to understand:

- the scope and requirements of the refreshed document.
- apply these revised requirements of the 2023 AMS to the design options and the viability assessment described at section 5.11 of this DOR.

This exercise resulted in the description of some options within this DOR being amended, and the rationale in the viability filter being reworded to reflect the reduction in the 'Ends' (from six to four) that modernisation of airspace must deliver.

However, the changes within the 2023 AMS did not require any amendments to be made to the design of options that had been presented to stakeholders.

All references to the AMS within this DOR are to the January 2023 version, and all subsequent assessment work within the Design Principles Evaluation (DPE) and Initial Options Appraisal (IOA) were also carried out with reference to this 2023 AMS.

3. Connection to the NATS En-route (Network) Airspace

3.1. Overview

Consistent with the Design Principle Programme and alignment to the AMS, it is essential that the future EMA airspace design is developed in association with, and to align with, the UK en-route airspace network and with the Future Airspace Strategy Implementation (FASI) programme.

FASI is the programme to redesign the entire airspace in the UK, including the airspace below 7,000ft surrounding airports used predominantly for departures and arrivals, and the en-route national airspace structure above 7,000ft.

FASI is a complex airspace design programme and the CAA's AMS requires coordination between the different sponsors of airspace change. These sponsors include airports in proximity to EMA such as Manchester (MAN) and the national ATC provider NERL, who are responsible for airspace change above 7,000ft including the upper airspace network. There is also a requirement within the stakeholder engagement process to take account of feedback from airports who are in close proximity to EMA but not part of FASI, and this includes Birmingham (BHX).

Engagement and alignment with NERL is a crucial aspect of the stakeholder engagement process required within CAP1616, and feedback from NERL has been taken into account as part of the engagement carried out at Stage 2.

The NERL ACP which relates to the deployment of EMA Future Airspace is called 'Future Airspace Strategy Implementation – North (FASI-N MTMA), MAN and East Midlands (ACP-2019-77)'. However, given the geographical position of EMA there will also be a need to coordinate design options to the south with NERL in relation to their London Airspace Management Programme (LAMP) (ACP-2020-043, 44 & 45) which is also known as FASI-South.

To inform the NERL airspace change process, EMA initially agreed requirements with NERL which detail what EMA require the NERL airspace to deliver as part of the FASI-N and FASI-S programmes. This led to bilateral meetings and workshops being held with NERL to align their emerging network designs with the design concepts being developed as part of EMA ACP. The result was a set of design assumptions being adopted by both parties, which are summarised in section 3.2 below and included in full at Appendix B. Further detail on the bilateral engagement with NERL is provided at section 5.9. These assumptions were also used to inform the visualisation simulations described in section 3.4.

In addition, this section explains:

- The requirements for the NATS En-route airspace and what this must deliver (section 3.3).
- A summary of discussions with NERL on the network interfaces and the visualisation simulations held by NERL (section 3.4).

- Managing the process within the national airspace masterplan (section 3.5).

3.2. FASI-N NERL MTMA Design Assumptions

Different airport ACPs are progressing through the CAP1616 ACP process at differing rates. To inform the interdependent future airspace network design and the EMA design process, whilst adhering to the design principles of both EMA and NERL's ACPs, a set of assumptions have been agreed between EMA and NERL and are detailed below:

- Whilst EMA sits between both FASI-N and FASI-S, it has been agreed that the EMA change will be deployed as part of the MTMA deployment cluster within FASI-N. NATS Scottish ATCC will remain the controlling authority for the network airspace and routes to the north of EMA and London ATCC to the south.

- There are constraints to this structure based upon the UK Traffic Orientation Structure (TOS) which is established to smooth traffic flows and decrease the safety risks associated with crossing traffic. The TOS dictates a direction of flow (via a one-way system in certain areas of airspace) and takes account of traffic demand, agreements with adjacent Flight Information Regions (FIRs), constraints on controlled airspace and the needs of the military.

- The NERL network is not considering major changes to the UK network COP. Traffic flows to and from airspace outside of the UK will therefore remain substantially unchanged.

- Some changes to the patterns for EMA arriving traffic is expected as NERL create a network within their ACP that is both more efficient and which creates fuel savings. This work will impact the placement of the arrivals structures above 7,000ft. Further information on the impacts of these traffic flows and resulting constraints and considerations can be found in section 5.8.

- Airborne holds will continue to be a design feature for contingency/resilience although they may not necessarily be for routine use. Whilst PIGOT and ROKUP are used in today's operation, there is no assumption on the number or position of these holds in the future. Further information on arrivals holds is contained in section 19.10.

- Whilst Flexible Use of Airspace (FUA) concepts will be explored, the military primacy in danger areas/restricted areas will remain unchanged.

- Where possible, the EMA design options will be developed within the confines of existing CAS. However, as these options are developed into a holistic system-wide solution, additional CAS may be required to provide connectivity to the wider ATS route network, to ensure appropriate separation can be provided, and to realise the benefits of the system wide design. This is in line with the EMA Airspace 1 design principle and the ends of the AMS.

  One area of potential additional CAS is to the east of EMA which responds to feedback from airlines and NERL, and which has the potential to create significant fuel and CO_2 savings. Any proposed changes to either the use or hours of this airspace will be included in coordinated consultation activities between EMA and NERL in Stage 3. Suitable design options that were developed through that process would then be consulted upon more widely in Stage 3 if pursued by EMA. However, for the purpose of creating design options, it has been assumed that it may be possible to make changes to this Class G airspace and the Area of Intense Ariel Activity (AIAA) to the east, and that this airspace will become available.

3.3. Future Requirements of the NATS En-route Airspace

EMA arrivals and departure routes are closely linked with the airspace design of the surrounding en-route airspace, which provides the air traffic service for the inbound and outbound traffic to and from EMA airspace above 7,000ft. As a result, a set of airspace requirements for NATS en-route airspace have been agreed, to ensure the designs of both parties are aligned as part of the FASI-N project within which this ACP will be deployed.

The requirements for NATS en-route airspace are aligned with the design principles and have been agreed between EMA and the FASI-N team. They set out what the future NATS network airspace must deliver in terms of outcomes and ensure the network creates a solution that allows EMA's future airspace to meet the design principles. They do not define options or solutions.

The full list of agreed requirements is provided at Appendix B. In summary, this states that the NATS en-route network should:

- Not be a constraint to EMA's capacity or growth.
- Not result in regular flow regulation being applied to EMA operations, including the Minimum Departure Interval.
- Be capable of supporting departures with an interval of 1 minute on all routes as per current ICAO standards.
- Not cause traffic to and from adjacent airports (including Birmingham and Manchester) to adversely impact the spacing of arrivals and departures to or from EMA.
- Provide CDA and Continuous Climb Operations (CCO) to EMA traffic above 7,000ft.
- Be sufficiently flexible to interface with a principle for EMA to design respite routes below 7,000ft.

In addition, we are required to develop our future airspace in alignment with the Airspace Masterplan, which is developed by ACOG. The process to manage and agree options within this Masterplan is described in section 3.5.

3.4. Network Interface Development: Bilateral Discussions with NERL

As a sponsor of a level 1 ACP, EMA are required to engage with a wide range of stakeholders, including aviation stakeholders such as NERL. At the same time NERL are also undertaking a level 1 ACP which requires them to create a comprehensive list of design options and to engage in a similar way with stakeholders including airport sponsors. This bilateral engagement between NERL and EMA has been achieved via:

- Airspace development workshops.
- Testing our designs with NERL during the formal EMA Stage 2 stakeholder engagement process.

- Participating and commenting in the NERL Stage 2 engagement process as an aviation stakeholder.
- Participating in NERL fast time Visualisation Simulations.

The NERL airspace development workshops were attended by Subject Matter Experts (SMEs) from both NERL and EMA and were created to ensure the NERL design options were a product of co-ordination and agreement between both parties. Further detail is described in section 5.9.

The output from these sessions has been captured in an Airspace Design Workshop Record (ADWR) for the MTMA. This is a NERL document which details the design assumptions used by both parties and contains a long list of potential network concepts which the group considered and discussed. The ADWR document tells the story of how concepts, options and designs have been developed by NERL, and is the formal NERL record of the output from the meetings and was used to support ACP submissions for NERL for the airspace above 7,000ft in the MTMA.

The information and assumptions within the ADWR were subsequently used by NERL to create network visualisation simulations in September 2022 and March 2023. These visualisation simulations are fast-time computer models of airspace and/or route designs, which provide NERL with the opportunity to discuss emerging network concepts with ATC SME staff within NERL. This work primarily addressed routes and holds above 7,000ft and was therefore the responsibility of NERL to complete. However, because this upper network has the ability to influence the design of routes below 7,000ft, airport stakeholders from within the MTMA including EMA, MAN, LPL and LBA were also invited to view the simulations, discuss the concepts and were invited to contribute to the feedback.

These visualisation simulations concentrated on the ability of the upper airspace network to facilitate:

- EMA departures to the west, north west, north and east
- EMA arrivals from the north

Neither departures from EMA to the south and south east, nor the arrivals from the south formed part of these simulations because this airspace is still being developed by NERL as part of the FASI-S project, rather than FASI-N. However as highlighted below, there is a recognised need for NERL to respond to the network interface and airspace change to the south as part of the national airspace master plan.

The NERL output from both of these simulations was treated in the same way as other stakeholder feedback and has been reflected in the design options being presented within this DOR. In particular, the NERL feedback on the interface with their emerging network contributed to the design of departure route options to the east, and the modification of the design envelope and addition of departures route options to the north west, as described in section 6.14. This alignment to the NERL network is in line with the Ends of the AMS with respect to both Simplification and Integration, which is therefore consistent with our Design Principle Programme.

NERL have also undertaken a project to remove the network airspace reliance on the ground based DVORs. This resulted in NERL redesigning all the Standard Terminal Arrival Routes (STARs) for EMA and the two arrival holds at ROKUP and PIGOT to the RNAV1 performance standard. These holds were previously dependant on the DVORs at Trent (TNT), and Daventry (DTY). This project did not result in any change of position of these arrival holds with the change for PIGOT being implemented in December 2020 and for ROKUP in May 2022 in line with AMS and the UK wide programme to reduce reliance on DVORs.

3.5. Managing the Process within the National Airspace Masterplan

As described above, the NERL network is developing separate ACPs for both the Manchester TMA (MTMA) as part of FASI-N and the London TMA (LTMA) as part of FASI-S. Whilst the deployment of the EMA ACP will take place as part of the MTMA cluster, the route structures from EMA to the south, south west and south east need to align with the future network flows of the LTMA. This is because of the location of EMA in relation to the airspace sectors in the NERL network.

Whilst NERL route development and simulation activities are progressing within the MTMA, in the LTMA, NERL are yet to develop a comprehensive list of design options or a future operating network. In addition, whilst concepts have been tested via the visualisation simulations described in section 3.4 above, there are elements of the MTMA design that remain subject to the feedback and agreement of other stakeholders including the military and GA communities.

As a result, EMA do not have full visibility of all aspects of the NERL network design within which we are required to align, which creates uncertainty in relation to:

- Route design option connectivity for departures and arrivals to and from the south and south east that are within the LTMA. These may evolve as a result of the design work within NERL and at other airports.
- The viability of airspace to the north east and east for EMA departure route options. NERL have led conversations with stakeholders including the military and the GA community to engage them on the concepts being proposed and the consequences for the extent of CAS. These areas of CAS are expected to create fuel savings for flights from both EMA and other airports, and if approved, may result in EMA flights needing to join or leave the NERL network in a different place to current operational assumptions. However, at this early stage of the process there is uncertainty as to the exact positioning of these joining points, therefore there is a requirement to maintain flexibility in the proposed options from EMA.
- The exact position of the network join for EMA departures to the north west. This uncertainty resulted in modifications to the design envelope which took account of the NERL feedback and ongoing analysis of traffic flows within the network. This is further described in section 6.14.
- The exact position of the arrival structures envisaged for EMA operations above 7,000ft. These will be subject to both the output of the DPE and IOA in Stage 2 and detailed design in Stage 3 of this ACP as described in section 1.4, Next Steps.

To address this uncertainty, EMA has collaborated closely with colleagues in NERL to create a comprehensive list of options that provide flexibility and have the ability to integrate with a new MTMA network. These discussions with NERL took account of:

- the current network traffic flows and emerging design options for the MTMA including routes to and from MAN, LPL and LBA.
- the options and orientation of the northerly hold for EMA above 7,000ft.
- assumed interface points for EMA flights to and from the south in the absence of a fully developed set of network design options.
- the current routes to and from BHX.
- the requirement to safely deconflict EMA departures and arrivals from each other.

As the NERL designs progress, it is possible that some of our design options will either be misaligned or conflict with their designs (or those of other airports). This may mean that some design options will not be progressed and that some design options will need to be further refined or modified in response to the progress of this work. Similarly, previously discounted options may need to be reconsidered in light of the NERL design work.

We will continue to engage in discussions with regards to both the MTMA and the LTMA in partnership with NERL and other airports to respond to any such interactions in line with the developing national airspace masterplan.

Our proposed approach to address any such further information becoming available is described as part of the 'Next Steps' in section 1.4.

4. Future Airspace – Operations

4.1. Overview

The EMA Future Airspace project has the potential to unlock a wide range of benefits for communities, passengers, airlines, the environment, and the regional economy. It is being progressed in line with UK Government policy which has highlighted the strategic need to upgrade the existing airspace network across the UK. This is supported by a UK wide strategy to modernise airspace, which for airports will require changes to the design of routes and operational ATC techniques used to manage flights below 7,000ft.

The EMA Future Airspace project is one part of this UK-wide programme and further details can be found in the Airport's SoN via the CAA Airspace Portal at airspacechange.caa.co.uk.

To align with the policy and the requirements of the AMS the arrival and departure procedures serving EMA will need to be updated which will enable the adoption of the latest technology, including satellite-based routes. Consistent with the SoN and the design principles, the EMA ACP will also need to deliver an airspace design that enables EMA to continue to grow, to make best use of its available runway capacity, while balancing the needs of communities and the environment in line with Government policy.

This section of the DOR describes the operational concepts incorporated into the design options presented in sections 6 to 29. These concepts outline how we expect the future airspace to operate, and form one of the foundations for the route option designs alongside the SoN, the design principles in section 1.3, information from the airline fleet equipage survey in section 5.5.1 and the rules contained within CAA and ICAO documentation.

These operational concepts were created with reference to this information and consolidated into the Concept of Operations (CONOPS) document described in sections 4.2 and 4.3.

In addition, this section explains:

- The CONOPS (section 4.2).
- The operational concepts within the CONOPS that have been accounted for in the design options (section 4.3).
- The approach taken to defining the 'do nothing' and 'do minimum' scenarios for both arrivals and departures (section 4.4).
- How Controlled Airspace (CAS) requirements have been considered at Stage 2 and will be considered further at Stage 3 (section 4.5).

4.2. Operational Concept (CONOPS)

The purpose of the CONOPS is to outline the operational concepts that will be used to deliver the benefits from the EMA Airspace Change project, consistent with the agreed design principles. In addition, it describes the air traffic management techniques that will be used to manage the proposed system of routes.

The CONOPS does not contain any airspace designs or routes. Rather, it outlines the concepts to be considered and incorporated into those designs and provides one of the foundations, alongside the design principles at section 1.3, for the development of the design envelopes and associated design options for departures and arrivals. The design options presented in this DOR take account of this document.

4.3. CONOPS: Future Operating Concepts

The CONOPS outlines the following future operating concepts that have been used to create the design options presented in sections 6 to 29 :

a) Scope of Design: EMA will be responsible for the redesign of inbound and outbound routes and procedures from the runway up to and including 7,000ft. This is in line with the responsibilities for airport sponsors within CAP1616. Above this altitude, the responsibility rests with NERL, and this includes the responsibility for the creation of any new network airspace, and the delay absorption procedures for all upper airspace including the airborne holds.

b) Performance Based Navigation (PBN) Standards: Currently, the airport relies on conventional ground based Doppler Very High Frequency Omni Range Radio Beacons (DVOR) navigational aids that are reaching the end of their operational life. In accordance with international obligations to transfer to Performance Based Navigation (PBN), there is a UK wide plan for these aging navigational aids to be withdrawn and this plan is reflected in the AMS. In addition, the Design Principle Technology requires the route designs to be based upon the latest aircraft technology widely available. With these requirements in mind and based on the results from the airline fleet survey described in section 5.5.1 the designs shall meet the requirements of all PBN mandates and will use:

- RNAV1 as a minimum and if required, RNP1.
- RNP Approach (RNP APCH) as the design standard for arrivals.
- ILS as the primary means of precision approach using a 3°descent gradient.

c) Network connectivity: The airspace change will be in accordance with the CAA AMS. Any change must allow connection to the wider UK en-route network and be aligned with the FASI-N and FASI-S programme and take into consideration the needs of other airports.

d) Continuous Climb: Consistent with the 'must have' Design Principle Programme and the AMS end that relates to improved environmental performance, all SIDs will be designed to provide continuous climb operations (CCO) from runway to an agreed joining point with en-route airspace (assumed to be 7,000ft unless agreed otherwise with NATS). Adopting continuous climb profiles also aligns with the design principles Emissions and Noise 3.

e) Continuous Descent: Similarly, all arrival routes will be designed to provide continuous descent approach (CDA) profiles from an agreed exit point at 7,000ft from en-route airspace to the joining point with the final approach.

f) Future proofing: In line with the Design Principle Airspace 1, flight paths should be designed to future proof EMA operations and should not be constrained by existing arrangements. This includes the current system of NPRs which will be reviewed and updated at a later stage in the process once the final routes have been agreed.

g) Runway capacity: In line with Government policy, the objective is to make 'best use' of existing runway capacity which may include changes to how some routes are used.

h) Systemisation: As described in section 2.5, arriving aircraft are currently vectored by ATC onto the final approach. In the future, and consistent with the AMS and the Design Principle Airspace 1, future routes will be designed to accommodate the principle of systemisation which entails reduced ATC intervention. The result is PBN routes that are de-conflicted by design and in accordance with CAA CAP1385 Performance-based Navigation: Enhanced route spacing guidance. For departures, this is anticipated to result in a significant reduction in tactical vectoring by ATC, with an increased number of aircraft remaining on their SIDs until joining the NATS upper network airspace. For arrivals, a reduction in vectoring is expected on the initial transition below 7,000ft, but to ensure safe separation between arriving aircraft is maintained, and runway capacity is used efficiently, some vectoring will be required prior to aircraft joining final approach. This vectoring may also provide a means to provide noise relief in accordance with Design Principle Noise N1. However, until departures and arrivals have been developed into systems that are safe, maintain the required separation from the routes at EMA and other airspace users, and which link into the NATS network, it is not possible to predict the scale of this vectoring or where it may take place. Work to develop these areas will take place in Stage 3 as the shortlisted design options are combined into operating networks.

i) Separation standards: Where systemisation is being applied between routes, the separation standards will be in accordance with those within CAA CAP1385 which is the guide for enhanced route spacing guidance. Where ATC vectoring is applied, the minimum radar separation will be 3nm.

j) Controlled Airspace (CAS): Consistent with the AMS and Design Principle Airspace 2, the route designs should minimise the impacts on other airspace users by limiting the need for additional Controlled Airspace (CAS). However, as the AMS also highlights the need for a balance between the requirements of various types of users, and the need to improve environmental performance, if it is possible to propose changes to the use or dimensions of CAS which provide a benefit to commercial operations these will be explored, and stakeholders will be engaged and consulted with.

4.4. 'Do Nothing' and 'Do Minimum' Options

The CAP1616 process requires the change sponsor to consider the 'do nothing' scenario and, as is the case at EMA, if 'do nothing' is not a feasible option, to consider the 'do minimum' option(s). The 'do nothing' scenario is used as the baseline for comparison in the options appraisals, including the IOA. The 'do minimum' options represent an 'informed view of the future', and describe the minimum changes required to address both the issues with the 'do nothing' scenario that mean that it is not a feasible option and to begin addressing the issues identified in the SoN. The 'do minimum' options are listed as design options in this DOR, so that they can be compared with other design options.

A description of and rationale for both the 'do nothing' scenario and the 'do minimum' options for both arrivals and departures is provided below.

4.4.1. 'Do Nothing' Departures Scenario

The 'do nothing' scenario for departures would mean that, when the ground based beacons (specifically DVORs) are taken out of service, there would be no published procedures for aircraft to fly.

These DVORs are expected to be phased out from early 2024, which is before the implementation of this airspace change. CAP1616 requires that the context is considered in defining the 'do nothing' scenario. EMA intends to follow the process under CAP1781 to allow the substitution of the current routes using PBN (specifically RNAV) on a temporary basis as commercial aircraft flying into EMA are already capable of flying these routes. This capability is evidenced by the results of the airline fleet equipage survey in section 5.5.1. Any aircraft unable to comply with these RNAV substitution routes will be provided with a bespoke clearance and radar vectors by ATC.

The assumption is that the implementation of CAP1781 will result in no changes in aircraft behaviour. This is based upon:

- CAP1781 (Page 6), which states that RNAV Substitution is intended to maintain existing tracks over the ground for an agreed period, during which the affected airspace is being redeveloped. The process also makes it clear that the CAA approval to use RNAV substitution is based on a demonstration that the aircraft tracks over the ground will be unchanged.
- To provide further assurance, the process requires sponsors to undertake pre and post monitoring of track keeping. This includes the use of existing ground tracks from which to monitor performance and, following decommissioning of the DVORs, these will be used as the baseline from which to monitor post implementation aircraft performance.
- The Flight Management System (FMS) coding providers have agreed to maintain their coding in accordance with Aviation Data Quality requirements which ensures any proposed coding changes will be agreed with the sponsor and the CAA.

EMA have therefore commenced the process to follow the CAP1781 guidance as required (including the pre and post implementation monitoring of track keeping) to assure the CAA and stakeholders that the assumption on there being no changes in aircraft behaviour is correct. This will include notifying airlines of the intention to apply RNAV substitution for them to ensure that all requirements of CAP1926 (General Requirements and Guidance Material for the use of RNAV Substitution) that apply to airlines are implemented.

By following this guidance, the reliance on the DVOR network will have been removed before the EMA Future Airspace project is implemented. However, the guidance under CAP1781 only allows for these substitution routes to be used for a maximum of five years. Therefore, a long-term solution is required to avoid these substitutions being removed from publication. Without a long-term solution, ATC would be responsible for issuing individual instructions to every aircraft prior to and during departure because the route would no longer be published.

The Design Principle Programme states that we must comply with the CAA AMS, and the 'do nothing' departures scenario would fail to do this. This is specifically in relation to the AMS end Simplification, which seeks to use the ability of technology to reduce complexity and improve efficiency:

"Consistent with the safe operation of aircraft, airspace modernisation should wherever possible secure the most efficient use of airspace and the expeditious flow of traffic*[3], accommodating new demand and improving system resilience to the benefit of airspace users, thus improving choice and value for money for consumer."

In addition, this removal of standardised instructions to aircraft would:

- Not align with the Design Principle Technology requiring the use of the latest navigational technology and flying techniques.
- Result in random track dispersal (due to ATC vectoring) which would not provide us with the opportunity to design routes that minimise noise. While random track dispersal would potentially aid in the achievement of Design Principle Noise N1 (which seeks to spread out the noise as a means of sharing), it does not align to Design Principle Noise N3. This requires us to minimise the number of people overflown, which would not be possible with random track dispersal as it is likely to increase the number of people overflown. It would also remove the ability to avoid locations that are especially sensitive to noise, as referred to by Design Principle Noise N4.
- Significantly increase ATC workload which would lead to a reduced traffic flow. This fails to meet the Design Principle Continuity, including the need to make best use of existing runway capacity.

Because the 'do nothing' departures scenario does not align with the 'must have' Design Principle Programme it is not a viable option and will not be carried forward as an option for assessment within the DPE. Indeed, the 'do nothing' scenario may very well represent a worsening in comparison with the current position.

However, applying the assumption to the 'do nothing' departures scenario that the substitutions permitted by the guidance in CAP1781 continues beyond the five-year deadline provides the best representation of today's operation. Therefore, whilst the 'do nothing' departures scenario is not a feasible option, it is used as a theoretical baseline within the DPE and IOA for comparative purposes only and to enable stakeholders to understand the impact/effect the 'do something' options would have.

4.4.2. 'Do Nothing' Arrivals Scenario

The 'do nothing' scenario for arrivals at EMA would be based upon:

- Use of the existing holds at ROKUP and PIGOT, with these holds remaining in their existing location. As described in section 3.4, these two arrival holds have already been converted to the RNAV1 performance standard.
- ATC vectoring aircraft onto final approach from these holds.

[3] The CAA uses the following overall definition of 'the most efficient use of airspace': The most aircraft movements through a given volume of airspace over a period of time in order to make the best use of the limited resource of UK airspace from a whole-system perspective. The CAA uses the following definition of 'expeditious flow': The shortest amount of time that an aircraft spends from gate to gate, from the perspective of an individual aircraft, rather than the wider air traffic system. (CAP 1616 Appendix G www.caa.co.uk/cap1616)

- Final approach continuing to utilise an ILS.

At EMA, arrivals are less dependent on navigation aids than departures under normal operations because aircraft are vectored by ATC from the two current holds, as described in section 2.5.

Under the 'do nothing' arrivals scenario, on leaving these holds, aircraft would be vectored to final approach by ATC as they are today, and aircraft would then join the ILS for the final approach phase. However, if the ILS is not operational, aircraft would require alternative (contingency) procedures to allow them to make an approach. At present this is achieved through procedures based on Distance Measuring Equipment (DME) and Non-Directional Beacon (NDB).

The Design Principle Programme states that we must comply with the CAA AMS, and the 'do nothing' arrivals scenario would fail to do this, in relation to:

- PBN Implementation: Current CAA policy[4] and section 3 of the AMS reflects the move towards PBN implementation and makes specific reference to legal, policy and other obligations with which UK airspace modernisation must comply. Specifically, the current policy refers to the PBN Implementing Rule (PBN-IR) (EU) 2018/1048 which requires certain aerodromes (including EMA) to deploy PBN approach procedures by 2030. The 'do nothing' scenario would not design and implement these approach procedures, and therefore would not comply with this AMS requirement.

- In addition, the AMS end Simplification requires complete redesign of the route network in busy terminal airspace, including that around airports, to take account of advances in new technology, especially satellite navigation, and the 'do nothing' option would fail to do this.

In addition, without PBN Approach procedures the 'do nothing' arrivals scenario would not align with:

- The 'must have' Design Principle Continuity. Under the 'do nothing' arrivals scenario, there would be only extremely limited contingency if the ILS failed, aside from the use of the NDB procedures for runways 09 and 27. This would also have a capacity impact during low visibility procedures scenarios due to the NDB approaches being non-precision with a higher decision height.

- The Design Principle Technology for airspace change to use the latest aircraft technology.

Because the 'do nothing' arrivals scenario does not provide procedures in accordance with the CAA AMS it does not align with the 'must have' Design Principle Programme and will not be carried forward as an option for evaluation within the DPE.

However, the 'do nothing' arrivals scenario provides the best representation of today's operation. Therefore, whilst it is not a feasible option, it is used as a theoretical **baseline** within the DPE and IOA for comparative purposes only to enable stakeholders to understand the impact/effect the 'do something' arrivals options would have when compared to today's operation.

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[4] Details of the current CAA policy can be found at https://www.caa.co.uk/commercial-industry/airspace/airspace-modernisation/performance-based-navigation/policies-and-regulations-for-performance-based-navigation/

4.4.3.'Do Minimum' Departures Options

The 'do minimum' option represents the minimum change required to address the issues identified with the 'do nothing' scenario and the issues in the SoN. For departures, the initial design of departure options involved a replication of the current routes to RNAV1 standard. Any replicated option would result in aircraft flying more accurately with more consistent track keeping, but the operations on that route would be little changed from today.

However, it is possible that, because of the ongoing analysis of options, development of designs by other change sponsors and the potential for changes to the NATS upper airspace network, a replicated route may:

- Clearly misalign to one of the 'must have' design principles, which would result in it being classified as Viable but Poor Fit within the viability process described at section 5.11; or
- Not be expected to pass the more detailed assessments carried out as part of the DPE and IOA process.

In such a scenario, the replicated option would not represent the 'do minimum' option. As such, it would not be carried forward to Stage 3 and one another option would need to be classified as the 'do minimum' option, in line with the criteria above and the requirements of CAP1616. If this possibility was identified during Step 2A, either as a result of stakeholder feedback or as part of the bilateral engagement process, an alternative, additional design option to represent the 'do minimum' has been created and identified in this DOR.

For the creation of the 'do minimum' options, design to the RNAV1 standard has been chosen because it is the lowest PBN navigation specification useable by 100% of the airlines that responded to the fleet equipage survey as detailed in section 5.5.1, compared to 82% for RNP1. This makes this the realistic 'do minimum' specification and is in line with the CAA AMS end Simplification and the need to secure the most efficient use of airspace.

Whilst the 'do minimum' option represents a change, if all the 'do minimum' option were to be implemented as a system, the ACP would not provide optimal benefits in relation to the following design principles:

- Noise N1: This requires us to design routes that, where practical, are spread out to reduce the impact of noise, and this includes the concept of noise respite. This comprehensive list of departures contains options that may allow this but the 'do minimum' option would constrain the operation to the current network of routes without this possibility.
- Noise N3: This requires us to limit and where possible reduce noise impact to communities. Many of our options have been created with the concept of reducing noise when compared to today's operation, but as above, the 'do minimum' option would constrain the operation to the current network of routes without this possibility.
- Continuity: This requires us to design airspace that enables the best use of the capacity of the existing runways in line with Government policy. The current SID designs could be optimised to provide an improved route structure, and a more efficient operating network, but the 'do minimum' limits this opportunity to improve runway optimisation.

While there are potential issues with the 'do minimum' option from the perspective of alignment with the design principles, as detailed in the DPE, this option replicates today's operation and the existing departure procedures to PBN standards.

The 'do minimum' for departures is therefore a feasible option for further assessment in the DPE and IOA. Even if the 'do minimum' is not an option that would otherwise pass through DPE and IOA, we will retain the 'do minimum' option as we consider it provides a useful (second) baseline against which stakeholders can see the likely impact of the minimum level of intervention required to address the SoN.

4.4.4. 'Do Minimum' Arrivals Options

The 'do minimum' for arrivals would incorporate the following:

- The retained use of the existing RNAV holds at ROKUP and PIGOT in their current location. This is because these holds are the responsibility of NERL not EMA.
- ATC vectoring aircraft from the holds onto final approach.
- A PBN compliant and ILS based final approach which aligns with the requirements of the AMS.

As stated in section 4.4.2 above, arrivals are less dependent on navigation aids than departures under normal operations because aircraft are vectored by ATC from the two current holds, as described in section 5.4. Also, as described in section 3.4, NATS have already designed new RNAV holds above 7,000ft at ROKUP and PIGOT.

Therefore, for EMA, there are two elements to be considered within the arrivals 'do minimum' scenario.

- The **Transition** from the RNAV holds at ROKUP and PIGOT to the Final Approach Fix (FAF) [Initial Approach Procedures].
- The **Final Approach** Procedures from the FAF to the runway.

Transition Procedures: Current operations at EMA rely on ATC vectoring to guide aircraft from the hold to the runway. The only published procedure capable of replication, for the purpose of a 'do minimum' option, would be the current Initial Approach Procedures (IAP) for "ILS/DME without Radar Control". These procedures are published at AD-2-EGNX-7-10 and AD-2-EGNX-7-11 of the UK AIP and act as a contingency during communications or radar failure.

However, if this were used as the 'do minimum' option, it would not align with the mandatory Design Principle Programme. This is because:

- These contingency procedures make use of the current PIGOT hold which is outside the viable arrivals design area. This design area was based upon the application of the Design Principle Programme which requires alignment to the AMS and is described in section 19.2 and shown at Figure 27 in section 19.3.
- Alignment to this design principle requires the achievement of a Continuous Descent Approach (CDA) to both runway ends. However, because the current 'PIGOT' hold is outside of this viable design envelope this is not possible and it

has been classified as Viable but Poor Fit within section 21.3. This misalignment is based on the distance to the FAF for runway 09 which results in a gradient below the minimum CDA criteria.

Therefore, although routes from ROKUP and PIGOT could theoretically be created to RNAV1 standard for contingency, the misalignment to the mandatory Design Principle Programme means that in practice aircraft would continue to be vectored to final approach by ATC as they are today and would join the ILS for their final approach phase.

As a result, in summary:

- No replicated 'do minimum' arrival transitions have been created.
- Under the 'do minimum' scenario, aircraft would continue to be vectored from the hold to the FAF as they are today.

Final Approach: CAA policy and the AMS which are driven by the PBN-IR (EU) 2018/1048 requires aerodromes to deploy PBN approach procedures by 2030. Specifically, part-AUR.PBN.2005 requires airports to implement RNP APCH procedures. This relates to the final approach to the runway and is therefore a 'do minimum' requirement.

The 'do minimum' option for this element will therefore be to design Final Approach Procedures using satellite guidance to Lateral Navigation (LNAV) and LNAV/ Vertical Navigation (VNAV) standard. This has been chosen because it is the ICAO recommended standard for the final approach phase and is a navigation specification useable by 100% of the airlines that responded to the fleet equipage survey.

This option closely aligns to today's operation and replicates existing arrivals approach procedures to RNAV standard. Therefore the 'do minimum' for the final approach element for arrivals is a viable option to design.

These final approaches have been designed and are detailed at section 22 for runway 09 and section 26 for runway 27.

In summary, the 'do minimum' scenario for arrivals would be:

- Retained use of the current holds of ROKUP and PIGOT.
- ATC vectoring aircraft onto final approach from these holds.
- PBN compliant final approach designs created to both LNAV and LNAV/VNAV standard.

4.5. Controlled Airspace (CAS) Requirements

The system of airspace classification determines the flight rules that apply and the procedures that must be followed. The classification that is assigned depends upon the types of air traffic involved, the density and complexity of air traffic and the need to maintain a high level of safety. In the vicinity of EMA, there is a mix of airspace including Classes A, D and G.

The UK AMS includes a provision to consider equitable access for all airspace users and to ensure the amount of CAS is kept to the minimum necessary for the safe provision of ATS. However, it also highlights the need for an appropriate balance between the requirements of various types of users, and the need to improve environmental performance. The requirements of the AMS are reflected in the EMA Design Principle Programme and also within our two design principles on Airspace which state:

- Airspace A1: Flight paths should be designed to future proof our airspace and should not be constrained by existing arrangements.
- Airspace A2: Our controlled airspace should be open to all authorised users; however, priority will be given to airport air traffic over other airspace users, except for emergency aircraft.

This ACP will seek to use the minimum volume of CAS with the lowest appropriate airspace classification to deliver a safe and efficient airspace design, and during Stage 2 we have applied the design principles to create a comprehensive list of departure and arrival design options. The comprehensive nature of the list of design options provides the flexibility to respond to the design principles on Programme and Airspace.

This approach recognises that the EMA ACP needs to take account of other change sponsors' airspace change programmes within both FASI-N and FASI-S as part of the Airspace Masterplan. In consideration of this, section 3.5 of the DOR references the possibility that the design options identified during Stage 2 may need to be further refined or amended in response to the options of other change sponsors, the solutions to safely resolve interactions, or the need to manage cumulative impact. For this reason, it would be premature to define future CAS needs at this stage rigidly.

The approach taken to the consideration of CAS at EMA, therefore, is as follows:

- At Stage 2, we have designed the majority of options within the boundaries of the current CAS to align with the design principles Airspace 1 and Airspace 2. Where some options terminate beyond the boundary of current CAS above 7,000ft, NERL have led separate engagement discussions with stakeholders on the concepts being proposed as the responsibility for creating this airspace rests with NERL. However, the responsibility for formal engagement and consultation with impacted stakeholders will remain with EMA where any proposed departure or arrivals routes pass through any volume of new airspace below 7,000ft. These consultation activities will be coordinated between EMA and NERL. Details on these concepts is provided in the description of each option within this DOR and is reflected in the assessment for each option within the DPE.
- This is particularly the case in relation to the viability of airspace for departure options to the east which have the potential to create significant fuel savings. NERL are in conversations with stakeholders including the military and the GA community to understand where additional CAS above 7,000ft could be required to optimise the entire network. These include discussions on the operating hours and the horizontal and vertical dimensions of this airspace. If this is supported, this may result in EMA options joining the NERL network in a different place to the position assumed by the options within this DOR to facilitate an optimal design. At this early stage of the process there is uncertainty as to the exact positioning of these joining points, therefore there is a requirement to maintain flexibility in the proposed options and these will be further refined, and detailed in full, within the Stage 3 consultation material. Further information on this airspace is detailed in sections 6.6 and 6.15, with the relevant

design envelopes and options described in section 7 for runway 09 and sections 12 and 16 for runway 27.

- In Stage 3 individual design options will be combined into operating networks that cover both arrivals and departures, and the need to integrate them within the wider airspace network. This will support more detailed analysis and evaluation and will allow the CAS requirements for groups of options to be considered. Within this work we will seek to identify:
    - The CAS requirements for the groups of options.
    - Whether changes to CAS dimensions have the potential to deliver safety, environmental or access benefits to stakeholders.
- The Stage 3 work will be conducted in cooperation with the CAA Airspace Classification team and will seek to identify if any benefits can be realised in advance of the changes forming part of this ACP.
- Any benefits would be likely to accrue across a wide range of aviation stakeholders including ATC and airspace users including airlines, the military, the general aviation community and may also include UAV operators in line with the AMS.

In line with CAP1616, all stakeholders (aviation and non-aviation) will be provided with an indication of the CAS requirements for each set of design options within our Step 3C Consultation material. This will provide an opportunity to review and comment on the analysis undertaken. Comments received will be considered as part of the consultation analysis activities in Step 3D.

5. Options Development Rationale

5.1. Introduction

This section describes the supporting rationale that was used to create the EMA comprehensive list of options including:

- Identifying the issues to be addressed in the SoN (5.2).
- Use of the design principles to influence the design options (5.3).
- A brief summary of the current operations at EMA (5.4).
- The factors informing the creation of the design envelopes and comprehensive list of design options, including the three-step design process (5.5).
- A summary of the results from the airline fleet equipage survey and how this has influenced the design criteria (5.5.1).
- Design Step 1: Creating the design boundary for departures and arrivals (5.6).
- Design Step 2: Details of the constraints and considerations within the boundary and how these influenced the design options (5.7).
- Design Step 3: How the design envelopes and the design options were created based on the information from Steps 1 and 2 and the airline fleet equipage survey, and how stakeholder feedback contributed to the development of these designs (5.8).
- How feedback from NERL via bilateral meetings and simulations has influenced the design options (5.9).
- How feedback from Birmingham Airport has informed the design options (5.10).
- How this comprehensive list of design options has been classified through the use of a viability filter (5.11).

Further information on the detailed process used to develop the departure envelopes and options can be found in section 6, and for arrivals in section 19.

5.2. Statement of Need (SoN)

In 2019, EMA submitted a SoN to the CAA, setting out why an airspace change was necessary. This step was completed in July 2019 when the CAA approved the SoN, agreeing that EMA should initiate an airspace change, with a provisional classification of 'Level 1' and an allocated reference of 'ACP-2019-44'.

Step 2A of CAP1616 requires change sponsors to identify a comprehensive list of design options that address the SoN and align with the design principles. To ensure that the design options proposed in the DOR addressed the SoN, the following key requirements from the SoN were considered:

- Removal of the reliance on ground based DVOR navigational aids by making greater use of satellite-based technology.

- Modernisation of airspace arrangements for aircraft operating to and from the airport at altitudes of 7,000ft and below.
- Making best use of new navigational technologies, so that the operational efficiency and environmental benefits that modern aircraft offer can be fully realised.
- Integration with other airports and the wider changes to the airspace system being pursued through the national airspace modernisation programme and in particular the FASI-N and FASI-S programmes detailed in section 3.
- Alignment to the policies and requirements described in the CAA AMS.

The process followed, including the consideration of the design principles during the classification of the design options, reflects these requirements and has ensured the design options are aligned to the SoN.

5.3. Design Principles

During CAP1616 Stage 1, Step 1B, a list of design principles was developed during engagement with stakeholders which are detailed at section 1.3. These design principles function as a framework which underpins how the design options were developed and are used to evaluate those design options.

There are three design principles which the design options **must** align with.

- Safety: Safety must take precedence over all other factors. Flight paths must be safe for airspace users, the airport, and communities on the ground.
- Programme: Any changes must align with the broader national airspace modernisation strategy, comply with national, international and industry regulations and legislation, and align with current and future Airspace Change Programmes in the north and south of the UK through involvement in the Future Airspace Strategy Implementation groups.
- Continuity: New flight paths must ensure the continuation of services offered today and meet any future demand, in keeping with local and national planning policy, and the Government's policy on 'making best use' of existing runway capacity.

As described in section 5.11, design options that did not align with one or more of these were classified as Viable but Poor Fit.

Whilst the design principles are referenced, and alignment to the design principles is shown in the description of the design option, this DOR does not provide a detailed assessment of the options against these design principles. Instead, these assessments are contained in the DPE.

5.4. Current Operations

EMA has one runway which is used in two directions. Runway 09 is used for easterly operations and runway 27 for westerly operations. Because the predominant wind direction in the UK is westerly, runway 27 is in operation for approximately 75% of the time and runway 09 for approximately 25%.

For departures there are currently two SIDs for runway 27 and four for runway 09. These link each runway direction to the NATS en-route airspace network at the SID termination altitude which varies between 6,000ft and FL90 depending on the direction that the flight is taking. At a height of between 3,000 and 6,000ft, ATC vectoring is routinely used to provide a route to connect to the NATS upper airspace network which results in a dispersed overflight distribution.

As described in sections 2.3 and 2.4, all of these current SIDs are required to be upgraded to PBN, either as a result of their reliance upon DVORs that are being withdrawn or in accordance with UK and international requirements.

Arriving aircraft approach UK airspace from several entry points before routing towards one of the two holds at ROKUP and PIGOT. For arrivals there is no dependency on DVORs, but ATC vectoring is used to establish aircraft on final approach to the runway, which again results in a dispersed overflight distribution.

A more detailed description of these current operations is provided in section 2.2.

5.5. Design Envelopes and Comprehensive List – Process

In order to respond to the SoN and to create a balanced set of design options, our development process considered five foundation elements, which were applied in a logical sequence to create the design options. These were a blend of regulatory requirements with which we must comply, information from airlines, and information relating to the future operations at EMA. These were combined with the EMA design principles outlined at section 1.3 to create the design envelopes and the comprehensive list of options.

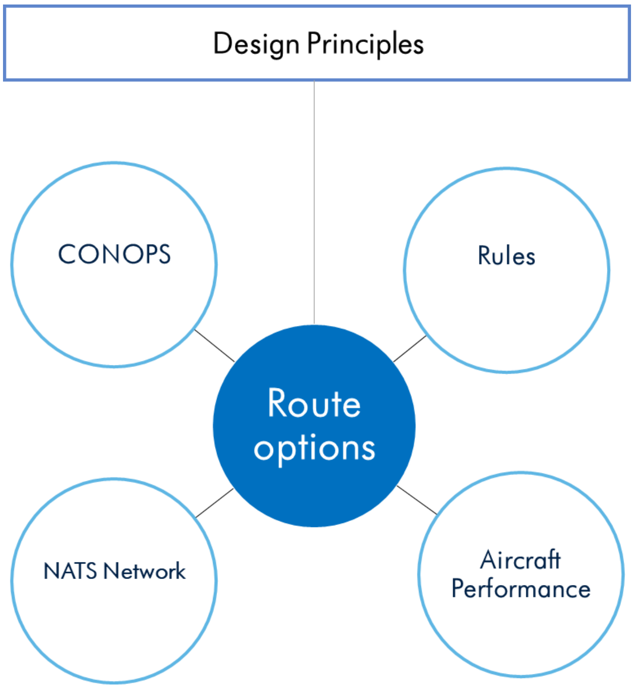


Figure 10: Design development foundations

A sequence was followed to provide a logical development path using these foundations.

- Step 1 - Information on aircraft performance from the airline fleet equipage survey described at section 5.5.1 together with ICAO and CAA rules was used to understand where aircraft could fly and to create a basic boundary for departures.
- Step 2 - The airspace and operations around EMA were reviewed to identify constraints and considerations.
- Step 3 - We applied the design principles and supporting CONOPS document (as described at section 4.2 to develop a set of design envelopes which terminate at 7,000ft. These design envelopes formed the basis from which to create the comprehensive list of design options that are contained within this DOR.

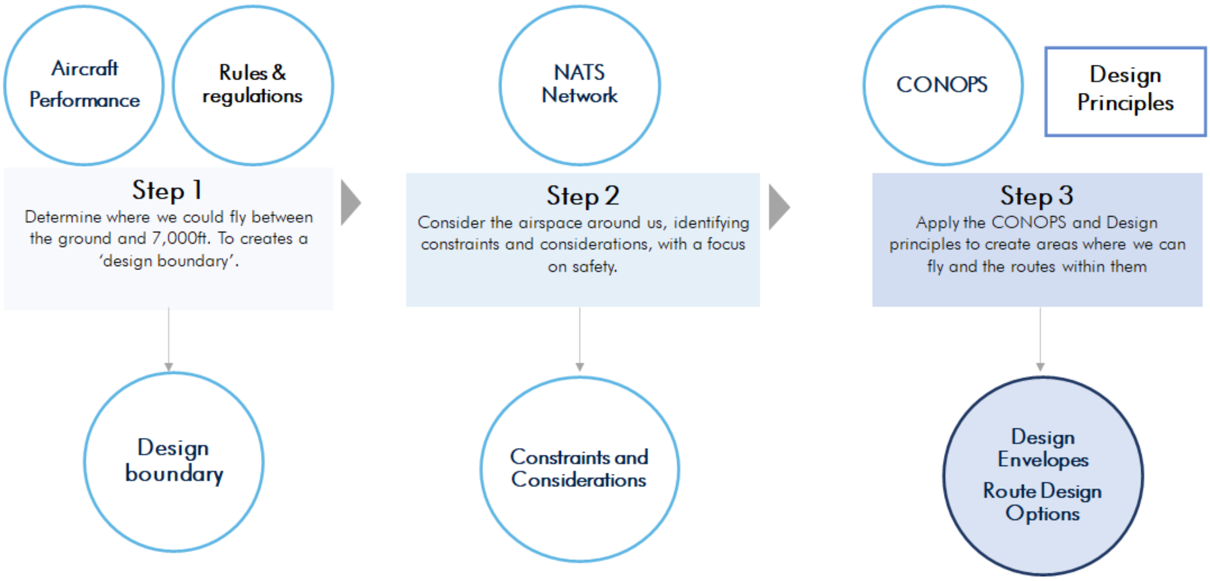


Figure 11: Design envelope development process

5.5.1. Aircraft Performance: Airline Fleet Equipage Survey

The Design Principle Programme states that airspace change must accord with the CAA AMS (which requires the use of PBN), with the Design Principle Technology, stating that we should make use of the latest aircraft technology widely available. To give effect to these principles, and prior to the commencement of design activities, we conducted a fleet equipage survey to find out what technology the airlines and their aircraft have and how they could fly.

The aim of this was to understand the capabilities of the aircraft regularly flown into and out of EMA to fly PBN routes, and also to understand the performance that could be achieved in the future. This information was important in informing the design work because it helped create design options that matched the operators' capabilities and responded to the design principles.

Whilst this fleet survey was initially conducted prior to the pandemic in 2020 it has been updated and refreshed during 2023 by work at EMA and other airports within the MAG group

(Manchester and London Stansted) to create a list that remains representative of current equipage.

Feedback received in engagement made clear that stakeholders were keen to see new technology adopted, particularly if that improved environmental performance. However, in some cases, such as the use of RNP-AR criteria to facilitate curved approaches, the fleet survey indicated that the level of equipage was low, and any designs created to these standards would therefore not be aligned to the Design Principle Technology. This rationale is further described in section 19.9e).

Figure 12 below shows airlines that responded to the survey, together with their ranking in terms of total movements at EMA. The remaining airlines did not respond to the survey.

Ranking (based on total movements)	Airline	Percentage of total EMA movements
1	Ryanair	19%
2	Jet2	12%
3	West Atlantic	12%
4	DHL	10%
6	TUI	5%
8	Star Air	4%
10	UPS	2%
11	Fedex	2%
12	West Air	2%
17	Loganair	1%
19	SwiftAir	1%
24	Bluebird	1%
25	Aurigney	1%
31	Qatar	1%
32	EasyJet	1%
Total % of movements covered=		73%

Figure 12: Fleet equipage survey airline responses

The initial questions focussed on airline capabilities at the time of the survey, but as indicated above, these have been updated by additional work which includes future capabilities in 2028, chosen as a potential operational date.

The results showed:

- **PBN departure capabilities:** All airlines that responded are capable of operating to at least RNAV1 capability as a minimum. This removes the need for reference to the ground based DVOR navigation aids that are being withdrawn from service. In addition, 98% of aircraft would be capable of RNP1 operations but only 83% of those would have the ability to perform these with radius fixed (RF) turns. Further details of these standards and their application in the design of design options at EMA is detailed in section 6.9.

- **PBN arrivals capabilities:** All airlines that responded are capable of flying RNAV1 arrival routes, and 98% are capable of flying a final approach with both lateral and vertical guidance (LNAV/VNAV). These airlines would fly an ILS precision approach which remains in line with the AMS. The main airline operators were also asked about their capability to fly RNP-AR approaches. Of those that responded, the capability to fly these approaches represented less than 20% of total movements. Further details of these standards and their application in the design of design options at EMA is detailed in section 19.9e).

- **Climb gradients:** All airlines that responded could achieve a minimum climb gradient of 6% and 95% could achieve 7%. This assumed a scenario of a fully laden aircraft, at an air temperature of +25c. The aim was to provide a challenging scenario where climb performance may be reduced as a result of the combination of high load factor and high temperature which has the effect of reducing lift.

The data on both the PBN capability and climb performance was subsequently used in the creation of both the design envelopes and the design options. The PBN capability was applied to the design options themselves in the creation of the options to RNAV1 criteria. The climb data informed the minimum gradient to be applied in the creation of the design envelopes, with design options designed to a default of 6%.

5.5.2. Rules

In line with design principles Safety and Programme, the development of the designs has ensured compliance with the relevant rules and regulations, principally those of ICAO and the CAA.

The rules for route design are governed by ICAO under PANS-OPS 8168 and this was used to inform the creation of both the design envelopes and the route options.

In addition, applicable CAA rules and policies were applied to the designs. These include the requirements within the AMS (CAP1711), and the CAA Airspace Containment Policy.

Where relevant, these have been referenced within this DOR.

5.5.3. NATS Network

Consistent with the Design Principle Programme and alignment to the AMS, it is essential that the future EMA airspace design is developed in association with, and to align with, the UK en-route airspace network and with the Future Airspace Strategy Implementation (FASI) programme.

FASI is the programme to redesign the entire airspace in the UK, including the airspace below 7,000ft surrounding airports which is used predominantly for departures and arrivals, plus the en-route national airspace structure above 7,000ft.

To inform the NERL airspace change process, EMA initially agreed requirements with NERL which detail what EMA require the NERL airspace to deliver as part of the FASI-N and FASI-S programmes. This led to bilateral meetings and workshops being held with NERL to align the emerging network designs with the design concepts being developed as part of EMA Future Airspace project.

Further information on the design assumptions and the requirements that EMA have for the NERL network are described in section 3.

5.5.4. CONOPS

The purpose of the CONOPS is to outline the operational concepts that will be used to deliver the benefits from the EMA Airspace Change project. In addition, it describes the air traffic management techniques that will be used to manage the proposed system of routes. However, it does not contain any airspace designs or routes.

Further information on the content of the CONOPS is at section 4.3.

5.6. Step 1 – Design Boundary

The first step was to create the viable design area for departures. This initially applied the information from the aircraft fleet equipage survey, which confirmed that all aircraft operating out of EMA could climb at a gradient of at least 6%. This 6% continuous climb established the outer boundary for where aircraft departing on each end of the runway could reach 7,000ft. The blue and green circles shown in Figure 13 show the theoretical positions where an aircraft climbing at this would reach this point from runway 09 in green and runway 27 in blue.

ICAO PANS-OPS 8168 rules on the position of the first turn after departure and turn radius were then applied. These create a more realistic design area and also describe areas where it is not possible to design departures according to these rules, as shown in Figure 13 by the red cross hatch area.

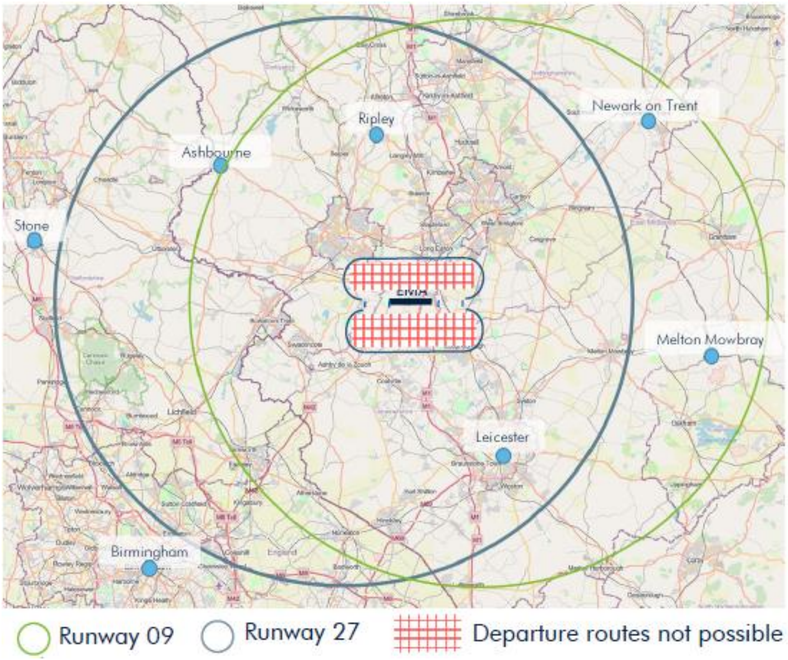


Figure 13: Departures design boundary for runway 09 and runway 27

A similar process was then undertaken to create the arrivals boundary. The Design Principle Policy requires alignment to the AMS, which includes the requirement for airspace change to improve environmental performance, specifically noise and emissions. Therefore, in creating this boundary, both the Design Principle Programme and those on noise and emissions guided the process for where the start of the omni directional boundary should be. The underlying rationale was that the quietest and most fuel efficient method of designing arrival routes was through a Continuous Descent Approach (CDA).

CAA and ICAO guidance provides for a range of acceptable gradients for a CDA, but in this first phase a gradient of 5.24% or 3° was used as this is aligns with recommendations within both CAA and ICAO documentation. As with departures, this was constructed as a circular omni directional arrivals boundary, based upon applying this 3° descent gradient from the start of our design responsibility at 7,000ft to the runway. This is shown in Figure 14 below where the outer edge of the blue circle shows the theoretical furthest point away that a CDA could be possible.

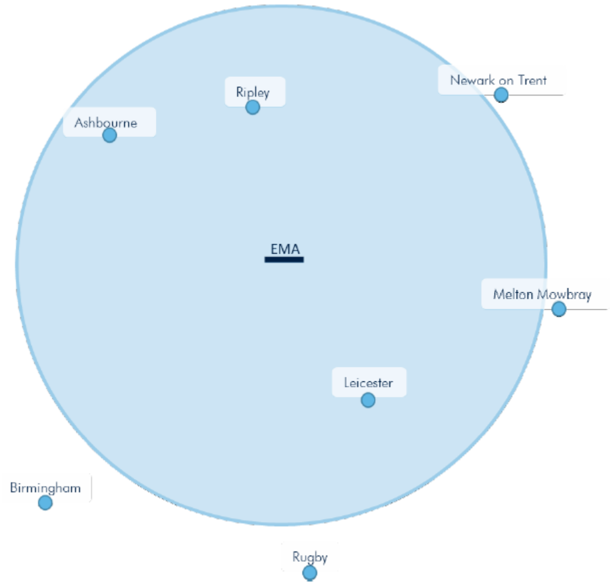


Figure 14: Arrivals design boundary.

These boundaries were used to understand the broad area within which we would expect aircraft to be at 7,000ft and to assist in the identification of design constraints. They were also used to inform the process to develop the departure design envelopes in Step 3 in section 5.8.

5.7. Step 2 – Constraints and Considerations

Within the design boundaries we identified a number of local factors that impact where design options could be placed. Some related to local airspace, whilst others related to adjacent airports or the NATS en-route airspace network.

These were separated into either constraints or considerations, and the comprehensive list of design options all took account of these factors. The constraints and considerations were developed by analysing the airspace and current operations in the airspace surrounding EMA and are defined as follows:

- Constraints were defined as aspects that have a direct impact on designs, or limit where we can place our design options.
- Considerations were defined as aspects that do not limit our designs but which we need to take account of in creating design options.

An initial set of constraints and considerations were developed and shared within the first phase of engagement. Feedback from stakeholders, and bilateral meetings with both NATS and adjacent airports, refined how these were accounted for when creating the design options.

The diagram and details in Figure 15 represent the most up to date version of these constraints at the time of compiling this DOR. To provide context in relation to the design areas, this also shows the departures design boundaries as the outer green and blue lines, and then the identified constraints and considerations that are within or adjacent to that.

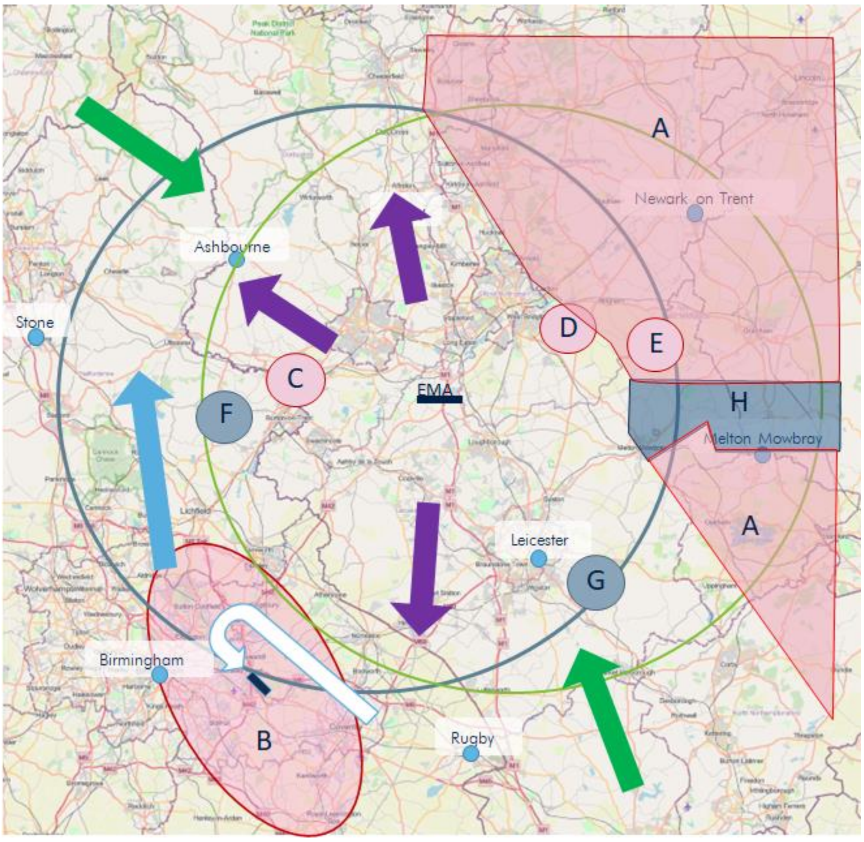


Figure 15: EMA Airspace: Constraints and Considerations

- Area A: Uncontrolled airspace - Constraint: This area of Class G airspace is used by the military and GA, and is not currently available to commercial flights, except through tactical coordination by ATC.
- Area B: Birmingham Airport (BHX) - Constraint: The location of BHX and their departure and arrivals routes place a constraint on departures and arrivals to the west and the south west of EMA. This constraint is driven by the need to retain safe separation between this airspace and EMA operations.
- Area C: Derby airfield – Constraint: This is used by GA traffic and has airspace dedicated to it via an Aerodrome Traffic Zone (ATZ) up to 2,000ft.
- Area D: Nottingham airfield – Constraint: This is used by GA traffic and has airspace dedicated to it via an Aerodrome Traffic Zone (ATZ) up to 2,000ft.
- Area E: Langar Parachute site – Constraint: This exists within Area A, Class G airspace. The creation of any additional CAS and routes need to ensure safe separation from this operation which can extend above 7,000ft.

- **Area F: Tatenhill airfield** – Consideration: This is used by GA traffic and has airspace dedicated to it via an Aerodrome Traffic Zone (ATZ) up to 2,000ft. Its distance from EMA means that aircraft will be well above this area and makes this a consideration rather than a constraint.
- **Area G – Leicester airfield** – Consideration: This is used by GA traffic and has airspace dedicated to it via an Aerodrome Traffic Zone (ATZ) up to 2,000ft. Its distance and location in relation to EMA makes this a consideration rather than a constraint.
- **Area H – Potential new controlled airspace (CAS)** – Consideration: There are significant environmental benefits for routing flights directly to the east. However, the creation of these routes is dependent on creating additional CAS in this area which will require some of the constraints created by Areas A and E to be relaxed. This will require stakeholder consultation and agreement which will be led by NERL and is described further in section 6.6.

Further information on each of these constraints and considerations and their impact on the creation of design options are detailed in section 6.6 for departures and section 19.8 for arrivals.

5.8. Step 3 – Design Envelopes and Design Options

5.8.1. Design Envelopes

Having considered all the factors in Steps 1 and 2, a set of design envelopes were then developed to serve as the foundation for creating design options. These design envelopes are defined as a 'swathe' or wide area of airspace that exists between the runway and 7,000ft and have a number of characteristics:

- The design envelopes are created bearing in mind the design principles, especially the three "must have" principles - Safety, Programme and Continuity. However, the assessment of the design options against the design principles is performed in the DPE.
- The design envelopes should support the creation of routes that adhere to PBN standards. This is in accordance with the Government's AMS and the design principles Programme and Technology.

Departures: The Departure design envelopes shared with stakeholders in the first phase of engagement are shown in Figure 16 below. These were updated following feedback, and the updated versions used to create the design options can be seen in section 6.4.

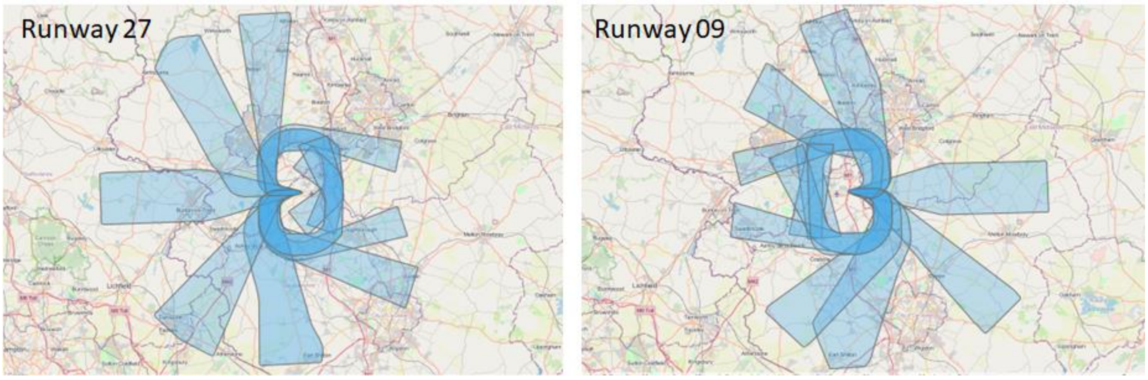


Figure 16: Initial departure design envelopes

The departure envelopes are based on a 6% continuous climb gradient to 7,000ft and were based around current routes where they exist. New envelopes were created if there may be a benefit aligned to one or more of the design principles including noise or emissions. These envelopes are at least 8km wide (4.5nm) at 7,000ft. This is to provide a wide area to design options which respond to the design principles and are sufficiently flexible to respond to stakeholder engagement feedback. Further information on the departure design envelopes can be found in section 6.

Arrivals: The Arrival design envelopes were created by applying ICAO PANS-OPS and CAA guidance for a 3° CDA from 7,000ft, and assuming a minimum 2,000ft joining point or Final Approach Fix (FAF) for both runway directions. This FAF was chosen to create the largest possible design envelope area and therefore a comprehensive range of options.

This process created an arc for each runway where a CDA would be achievable, and where these arcs overlap, a CDA would be possible to both runways. This overlapping area is defined as the arrivals design envelope and is shown in Figure 17 below. The unshaded area in the middle shows where the design of left or right turns into airspace either side of the runway at EMA would be Unviable in line with the description at section 5.6.

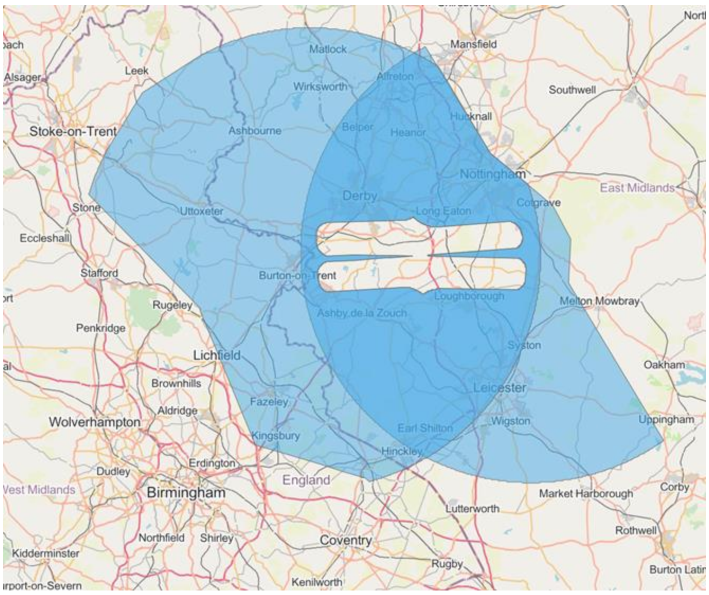


Figure 17: Arrivals design envelopes: the overlapping area within which a CDA to both runways is possible

These were shared with stakeholders in the first phase of engagement and provided the area within which arrival design options are created. Further information on the development of the arrivals envelopes can be found in section 19.

5.8.2. Design Options

Following the first phase of stakeholder engagement, changes were made to the design envelopes to take account of stakeholder feedback.

For departures, this feedback influenced the extending, widening, and merging of other design envelopes to give greater scope for respite for overflown communities. It also resulted in the discontinuation of a number of the design envelopes as detailed in section 6.4

For arrivals, in response to concerns about the level of concentration and the impact this could have on overflown communities, options were created that provide different final approach joining point heights to create a level of relief and allow for the creation of alternative types of routes that may give the opportunity for noise respite.

- For **departures**, the starting point for the design of the design options was a PBN replication of the existing SID (if there was an existing SID within the design envelope) to represent a 'do minimum' baseline. Having established the 'do minimum' option for the design envelopes containing existing routes, further design options were developed within the design envelope that complied with the design principles. The aim of any new routes was to achieve a clear and objective benefit that aligned with one or more the design principles. Examples include creating a more direct route to reduce emissions, reducing the number of people overflown or avoiding noise sensitive areas. All SID design options terminate at 7,000ft. Where a design envelope did not contain an existing route, a new set of design options were developed using the same principles.

  An example of the departures material presented to stakeholders is shown at Figure 18 below, and further detail on the departures development process is provided in section 6.

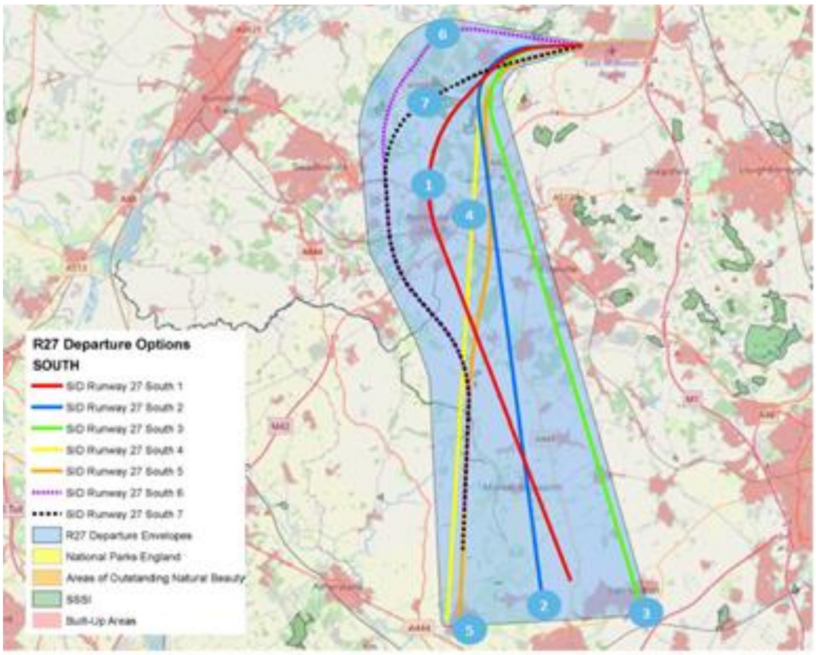
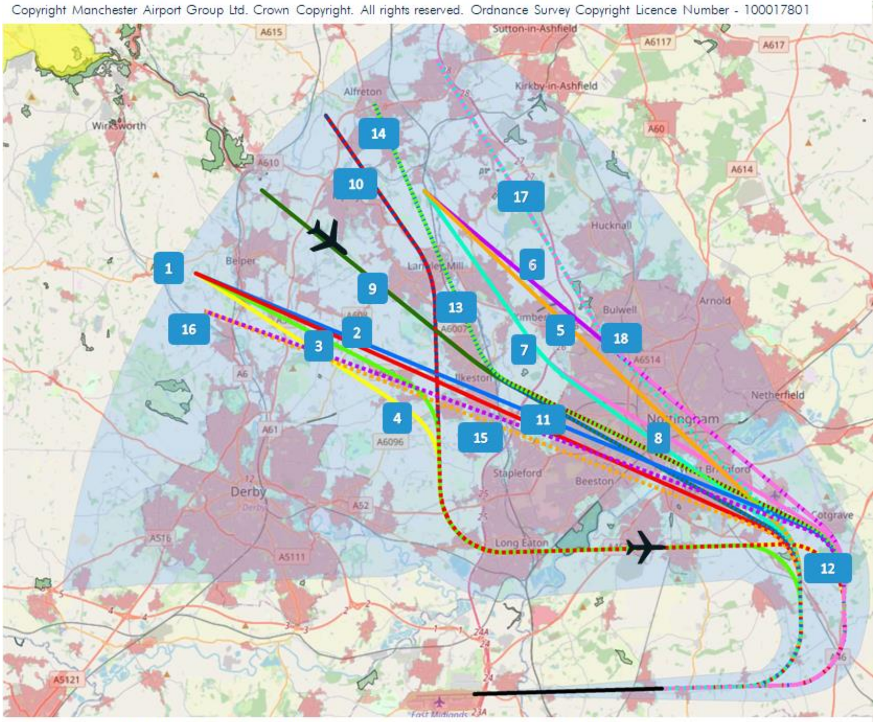


Figure 18: Example departure envelope containing design options

- The **arrivals** design envelope and the overlapping area created in the first stage was used as the foundation within which to start the arrivals design options. All arrivals options start at an Initial Approach Fix (IAF) of 7,000ft which is contained within this overlapping area. Any IAF outside this area, or which was unable provide a CDA within the required criteria was not fully aligned to the Design Principle Programme and could only be classed as Viable but Poor Fit as referenced in section 5.11.2.

  As with departures, arrivals design options were developed based on one or more of the design principles. As described in section 19.6, each approach transition starts at the IAF at 7,000ft which connects to an intermediate segment at the Intermediate Fix (IF) and then a final approach at the Final Approach Fix (FAF) which takes aircraft to the runway. By varying the distance between the IF and the FAF, options were created to provide an element of noise relief. In line with the feedback received, the design process also created direct and indirect options that may give the opportunity for noise respite as detailed in section 19.7.

  An example of the arrivals material presented to stakeholders is shown below, and further detail on the arrivals development process is provided in section 19.



Options shown are for illustration only and are subject to change as we progress through the CAP1616 process.

Figure 19: Example arrivals envelope containing design options

For both departures and arrivals, each design option, and the link to the relevant design principles, was communicated via phase two of the stakeholder engagement process, with further changes being made to the design options to take account of the feedback received. This is described at section 6.12 for departures and section 19.2 for arrivals.

The content within the DOR represents the comprehensive list of design options that takes account of both phases of stakeholder engagement and the feedback received from NERL and other stakeholders via bilateral meetings.

5.9. Bilateral Meetings: NERL

As a sponsor of a level 1 ACP, EMA are required to engage with a wide range of stakeholders including those also within the FASI programme, and as a result, NERL were invited to and responded to the Stage 2 stakeholder engagement sessions.

In addition, bilateral meetings were held with NERL to explore the detailed network solutions being developed as part of EMA Future Airspace project. This bilateral engagement has been achieved via:

- Airspace development workshops.
- Testing our designs with NERL during the formal EMA Stage 2 stakeholder engagement process.
- Participating and commenting in the NERL Stage 2 engagement process as an aviation stakeholder.
- Participating in NERL fast time visualisation simulations.

Further detail on this process is described in section 3.4.

This NERL engagement and feedback was used to agree and where necessary refine design options, or to highlight where potential issues may exist that require further work in Stage 3. These areas included but were not limited to the following:

a) EMA departures to the east: NERL have led engagement conversations with impacted stakeholders including the military and the GA community on the concepts being proposed for additional CAS to permit departures to the East. These include discussions on the operating hours and the horizontal and vertical dimensions of this airspace. This led to the creation of the EMA departure options to the east from both runway 27 and 09. If this is supported, this may result in EMA options joining the NERL network in a different place to the position assumed by the options within this DOR to facilitate an optimal design. It is therefore not possible for EMA to fully incorporate these designs into any future network with certainty and there is a need for EMA to retain a degree of flexibility in the position of design options in this area, with the dependency on CAS being available being reflected in the DPE and IOA.

b) EMA departures to the north west: As described in section 6.14 the EMA options were designed around an envelope based on the current TNT SID as the 'do minimum' option. However, the results of NERL simulation exercises which took place as part of the Stage 2 stakeholder engagement process, highlighted potential interactions above 7,000ft between these original EMA departures and inbounds to Manchester (MAN) descending on a similar heading. As a result, this design envelope was modified to create the opportunity for additional design options to be added, as highlighted in section 9 for runway 09 and section 14 for runway 27. These additional design options provided the scope to resolve the potential conflict and included an alternative option that could be used as the 'do minimum' if the current TNT departure was not carried forward from the DPE or IOA.

c) EMA departures to the west: The concept of Flexible Use Airspace (FUA) remains a strategic priority for NERL and forms part of the AMS. However, once above 7,000ft all departure options in this design envelope would route through an area without a network joining point, and subsequently through the North Wales Military Training Area (NWMTA) which is used extensively for high speed training by the RAF. Further conversations will be required with NERL and the military in Step 3A to confirm the viability of any routes in this direction.

d) EMA departures to the south east: NERL raised a concern that this design envelope has the potential to route traffic in the opposite direction to the network flow, which may limit the ability of EMA departing aircraft to receive a continuous climb. However, this interaction is in airspace being developed as part of the FASI-S programme and which is not yet at a mature stage to assess interactions. Therefore, all options were retained for analysis in the DPE and IOA, with further work to be carried out to analyse their viability in Step 3A.

e) EMA arrival holds: NERL confirmed their analysis into the type of arrivals structure for EMA. As with the current ROKUP and PIGOT, future arrivals holds above 7,000ft will use two racetrack type patterns to PBN standard. Whilst these will be to the north and south of EMA, the exact position is not yet determined. This has been accounted for by creating a wide range of IAFs and departure design options to retain flexibility for where routes below 7,000ft may start.

EMA will continue to work collaboratively with NERL through subsequent stage of the network ACP to create a network design that facilitates the EMA design principles. As part of this, EMA have provided route information to NERL to populate their visualisation simulations and future detailed design work to advance the network developments. Further work based on the results of this and future simulations is expected in Step 3A of ACP.

5.10. Bilateral Meetings: Birmingham Airport (BHX)

BHX is the closest major airport to EMA and resolving any interaction between routes is a key requirement of this airspace change in line with the aims of the AMS. However, BHX have already completed their airspace modernisation work in advance of EMA and are not part of the FASI programme. Therefore, the resolution of interactions has been actioned on the basis of the current BHX route network, with no changes to their operation envisaged.

The CAP1616 process requires a comprehensive list to be developed, which has resulted in a set of route options where sone conflictions with BHX may exist. However, because the exact profile of the EMA design options is not finalised, it is not appropriate to discount options on this ground at this stage. As a result of the potential for interaction, bilateral meetings were held with BHX during Stage 2. BHX were also involved as a stakeholder within the EMA Stage 2 engagement process. Further work to determine the extent of these interactions will be undertaken in Step 3A.

Within the bilateral discussions, the departure and arrival design envelopes with the potential to interact with BHX were discussed, with feedback provided as follows. This has been reflected in the subsequent analysis of the design options in the DPE and IOA:

a) EMA 27 north west: No interactions were identified with either the original design options or the additional options following the identification of the possible misalignment with the emerging NERL network, described in section 5.9b).

b) EMA 27 west: Departures to the west create a potential interaction with flights to and from BHX to the west of Burton upon Trent. In particular these options may interact with arrivals from the CHASE hold, and arrivals that are being vectored in a left-hand pattern for runway 15 at BHX. Whilst these BHX operations were identified as a constraint to EMA operations, this is not a published procedure but is used to create a more fuel efficient operation for their arrivals. Detailed design work is required with NERL and BHX to understand if safe separation exists or can be achieved through the modification of the EMA options.

c) EMA 27 south west: There are potential interactions to the east of the Birmingham CTA in the vicinity of Nuneaton with highlighted interactions between EMA 27 south west departures and the BHX LUVEM departures from runway 15 and UNGAP departures from runway 33. Further detailed design work is required with BHX to understand if safe separation exists or can be achieved through the modification of these options.

d) EMA 27 south: The existence of the current radar buffer and the position of the design options did not appear to create any significant interaction.

e) EMA 27 arrivals from the south: No interactions were identified.

As discussed above, EMA will continue to work collaboratively with BHX and if necessary NERL through subsequent stages of this ACP to refine the design options. As highlighted in section 3.5, it is possible that this work will identify some options that cannot be safely deconflicted from the BHX designs which may mean that some EMA options will be discounted.

5.11. Design Options Classification – the Viability Filter

In line with CAP1616 and the process outlined above, a comprehensive list of design options was created. This was informed by application of the design principles and feedback from engagement. This created a balanced set of options because each design option responds to at least one or more of the design principles.

However, because of the need to create a comprehensive list of options not all of the design options created were feasible or aligned with the 'must have' design principles of:

- Safety
- Programme
- Continuity

Therefore, our design process adopted an approach that identified a long list of options and then refined this list of options to focus on the viable options to be progressed to the full DPE. To achieve this, a qualitative viability filter was applied to the long list of design options. This resulted in design options being classified in one of three categories according to their compliance with safety requirements and alignment with the 'must-have' design principles listed above.

The categories assigned to the design options were:

- 'Unviable';
- Viable but Poor Fit or;

- Viable and Good Fit.

Figure 20 below shows the process used to differentiate between each category.

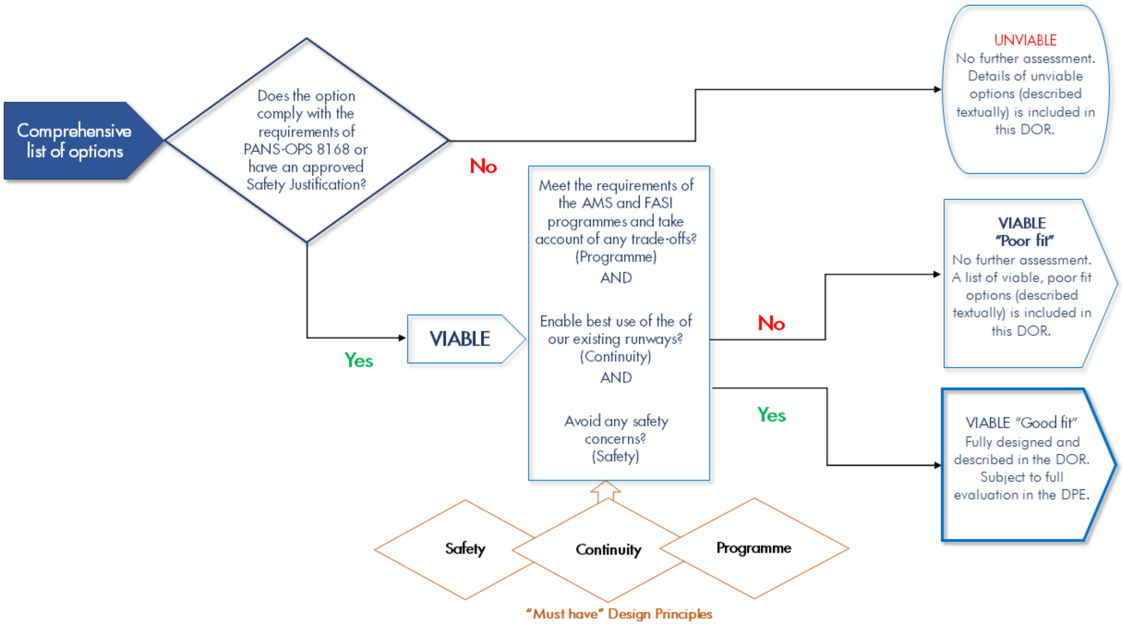


Figure 20: Flow diagram of viability analysis

5.11.1. Unviable

'Unviable' design options were defined as options that:

a. Would not comply with the minimum requirements of PANS-OPS 8168 or;
b. Would not have an approved safety justification for the non-compliance with the PANS-OPS criteria.

'Unviable' design options include those that may be non-compliant with PANS-OPS in relation to:

- Minimum Stabilization Distance (MSD) between turns.

- Position of the first turn in relation to departure end of runway (DER). As detailed in Appendix A, whilst CAP778 states that the turn point shall be no closer to the departure end of the runway (DER) than 1nm, it allows for some exceptions. Specifically, Para 4.1.3 states that where the climb gradient is greater than the PANS-OPS minimum of 3.3%, it is permissible to create a first turn closer than 1nm from the DER for environmental purposes but no closer than 0.61nm. Therefore, for the purposes of assessing viability, the earliest turns considered within the design process are between 0.61nm and 1nm from the DER.

- Turn radius based on speed, altitude and climb gradient.

- Procedure Design Gradient (PDG).

Some existing EMA SIDs commence their first turn in compliance with the ICAO PANS-OPS criteria, but at a point that is less than the 1nm recommended within CAP778. These existing SIDs are supported by a CAA approved unit safety case and have therefore been demonstrated to be safe since their introduction. On this basis, any option that replicated these existing SIDs or which had a first turn at an identical position were not classified as being 'Unviable' as a result. It was then considered whether these options would meet the requirements of the design principles Safety, Programme or Continuity, as described at 5.11.2, below.

The categories and nature of the design options identified as 'Unviable' are summarised for each design envelope within a table at the start of each section. However, due to the volume of 'Unviable' options, these were not designed or subjected to further analysis. This approach is consistent with both the Design Principle Safety, and the guidance given in CAP1616 paragraph 127, which acknowledges that the scope for multiple options may be limited where, for example, options do not align with relevant international standards (in our case, PANS-OPS 8168).

The basis for options being Unviable is described but these were not progressed to the DPE or IOA.

5.11.2. Viable but Poor Fit

Viable but Poor Fit options are those that would not meet the requirements of at least one of the design principles Safety, Programme or Continuity. These options are described in this DOR and the DPE but were not subjected to a full evaluation in the DPE or progressed to the IOA, as they do not address the SoN or align with the design principles. The assessment undertaken was based on a high level qualitative operational judgement of the comprehensive options list and took place within the design process by the relevant SMEs.

The viability assessment was not intended to identify those options that responded well to the design principles Safety, Policy or Capacity, which would be a test of 'Pass', but rather to identify where an option clearly failed to align to one or more of the three 'must have' design principles when compared to the other longlisted options. In this respect, the viability assessment does not replicate or replace the DPE process which evaluates each Viable and Good Fit option against the full range of design principles.

Options that were classified as a provisional Viable but Poor Fit were given a red classification, on the basis that they clearly misalign to one or more of the 'must have' design principles. All Viable but Poor Fit options were identified with a letter prefix ahead of the identification number, e.g. A6.

However, this rating was applied cautiously and if there was a potential that the option might align, then it was classified as Viable and Good Fit and carried forward for more detailed assessment. As a result of the more detailed assessment in the DPE and the IOA, it was then determined whether the option should be retained or be confirmed as being misaligned to the design principles and not carried forward.

Further, as described below, the Design Principle Programme incorporated a two-step test to determine whether an option initially identified as Viable but Poor Fit (as a result of a failure to meet a particular aspect of the design principle requirements) might offer a material benefit in respect of other requirements and present a reasonable trade-off such that it should be retained for further consideration.

Those options assessed as Viable but Poor Fit covered aspects such as:

- Clear and unsafe conflicts with other routes at EMA.

- Clear and unsafe conflicts with routes at adjacent airports, or with other areas of airspace.
- Environmental performance resulting in non-compliance with policy, including routes that were fuel inefficient because of the highly indirect nature of their track or where there was the potential for a negative noise impact when compared to other options within the same design envelope.
- Options which routed through areas where we had identified constraints or where there was an obvious interaction with routes of other airports. This includes options that route in directions that conflict with the network traffic flows. However, it did not include those areas where bilateral discussions had indicated the potential to mitigate the constraint. An example of this is Area H, as described in section 5.7, for which NERL have commenced dialogue to create new CAS.

The criteria used at this stage are described below.

5.11.2.1. Design Principle Safety

Safety is the number one priority for all airspace changes, and the application of this design principle sought to identify if inbuilt operational hazards or significant safety concerns were present. If no hazard or concern was identified, then the relevant option was given a 'green' rating for this design principle. If a hazard or concern was identified, then in the absence of a full safety analysis at this stage of the CAP 1616 process, a qualitative assessment was made in terms of whether the risk could be reduced to a tolerable level. If additional safety mitigations, or processes, including but not limited to extending controlled airspace, could mitigate the hazard or concern then the option was awarded an 'amber' rating. If a hazard or concern was identified and no suitable mitigations could be identified, then it was awarded a 'red' rating. This assessment is detailed within the rationale for each Viable but Poor Fit option in sections 7 to 18 for departures and section 23 to 29 for arrivals.

Examples of hazards or safety concerns could include but not be limited to:

- The relevant option has the potential to create a hazardous interaction between the route and other aircraft either at EMA or at adjacent airports.
- The route may extend into uncontrolled, military or Class G airspace. Routing commercial aircraft within this class of airspace, which is also used by general or military aviation, is not considered to be safe, and all departure and arrival design options should remain wholly inside controlled airspace in accordance with CAP778 and the CAA Policy for the design of controlled airspace structures. As described above, the exception to this is where bilateral discussions have indicated the potential to mitigate or remove this constraint. The continuation of this category of options during Stage 3 is dependent on the CAS being created.
- It may not align with controlled airspace (CAS) containment requirements with respect to the minimum distance between aircraft operating in Class D airspace (the airspace surrounding EMA) and Class G airspace as described in the UK CAA "Policy for the design of controlled airspace structures". Whilst this states that routes 'should' be no closer than a minimum distance from the boundary of CAS, it recognises a safety risk by describing a minimum separation criteria of 3nm and mandating the need for a safety case if this criteria cannot be met. This safety risk is also identified in CAP493 Manual of Air Traffic Services Part 1 (MATS Pt.1) which recognises the risk of a loss

of separation between aircraft operating close to the boundaries of controlled and uncontrolled airspace. The creation of an option that misaligns with the CAA policy statement would not satisfy the requirement for options to 'be safe for airspace users, the airport, and communities on the ground which is the criteria stipulated by the Design Principle Safety, and for this reason, any options that fail to meet this minimum separation requirement were classified as Viable but Poor Fit.

Where such an option was within a design envelope that also included fully contained options, an assessment was carried out to consider whether there were any material additional benefits to be gained from the continued inclusion of the Viable but Poor Fit option which may be mitigated via a safety case. If these benefits existed, it would be re-classified as amber in line with the rationale applied elsewhere in the Viability analysis. If not, it remained as Viable but Poor Fit.

5.11.2.2. Design Principle Programme

This design principle requires options to comply with national, international and industry regulations and legislation and the CAA AMS (CAP1711) which sets out the 'Ends' that airspace modernisation must deliver. Because the Ends are wide ranging, it may not be possible for options to fully meet all of the Ends at this stage, and this is recognised in the criteria used for Design Principle Programme as part of the Viability Filter.

Because route options needed to be aligned to the requirements of PANS-OPS 8168 in order to avoid being classed as 'Unviable', alignment to these regulations has already been covered in order for an option to reach this stage.

In addition to this, and the AMS, consideration was also given to the provisions of:

- Department for Transport Air Navigation Guidance 2017.
- CAP493 Manual of Air Traffic Services Part 1 (MATS Part1).
- CAA Policy for the design of controlled airspace structures – August 2022.
- CAP1385 Performance-based Navigation: Enhanced route spacing guidance.

The approach taken was to use a two-step process which recognised the potential for a trade-off in meeting these ends:

- Step 1: Viability assessment: The option was considered against the AMS 'ends' and, if there was clear misalignment, it was given a provisional red rating.
- Step 2: Trade Off Assessment: Any options identified as 'provisional red' in respect of Design Principle Programme were then assessed to consider the potential for trade-offs with respect to any other 'ends', including but not limited to a consideration of the altitude based priorities in the DfT Air Navigation Guidance 2017 (ANG). If there was potential for the option to provide a material benefit (i.e. One of a sufficient scale to merit a change), including in respect of noise below 4,000ft, then it was re-classified with amber rating in relation to Design Principle Programme. The result of this re-classification varies according to the classification against the other design principles of Safety and Continuity and is shown in section 5.11.3. However, if there

was no material benefit then the option remained as Viable but Poor Fit and marked as red for Design Principle Programme.

Step 1: Viability assessment

The four 'ends' within the AMS and how we considered them in relation to Design Principle Programme as part of the viability filter are described below:

i. **Safety: Maintaining and, where possible, improving the UK's high levels of aviation safety has priority over all other 'ends' to be achieved by airspace modernisation.**

   This highlights the priority that safety has in airspace change. This was considered by identifying any options that would not be aligned to PANS-OPS or the wider industry requirement to implement PBN unless an existing safety case was in place for existing routes. The AMS safety 'end' is not considered here as part of Design Principle Programme but as part of the Design Principle Safety assessment.

ii. **Simplification: Consistent with the safe operation of aircraft, airspace modernisation should wherever possible secure the most efficient use of airspace and the expeditious flow of traffic, accommodating new demand and improving system resilience to the benefit of airspace users, thus improving choice and value for money for consumers.**

   The provision of runway throughput to make best use of the capacity of the runway at EMA is captured within the must have Design Principle Continuity. Therefore, the consideration of the AMS Simplification 'end' as part of the Design Principle Programme assessment focused on the potential for route options to;

   - interact with the routes to and from adjacent airports or;
   - misalign with the traffic flows within the wider NATS network which are being created as part of the wider FASI-N and FASI-S projects.

   Details on the position of the main constraints and considerations is provided in section 5.7 which shows the potential interactions in the vicinity of EMA. These interactions were not considered to be unsafe but may require mitigations such as a stop climb or descent profiles or ATC intervention to resolve.

   The assessment on how EMA options will contribute to improvements in network resilience will be considered as part of Step 3A design activities, and the creation of operating networks described in section 1.4.

iii. **Integration of Diverse Users: Airspace modernisation should wherever possible satisfy the requirements of operators and owners of all classes of aircraft, including the accommodation of existing users (such as commercial air transport, General Aviation operations, military, taking into account interests of national security) and new or rapidly developing users (such as remotely piloted aircraft systems, advanced air mobility (aerial taxis), spacecraft, high-altitude platform systems).**

   The AMS calls for a transition towards greater integration of air traffic including GA, the military and remotely piloted aircraft systems. An option would not meet this 'end' where it had the potential to reduce airspace access for these users, including the need for additional CAS.

However, the AMS also highlights the need for a balance between the requirements of various types of users, and the need to improve environmental performance. Therefore, should future requirements necessitate the introduction of additional CAS such that it has minimal or no impact on other users (for example night time use only) then this has been assessed as partially aligning with this 'end' and therefore rated as amber.

This end also recognises the changing requirements of the military in terms of their use of airspace. Misalignment to this 'end' covered any option that had potential to adversely impact military operations by interacting with existing military airspace.

iv. **Environment: Environmental sustainability will be an overarching principle applied through all airspace modernisation activities. Airspace modernisation should deliver the Government's key environmental objectives with respect to air navigation as set out in the Government's Air Navigation Guidance (ANG) and, in doing so, will take account of the interests of all stakeholders affected by the use of airspace.**

The environmental end facilitates a trade-off between noise and emissions and was considered in line with the 'Altitude based priorities' in the ANG, i.e. To minimise or reduce noise below 4,000ft. In the airspace between 4,000 feet and 7,000 feet, the environmental priority should continue to be noise, unless this would disproportionately increase CO_2 emissions.

- <u>Noise impact</u>: This was considered by identifying any routes that demonstrated a clear inability to provide noise benefits when compared to other options within a design envelope.

For departures the judgement was made based upon a qualitative assessment utilising maps from Ordnance Survey. An assessment up to 4,000ft was made by considering just over the first half of the route whilst the later part of the route was treated as representing the climb between 4,000ft and 7,000ft.

For arrivals a CDA gradient of between 3.5° and 1.5° was required to be considered as delivering noise benefits, this is within PANS-OPS recommended range and also encompasses the optimal descent gradient identified within CAA Low Noise Arrival Metric (CAP2302). Options that had a gradient outside of this range were classified as having a detrimental noise affect and Viable but Poor Fit. With respect to the environmental trade-off for arrivals, the potential to achieve a CDA was considered to offer a noise benefit rather than a fuel benefit.

- <u>Carbon emissions</u>: This was judged based on a qualitative assessment of the track length. A track was evaluated as longer and less direct if it deviated from the relevant design envelope before returning to the SID aiming point. Longer tracks necessitate a greater fuel burn and therefore increased emissions.

- <u>Air quality</u>: Because of the specialist nature of analysis required, Air Quality impact was not specifically considered within the viability assessment and so no options were discounted due to air quality implications.

<u>Step 2: Trade Off Assessment</u>

As highlighted, the assessment of the Design Principle Programme involved two-steps, the second being to consider if there was potential for the option to provide a material benefit (i.e. One of a sufficient scale to merit a change) in one AMS 'end' that could be traded-off against a misalignment in another AMS 'end'.

5.11.2.3. Design Principle Continuity

The application of this 'must have' design principle identified design options which may create interactions with airborne holds, arrival routes or departure routes at EMA. Whilst not unsafe, these may require ATC tactical intervention and result in a reduction in capacity. This assessment is detailed within the rationale for each Viable but Poor Fit option. This design principle within the viability assessment was rated 'red' if interactions were identified or 'green' if not.

5.11.3. Summary of Option Classification

In assessing the options against the three 'must have' design principles, as described above they have been given a red, amber, or green rating for each of the three design principles independently. The ratings of red, amber and green indicate the extent of alignment with the relevant design principle, as shown in Table 4.

Red	The option was judged to be misaligned to the design principle.
Amber	**Design Principle Safety**: Hazard or significant safety concerns have been identified however, additional safety mitigations or processes, including but not limited to, an increase of controlled airspace have been judged to be feasible. **Design Principle Programme**: There is a misalignment with one of the three AMS ends considered for the purpose of Design Principle Programme (Integration, Simplification or Environmental) which would generate a red rating. However, further analysis as part of the trade-off assessment identified a material benefit in another AMS end which resulted in the option being rated as amber.
Green	No misalignment was identified.

Table 4: Viable assessment: colour categories

Any option that was categorised for any of the three 'must have' design principles Safety, Programme or Continuity, as being red was deemed to be Viable but Poor Fit.

Any option without a red rating, even if it contained amber ratings was retained as Viable and Good Fit for further consideration within the DPE. This is because it was not possible to categorically conclude it was sufficiently 'poor fit' to exclude it at this stage. This is illustrated in Scenario 1 below.

If either of the other two design principles were categorised as red then the option would be identified as Viable but Poor Fit and was not carried forward for further evaluation, as illustrated in Scenario 2.

Similarly, Scenario 3, which contains two green ratings and one red, is categorised as Viable but Poor Fit.

Scenario 1: Retained as Viable and Good Fit for further assessment in the DPE. Whilst this formed part of the viability process, it did not result in any options being re-classified and returned to Viable and Good Fit:

Option	Keeping the Skies Safe	Joined Up Approach	Meeting demand
Option name	S	P	C

Scenario 2: Remains classified as Viable but Poor Fit and is not assessed further.

Option	Keeping the Skies Safe	Joined Up Approach	Meeting demand
Option name	S	P	C

Scenario 3: Remains classified as Viable but Poor Fit and is not assessed further.

Option	Keeping the Skies Safe	Joined Up Approach	Meeting demand
Option name	S	P	C

The output from the assessment is detailed within the rationale for each Viable but Poor Fit option with sections 7 to 18 for departures and sections 21.3 and 23 to 29 for arrivals. The description includes details of any misalignment and the assignment of a colour status for the option against the 'must have' design principles.

5.11.4. Viable and Good Fit

Design options that were classified as Viable and Good Fit were defined as routes that would be expected to meet the three 'must have' design principles Safety, Programme, and Continuity with which all design options must comply. These are included as numbered options in this DOR and were progressed for full evaluation within the DPE.

6. Departure designs – Introduction

6.1. Overview

Sections 7 to 18 of this DOR provide a technical overview of the departures design envelopes and a breakdown of the design options within them. In line with CAP1616 guidance, the departure design options start at the runway and end at 7,000ft.

This section of the DOR contains details of:

- An explanation of the Departure Design Envelopes (6.2).
- How the Departure Design Envelopes were developed (6.3).
- The phase one stakeholder engagement process and the feedback on the Departure Design Envelopes (6.3.1).
- The Design Envelope changes made following phase one stakeholder engagement feedback (6.4).
- The development of the Departure Design Options shared in phase two stakeholder engagement (6.5).
- The constraints and considerations that informed the departure designs (6.6).
- Other assumptions and considerations applied to departure designs (6.7).
- The PBN design criteria we've used and why (6.9).
- The climb gradients we've used and why (6.10).
- The criteria used for the first turn after departure (6.11).
- The phase two stakeholder engagement process and the feedback on departure design options (6.12).
- NERL engagement and the impact of their feedback on departure design options (6.13).
- Design options development to the north west following NERL feedback (6.14).
- Design options development to the east and south east (6.15).
- The departures development strategy in Step 3A (6.16).
- A summary description of the departure options (6.17).

6.2. Departure Design Envelopes - Summary

The EMA design envelopes start at the runway and expand around a nominal centreline until they are at least 8,000m or approximately 4.5nm wide when they reach 7,000ft. This provides lateral flexibility to create design options that respond to different elements of the design principles and to respond to stakeholder feedback through the engagement process. To enable us to create the widest range of options, the design envelopes are defined by the end point of the routes created within them, rather than by defining a fixed end point for all design options. Again, this gave us the ability to create different lateral and vertical tracks for the design options.

The dimensions of the individual design envelopes are based upon the rationale and diagrams within CAA CAP1498 'Definition of Overflight' document. This states that a 1,888m lateral displacement at 7,000ft would be expected to result in a 3dB reduction in noise which is the minimum difference that can ordinarily be perceived on the ground. By expanding the width of the end of the envelope from 1,888m to a 4,000m lateral displacement either side of centreline this will equate to a total end width of 8,000m or 4.32nm. For design purposes, the total end width was rounded up to 4.5nm to provide a wide area within which to create design options and a broader range over which to reduce the impact of noise.

In some cases, individual design envelopes were combined into a single envelope between the phase one and phase two engagements if the initial routes were similar. For example, the individual envelopes to the south west, south, and south east from runway 09 were combined into a single southbound element because of the similarity of the initial part of existing SIDs and to provide greater scope for design. This is described in section 6.4 below.

6.3. Development of Departure Design Envelopes – Process

The departure options design process comprised a sequence of steps commencing with the creation of our initial design envelopes – broad areas where it would be possible to design options.

The first step was to create the viable design area for departures. This used the information from the aircraft fleet equipage survey, which confirmed that all aircraft operating out of EMA could climb at a gradient of at least 6% to 7,000ft.

Further detail on the process to create the initial design envelopes is detailed in section 5.6 and 5.8.

This created a theoretical omnidirectional (circular) line assuming a constant climb onto which were applied the ICAO and CAA rules on procedure design to create a more realistic design area. For departures, this exercise included the consideration of:

- The PANS-OPS criteria, with regards to the position and radius of the first turn after departure. This ruled out certain areas within the initial boundaries where we could not put forward design options.
- The constraints and considerations which may impact departures. These included operations from adjacent airports, such as BHX and MAN, the position and dimensions of controlled airspace, and the NATS upper airspace network traffic flows. Further detail on these constraints and considerations are shown in section 5.7 and section 6.6.

Having established the above constraints and considerations, a set of initial design envelopes were produced, taking into account:

- Rules: CAA and ICAO PANS-OPS rules relating to Instrument Flight Procedure (IFP) design, including turn altitudes and radius and stabilisation requirements.

- **Aircraft performance**: The fleet equipage survey gave us detail on the navigation standards that airlines can fly and the climb performance they can achieve.
- **Existing SIDs**: Where a departure route already existed, this route formed the foundation of the design envelope in order to provide an indication of existing baseline traffic and to create a 'do minimum' option. Where no SID existed, a new envelope was created.
- **Network**: Traffic flows within the airspace around EMA and potential 7,000ft connection points for EMA traffic (both arrivals and departures) with the NATS network. At this early stage, the lack of a connection point did not preclude the creation of an envelope, unless this had been identified as constraint as per section 6.6.
- **Design principles**: The design principles as detailed in section 1.3 and the SoN that supports these.
- **CONOPS**: The EMA CONOPS to support the change, specifying how the new airspace should work.

As detailed in section 6.2 these design envelopes start at the runway and typically expand until they are at least 8,000m or approx. 4.5nm wide when they reach 7,000ft. This approach provided lateral flexibility to create design options that responded to different elements of the design principles, including noise, fuel burn and emissions or interaction with traffic from other airports. These envelopes were then shared with stakeholders at phase one of the Stage 2 engagement process.

6.3.1. Stakeholder Engagement Phase One

Stakeholder engagement took place in two phases. Phase one introduced the design concepts and the design envelopes, and phase two took into account the feedback from phase one and provided detail on the design options.

During the first phase of engagement, stakeholders were provided with information on current operations, how airspace is divided and the constraints and considerations that we had applied in creating the design envelopes. The process followed to design the initial design envelopes was explained and maps showing each envelope were presented, with stakeholders being asked to comment on both the concept and the position of these design envelopes. We then considered this feedback and applied the design principles to refine the design envelopes and create a comprehensive list of design options within them.

In the phase one engagement, stakeholders were presented with a total of 24 envelopes, which were made up of 12 envelopes for runway 27 operations and 12 for runway 09 operations as shown in Table 5 below. These envelopes constituted main and alternative envelopes that offered the potential to provide predictable respite.

Runway 27		Runway 09	
North	North - alternative	North	North - alternative
North west	North west- alternative	North west	North west- alternative
West		West left turn	

South	South- alternative	West right turn	
South west	South west- alternative	South west	South west- alternative
Southeast		South	South- alternative
East right turn		South east	
East left turn		East	

Table 5: Phase one engagement design envelopes

Feedback from phase one demonstrated that stakeholders understood how the departure design envelopes had been created and recognised the difference in the existing structure and the proposed options.

However, stakeholder groups were consistent in providing negative feedback for the alternative departure envelopes, in particular the wrap-around options. Aviation stakeholders felt these would result in additional fuel burn and community stakeholders expressed concern that these would result in greater noise impacts for some communities close to the airport who could be impacted by departure routes on both runway ends.

Further information on this part of the engagement process can be found in section 3 of the Stakeholder Engagement Report.

6.4. Departure Design – Design Envelopes Changes post Phase One Stakeholder Feedback

In light of stakeholder feedback received in phase one, a number of the original design envelopes were modified to enable the creation of additional respite opportunities or provide opportunities for a more comprehensive set of route options. In addition, the negative feedback on the alternative design envelopes resulted in these design envelopes being discounted.

These changes are detailed in Table 6 and Table 7 below and shown on the accompanying maps (Figure 21 and Figure 22). These maps show the amendments made to the design envelopes between the phase one and phase two engagement, including where envelopes were extended (green) and where areas were removed or discounted (red).

Runway 27	
North	Extended east and west to enable improved network connectivity (Programme) and create potential for route options that reduce noise impact (Noise N3).
North - alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
North west	Extended to avoid the west side of Derby (Noise N3) and to create potential for route options that closely follow major road networks (Noise N2).
North west- alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
West	No changes.

South	Extended slightly north to enable the creation of offset route options that provide noise relief to communities on the extended runway centreline (Noise N3).
South- alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
South west	Extended slightly north to enable the creation of offset route options that provide noise relief (Noise N3).
South west- alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
Southeast	Widened to the south to enable the creation of additional route options that aim to follow major road networks (Noise N2).
East right turn	Extended south in response to stakeholder feedback for route options with a tighter initial turn to reduce noise impact (Noise N3).
East left turn	The envelope was discounted for two reasons. Firstly, it was identified that the combination of this envelope, together with other runway 27 departure envelopes to the south west, south and south east would not make best use of runway capacity by reducing the ability for one minute departure separations (Continuity). Secondly, it was deemed that the combination of four departure envelopes, including those that take the greatest percentage of EMA flights, in the area just to the south west of EMA would not allow for the spreading of noise impacts (Noise N1).

Table 6: Runway 27 envelope changes following phase one engagement

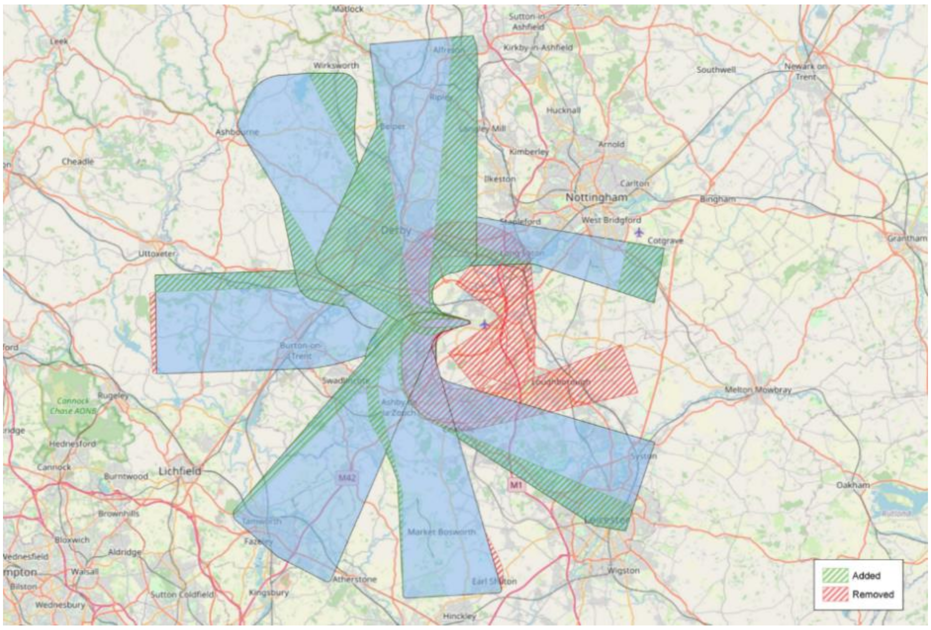


Figure 21: Runway 27 Departure envelope modifications

Runway 09	
North	The eastern boundary was reduced slightly to ensure the route options align with CAA rules on airspace containment (Safety)
North - alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
North west	Widened in response to stakeholder feedback for route options that offer potential to create noise respite and/or relief between Derby and Nottingham (Noise N1 and N3)
North west- alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
West left turn	No changes.
West right turn	The envelope was removed due to interactions with southerly runway 09 departure envelopes which would limit runway throughput (Continuity).
South west	Combined with south and south east envelopes to form a single southern envelope. This was due to SID similarity on the initial part of the route, and to aid flexibility in creating design options.
South west- alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
South	Combined with south west and south east envelopes to form a single southern envelope. This was due to SID similarity on the initial part of the route, and to aid flexibility in creating design options. In addition, the space between the original south and south east envelopes was filled in to provide additional opportunity to create route and respite options. (Noise N1 and N3)
South- alternative	Discounted as a result of negative stakeholder feedback and misalignment with design principles Noise N1 and N3 and Emissions.
South east	Combined with south west and south east envelopes to form a single southern envelope. This was due to SID similarity on the initial part of the route, and to aid flexibility in creating design options. Reduced in size to ensure separation from arriving traffic. (Safety)
East	No changes.

Table 7: Runway 09 envelope changes following phase one engagement

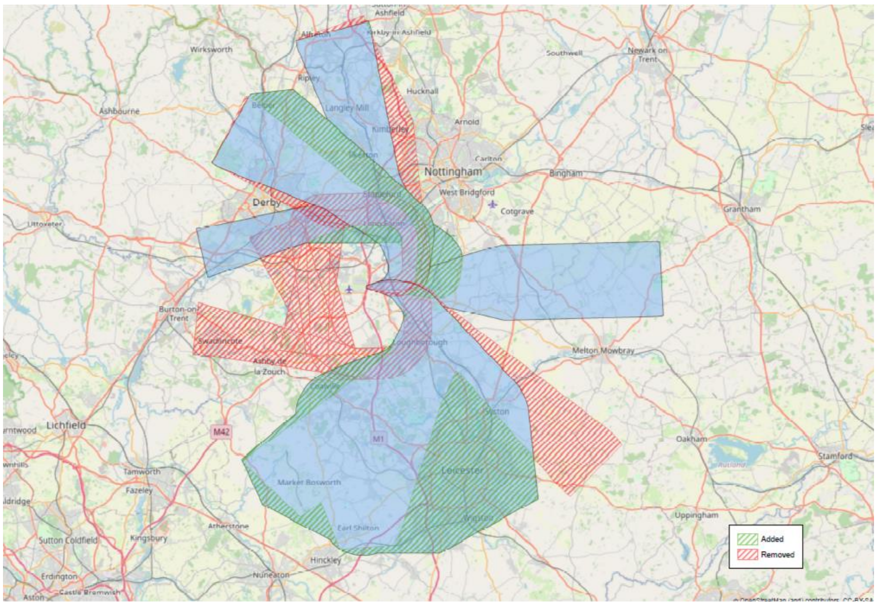


Figure 22: Runway 09 Departure envelope modifications

6.5. Departure Design – Design Options Development Process

Having amended the design envelopes and considered the feedback identified by stakeholders at phase one engagement, a set of design options was created within the revised design envelopes. The creation of these options considered the criteria detailed in section 6.3 (including PANS-OPS rules, aircraft performance, network and the design principles).

The starting point for each option was a PBN replication of the existing SID (if there was an existing SID within the design envelope), used to represent the 'do minimum' option. These options were created with a track as close as possible to the existing conventional SID, using the current turn criteria and design parameters.

However, because UK guidance on the first turn after departure, as detailed in CAP778, differs slightly from the criteria within PANS-OPS 8168, an option was also created using these CAP778 criteria. This provides a first turn at a minimum position of 1nm beyond the Departure End of Runway (DER) and creates a similar track to the existing SID but is not the replicated or 'do minimum' option. This difference in turn initiation results in the small difference that is visible between the tracks shown on the maps in sections 7 to 18. Further details on the criteria for the first turn are shown in section 6.11 and Appendix A section D2 and D3.

Having established the 'do minimum' option, further design options that responded to the design principles were then created within the design envelope. These options included those that:

- Route to reduce the impact of noise by limiting the number of people overflown (Design Principle Noise 3).
- Provide a more direct routing to the joining point with the NERL network airspace to reduce fuel burn (Design Principle Emissions).

- Reduce delays on the ground for following aircraft on different routes by creating route divergences that make best use of runway capacity (Design Principle Continuity).
- Route over areas where levels of ambient noise could be expected to be higher, such as motorways or rail network (Design Principle Noise N2).

Because some design envelopes are new, there will not always be an existing SID upon which to build a 'do minimum' replication. In these envelopes the design options were designed using the same concept, with each of the options being created to align with one or more of the design principles.

Each departure design option is described in this DOR in sections 7 to 18.

6.6. Departures – Constraints and Considerations

As described in detail in section 5.7, the constraints and considerations for departures were developed by analysing the airspace and current operations in an area around EMA:

- **Constraints** were defined as aspects that have a direct impact on designs, or limit where we can place our arrival design options.
- **Considerations** were defined as aspects that do not limit our designs but which we need to take account of in creating arrivals options.

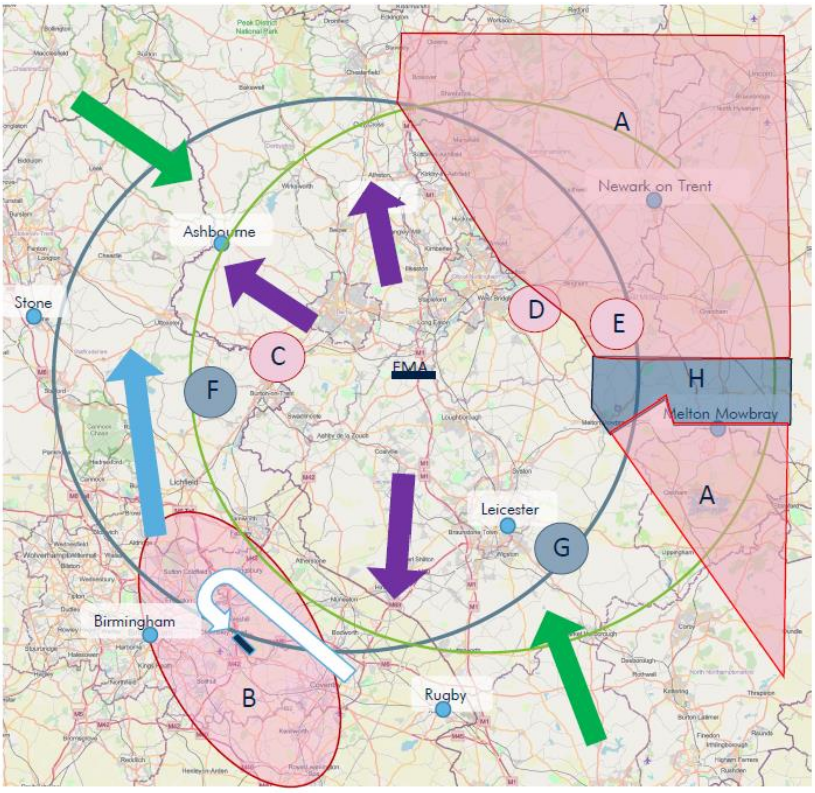


Figure 23: Departures constraints and considerations

The map above shows all constraints and considerations that were considered and presented as part of stakeholder engagement. The principal constraints for departures are:

- **Area A – Uncontrolled airspace**: This area of Class G airspace is used by the military and GA, and is not currently available to commercial flights, except through tactical coordination by ATC. The unavailability of this airspace was used as a constraint in the creation of departure route options to the north and south east. However, because there are significant environmental benefits enabled by new CAS in this area, design options to the east were created in this area with their viability being contingent on the creation of the required airspace by NATS.

- Area B – Birmingham Airport (BHX): The location of BHX places a constraint on EMA departures to both the west and the south west because of the need to retain safe separation. Their airspace and routes influenced the creation of the EMA departure design options, with a wide range of options being developed to give an ability to deconflict from BHX. However, safety analysis and detailed design work will need to take place in Step 3A which may lead to the discontinuation or modifications of departure options to the west and/or the south west.

- Area E – Langar Parachute site: This influenced the placement of departure route options to the east because of the need to ensure safe separation between EMA flights and this operation which can extend above 7,000ft. Because it is adjacent to area H where new airspace may be created for routes to the east, bilateral discussions with the stakeholders for this operation will form part of any NERL led airspace change for new CAS in Area H.

The principal considerations for departures are:

- Area H – Potential new controlled airspace (CAS): As noted in the description for Area A above, there are significant environmental benefits for flights to the east which would provide a more direct route for departures to north east Europe. This has resulted in the creation of design envelopes and options in this area described in sections 7 for runway 09 and sections 12 and 16 for runway 27.

  NERL have led engagement discussions with particular impacted stakeholders (military and the GA community) on the concepts being proposed in this area as the responsibility for creating this airspace rests with NERL. However, the responsibility for formal engagement and consultation with impacted stakeholders will remain with EMA where any proposed departure or arrivals routes pass through any volume of new airspace below 7,000ft.

  Future activities in relation to this airspace are detailed in section 6.16 below.

6.7. Departures Design – Other Assumptions and Considerations

a) Systemisation and ATC vectoring: Consistent with the design principles Programme and Technology, the departure design options have been designed to accommodate the principle of systemisation (minimal ATC intervention). However, it is expected that some ATC vectoring will still be required to ensure safe separation between aircraft is consistently maintained, or for weather avoidance, for example during thunderstorm activity.

b) Current arrivals noise procedures: To present a comprehensive list of viable design options, the design process has not been constrained by the existing Noise Abatement procedures. This is in line with the Design Principle 'Fit for the Future' (Airspace 1) which states that "*Flight paths should be designed to future proof our airspace and* *should not be constrained by existing arrangements.".* Any changes required to these noise procedures will be addressed separately as required.

c) Replication: For all of the 'do minimum' options, the term "replication" is used in the route description. This refers to a route design that has been developed to match an existing route as closely as possible. However, the existing routes are based on the criteria associated with ground based infrastructure, whereas the new replicated routes are designed using the criteria for satellite based navigation. These criteria are slightly different and for this reason it is not always possible to exactly replicate a conventional procedure using a satellite-based procedure particularly in the construction of turns.

In addition, the increased accuracy associated with flying PBN routes may result in some changes to the distribution of traffic, even if flying a replicated route. Once again this is down to the criteria associated with the construction and flyability of these PBN routes.

6.8. Departure Designs - Noise Considerations

Both our design principles and the results of stakeholder engagement reflect the prominence of the consideration of noise to EMA operations and this airspace change. This is further supported by the AMS and the Air Navigation Guidance (ANG).

The table below provides a brief summary as to how our departure design options sought to address the main noise considerations within the design principles or have applied feedback from stakeholder engagement relating to noise to modify designs. References to where further detail can be found are included in the below table.

Sharing the load	Noise 1 (N1)	Flight paths should, where practical, be spread out to avoid concentration of aircraft activity to share any noise impacts. As described in section 2.4, EMA only has two SIDs for daytime use on runway 27 and three for daytime use on runway 09. Given that runway 27 is the predominant departure runway, this has the effect of concentrating departures on a small number of routes. In response to this we have: • Created new design envelopes from both runway directions to the east, south west and west, and from runway 27 to the south east and north (runway 09 already has a daytime route to the north). These additional envelopes and the design options within them have the potential to spread the flights across a larger number of SIDs when compared to current operations. The departure design envelopes that were shown at phase 2 stakeholder engagement and were used to create the design options are shown at section 6.4. • Worked with NERL on the concept of routes to the east through the provision of new CAS. Whilst the benefit of routing east is principally a fuel saving, it would also mean that aircraft heading east would no longer need to route south initially on a DTY departure and would instead have a dedicated route. If progressed, the east route would therefore result in a reduction of the percentage of traffic using the DTY SID. The east envelopes are described at section 7 for runway 09 and section 12 for runway 27. • Created options across the width of each envelope. This gives the potential to offer either noise respite or noise relief when options are combined into an operating system at Stage 3A.
Responsive flight paths	Noise 2 (N2)	Where flight paths have to overfly communities, we will consider existing noise in the local area, and will select flight paths to mitigate effects on areas with relatively low levels of ambient noise. In response to this we have: • Created a comprehensive range of departure options with different characteristics, some of which fly over rural areas and some over urban areas including large towns, and road and rail interchanges. If there is a link to this N2 design principle within a particular option, it is shown in the "Reason for Inclusion" column in sections 7 to 11 for runway 09 and sections 12 to 18 for runway 27.

Limiting disturbance	Noise 3 (N3)	Flight paths should seek to limit and, where possible, reduce noise disturbance to communities – especially at night. In response to this we have: • Designed a range of options, some of which specifically avoid the overflight of large towns and urban areas. • Taken account of the location of communities relative to the runways. The impact of aircraft noise on most communities varies according to the wind direction and the runway in use. However, some communities, particularly those on, or close to the extended runway centreline, experience noise from both departing and arriving aircraft regardless of the wind direction. Therefore, and in response to stakeholder feedback we have created offset routes within the comprehensive list that deviate by up to 15° after take-off. If there is a link to this N3 design principle within a particular option, it is shown in the "Reason for Inclusion" column in sections 7 to 11 for runway 09 and sections 12 to 18 for runway 27. Further work on evaluating design options in respect of this N3 design principle will be conducted in the DPE and the IOA, both of which are required to take account of the ANG which priorities noise below 4,000ft. Reducing night noise is a consideration of relevance to how routes are operated as a system, rather than in the determination of their locations. As such, this is not a consideration of this DOR but will be addressed at Stage 3 and beyond as operating systems become developed, and further work is conducted on the appraisal of options including noise modelling.

Noise sensitive locations	**Noise 4 (N4)**	Flight paths should, where practical, avoid locations that are especially sensitive to noise. Because of the need to provide a comprehensive list of options, both the design envelopes and the options within them have covered areas that are deliberately wide ranging. Nonetheless, the process to create the design options has taken account of locations where peace and tranquillity may be important, and where these are recognised areas, aimed to create options within the comprehensive list that avoid these locations. However, the evaluation of whether these locations are overflown is not part of this DOR but will be considered further in the DPE and IOA.

6.9. PBN Design Criteria

In line with the results of the airline fleet equipage survey detailed in section 5.5.1, both the replicated design options, and the new options have been designed as RNAV1. There is one departure that has utilised RNP1 with Radius to Fix turns (RNP1+RF) and this is made clear within the description for 27 East Option 4 at section 12.7.

Both design standards have an accuracy requirement of within 1nm and are fundamentally similar. The use of these in the EMA departure design options is detailed below:

- RNAV1: The use of RNAV1 aligns with the AMS requirement to upgrade to PBN but has the lower aircraft equipment requirement and is therefore more suitable for a wider range of aircraft to fly the routes accurately. When aircraft fly RNAV routes, they may sometimes refer to ground based DME systems to assure their position. This means that, whilst the aircraft will fly within the accuracy criteria required within the ICAO standard, some dispersion can occur within a turn, depending on how far away these DME systems are.

  The fleet survey confirmed that all aircraft operating into EMA were capable of flying routes designed to this standard and as a result, this was the baseline design standard for all EMA departure routes.

- RNP1+RF: This requires on board navigational accuracy monitoring and alerting system and offers a constant radius of turn. It makes no reference to any ground based system with all navigation conducted via satellite reference. This type of procedure is highly accurate in the turn with very little dispersion, but the enhanced equipment requirements mean that not all aircraft are currently able to fly it (especially the RF legs).

  For EMA, the fleet survey confirmed that only 82% of aircraft operating into EMA were capable of flying routes designed to this standard and in line with our Design Principle Embracing Technology, this type of procedure was not used except in one case where a specific turn radius was required.

- RNP-AR (Authorisation Required): In the first phase of engagement, some stakeholders asked us to consider the implementation of RNP-AR procedures. This is a specialist type of PBN procedure but is only used for arrivals, and therefore no departure options can be created to this standard. Further information on RNP-AR approaches is detailed in section 19.9e).

6.10. Climb Gradient Criteria

As detailed in section 5.5.1 the airline fleet equipage survey asked airlines to supply information on both their PBN capabilities and their climb performance.

The question asked was: Assuming ISA +10 conditions (25°c) could the worst performing aircraft that operates from EMA fly a departure procedural design gradient of 6%, 7% or 10% to 7,000ft? The survey indicated that all aircraft are capable of climbing at 6%, and 94% could meet a gradient of 7%.

Based on this information, the design envelopes were designed to accommodate a minimum climb gradient of 6%. This ensures we make available a route structure for all aircraft operating to and from the airport.

Whilst the choice of 6% was informed by the fleet equipage survey, bilateral discussions with NERL have confirmed that that their network concept does not seek to place vertical restrictions to aircraft climbing more quickly than this 6% minimum. Aircraft will therefore be permitted to use their preferred climb rate unless specific conflicts exist that require altitude restrictions to be applied.

6.11. First Turn Criteria

The position of the first turn was designed through the application of the rules outlined in PANS-OPS 8168 and the recommendations within the UK from CAP778. Both refer to the DER, which is the Departure End of Runway, and which determines the start point for the design of a departure procedure.

As detailed in Appendix A, whilst CAP778 states that the turn point shall be no closer to the DER than 1nm, it allows for some exceptions if there is an environmental benefit. However, it states that under no circumstances shall the first turn be designed closer than the 0.61nm from the DER that is within PANS-OPS 8168. This minimum is reflected in the viability assessment at section 5.11.

At EMA, the revised replicated routes fall within this acceptable range, with the minimum having a first turn at 0.66nm from DER on runway 27. An earlier turn to the ICAO minimum permissible of 0.61nm was considered which would represent a difference of approximately 93 metres in the placement of the first turn.

Analysis on the noise impact showed that this small change of lateral distance when combined the expected height of the aircraft would result in a benefit of less than 1dB. CAP1498 (Definition of Overflight para. 3.19) states that "3dB is the smallest difference between two noise levels that the average person can perceive" and on that basis, this change of less than 1dB would not have created any benefit or perceptible noise reduction for the communities that had requested this change to be considered.

In addition, because the turn at 0.66 miles is in use in current operations, it is supported by a CAA approved unit safety case having been demonstrated to be safe since introduction. A change to the ICAO minimum of 0.61 may be viable but would require additional safety justification to be made.

Given there is no anticipated noise benefit to support this as required by CAP778, no further amendment was made.

6.12. Stakeholder Engagement - Phase Two

The purpose of the second phase of engagement was to update stakeholders on the changes made to the design envelopes following the feedback received in the first phase of engagement and to outline the design options that had subsequently been developed. This engagement also included an explanation of the Viability filter applied to design options, as detailed in section 5.11. Stakeholder feedback collected in this second phase of engagement informed the revision of the design options for departures, and also influenced the creation of additional route options.

Within this phase, specific feedback was received relating to the use of offset departures to reduce the impact of noise:

- Runway 27: Stakeholder feedback asked for options be created with either a greater southerly or northerly offset to avoid communities close to the extended runway centreline in line with the Noise N3 design principle. In response to this, additional route options were created with the maximum possible PANS-OPS offset of 15° in the 27 south and 27 south west envelopes. An additional option for 27 south west was also created that gave potential benefit to both communities close to the extended runway by using a 15° offset and also those further along the route by routing between settlements. The full suite of options for runway 27 south are shown at section 15 and runway 27 south west at section 17.
- Runway 09: Stakeholder feedback also asked for additional offset options be created from runway 09. Options were therefore created with the maximum southerly offset of 15° in the 09 north west, 09 north, 09 east and 09 south envelopes which are all shown in the respective sections for these options.

Other feedback asked us to consider amending routes to take them away from specific areas or between specific communities in line with the design principles relating to noise. Each suggestion was considered individually to understand whether it was viable and whether it could deliver an additional benefit, and if so, these modifications were incorporated into the designs that are recorded within this DOR. Further details of this are detailed in the SER Appendix 10 Summary of Feedback Responses and Q&A.

6.13. Engagement with NATS NERL on Departure Options

As a key stakeholder and the operator of the upper airspace network, NATS NERL were part of the formal phase two engagement process described in section 6.12 above and provided feedback to that process. In addition, as part of the ongoing design process, engagement with NERL has taken place via bilateral design meetings and workshops. These have been used to discuss the EMA departure design envelopes and design options, and to use this feedback to modify designs where required.

These meetings and workshops were attended by Subject Matter Experts (SMEs) from both NERL and EMA and were held to ensure the design options of both parties were a product of co-ordination and agreement. The output led to the creation of NERL visualisation simulations which considered the whole of the southern MTMA including the ability of the upper airspace network to facilitate EMA departures to the west, north west, north and east.

For departures, the design option work has taken account of the following:

a) Whilst EMA sits between both FASI-N and FASI-S, it has been agreed that the EMA change will be deployed as part of the MTMA deployment cluster.

b) As described in section 3 the designs within this DOR have been created via a combination of airspace development workshops, involvement of NERL as a stakeholder as part of the formal Stage 2 engagement process and by NERL fast time visualisation simulations. This work has focussed on network operations to the north, meaning that departures to the south have not been discussed in detail because this airspace is still being developed as part of the FASI-S project. However, EMA will continue to work with NERL to align designs to the network interface, and to the airspace changes to the south as part of the national airspace master plan.

c) The NERL network is not considering major changes to the UK network COP. The interface points with airspace outside of the UK will therefore remain substantially unchanged, although new COPs may be created following negotiation between NERL and adjacent airspace authorities.

d) There exist some constraints to the upper network structure based upon the UK Traffic Orientation Structure (TOS). This is established to smooth traffic flows and decrease the safety risks associated with crossing traffic. The TOS dictates a direction of flow via a one-way system in certain areas of airspace and takes account of traffic demand, agreements with adjacent Flight Information Regions (FIRs), constraints on controlled airspace and the needs of the military.

   Some proposed changes to this structure have already been identified as part of EMA Stage 2, work as highlighted in section 6.14 and 6.15, with more changes expected as NERL create a network within their ACP that is both more efficient and which creates fuel savings. This work will influence the placement of the EMA departure envelopes and departures route options to ensure the alignment with the flow of traffic and to create safe separation. This work will be conducted within Step 3A detailed design activities.

e) Whilst Flexible Use of Airspace (FUA) concepts will be explored, the military primacy in danger areas/restricted areas will remain unchanged. Whilst this doesn't directly impact EMA departure design options below 7,000ft, if the route taken within the upper airspace network above 7,000ft is likely to pass through military restricted airspace, this will impact the viability of the route within a wider system. This may lead to these routes being discounted due to misalignment with the wider network and the Design Principle Programme, specifically the Integration and Simplification ends of the AMS. Further work on this will be conducted during Step 3A.

f) The UK AMS includes a provision to consider equitable access for all airspace users and to ensure the amount of CAS is kept to the minimum necessary for the safe provision of ATS. However, it also highlights the need for an appropriate balance between the requirements of various types of users, and the need to improve environmental performance. On this basis, it has been assumed by NERL and EMA that it is possible to propose changes to the use or dimensions of CAS if there is a benefit to be gained to commercial operations from doing so. This includes proposals for routes through Class G airspace or Areas of Intense Ariel Activity (AIAA).

Any changes would be subject to negotiation and agreement with the relevant stakeholders and would form part of a separate ACP. The potential change of most relevance to EMA relates to the area to the east of EMA (area H in section 6.6) which would respond to feedback from airlines and NERL as to the potential to create significant fuel and CO_2 savings. Any changes to either the use or hours of this airspace would be coordinated by NERL, and form part of a NERL sponsored ACP. For the purpose of creating design options, it has been assumed that this airspace may become available, with further work on this concept to be conducted during Step 3A.

The full list of NERL MTMA design assumptions is detailed at section 3.2.

6.14. Design Option Development – North West Departures

Feedback from NERL via the visualisation simulations described in section 3.4 and additional bilateral meetings concluded that the majority of the EMA design options within runway 27 north west envelope, and a small number of those within the 09 north west envelope may not be aligned to NERL's developing network design.

This potential misalignment related to all options within the envelope but was most significant for those that terminated or headed to a point north and east of the TNT DVOR. The misalignment relates to the interaction above 7,000ft between EMA departures climbing towards the TNT DVOR and inbounds to Manchester (MAN). MAN inbounds will be descending on a similar heading between TNT and the DAYNE hold, which is the southerly hold for all MAN traffic. This presents a risk that EMA departures may not be permitted continuous climb into the network, which would impact fuel burn and emissions.

Whilst this conflict would be above 7,000ft, it creates a potential misalignment with the EMA Design Principle Programme, both through the link to the Simplification end of the AMS (which requires the designs of airports and the network to be aligned) and the reference to FASI. From NERL's perspective the conflict does not use systemisation as a means to reduce complexity and improve safety and efficiency which is misaligned to the ends of the AMS, and routes EMA departure options on a potentially unsafe track towards airborne holding facilities. This introduces route convergence and misaligns to the NERL Safety design principle. However, at the time of the feedback, the NERL network design had not been fully tested. This created the need for a set of proposed EMA designs which included the design options already created but also accounted for the feedback relating to the revised network join.

NERL and EMA discussed four potential solutions to address this misalignment:

- Option 1: EMA do not make a change in response to the conflict and retain the runway 27 north west envelope and options unchanged. This would not resolve the interaction and may result in ATC intervention resulting in EMA departures not receiving a continuous climb once within the network. This would have a fuel and emissions disbenefit, and possibly increase the number of people affected by noise. In summary, the EMA routes would be misaligned to the network flow which would not align to the must have Design Principle Programme.

- Option 2: EMA create additional 27 north west departure options which terminate approximately 5nm east. This 5nm lateral shift is based upon the separation standards between routes within CAA CAP1385 guidance. Whilst this may create separation from the MAN inbounds, it would not align with the EMA must have Design Principle Safety due to the possible interaction with EMA arrivals from the north, and the Design Principle Emissions by creating unnecessary track miles. It is also likely to interact with the 27 North departures envelope.
- Option 3: NERL realign the MAN inbound tracks which would involve a lateral shift of these routes by approximately 5nm east above 7,000ft. Whilst this would resolve the conflict with the EMA 27 north west departures, this would place MAN traffic above 7,000ft in direct conflict with EMA arrivals descending from the north. This may lead to hazardous interactions or result in ATC intervention being required. In summary it would misalign to the network flow which would not align to the AMS Simplicity end, the EMA must have design principles Safety and Continuity, or with the NERL Safety design principle.
- Option 4: EMA extend the 27 north west design envelope to the south west by approximately 5nm of the original position and create additional options within this area. This would also require the realignment of several options within the 09 north west envelope which were originally created on a heading that terminated north of TNT, and which resulted in a similar conflict to that created by the runway 27 options.

  Whilst requiring additional options to be created by EMA, this would align all options with the NATS network flows (both current and proposed), deconflict the EMA departures from the MAN arrivals, and would allow EMA routes to be created to avoid Derby in line with the Design Principle Noise N3. This would give greater assurance on a continuous climb for EMA departures and may also increase flexibility for EMA operations by creating greater separation between EMA north west departures and EMA arrivals from the north.

Option 4 was therefore agreed with NERL as the option to be progressed. This resulted in the extension of the 27 north west departure envelope together with:

- The creation of additional route options aligned to the revised network joining point (W39B shown in Figure 24 below) within the Runway 27 North West Design Envelope. These are detailed at section 14.
- The modification of design options within the 09 North West Design Envelope which are detailed at section 9.

Figure 24 below shows the additions made to the 27 north west design envelope.

The current network joining point can be seen to the north west at “TRENT”, together with the proposed revised joining point at “W39B”. The blue area represents the original envelope that was created and contains the replicated TNT departure, depicted by the black line as “R27 D NW 01A”. The green area represents the additional area within which new options were created and which are aligned to the W39B network joining point.

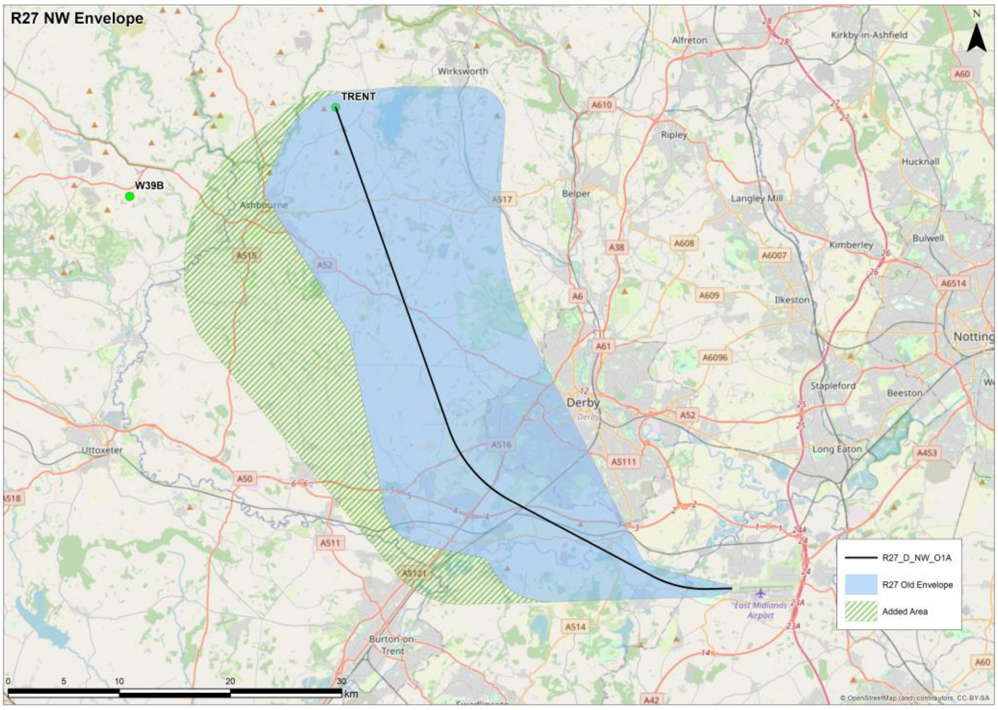


Figure 24: Addition made to the Runway 27 North West Design Envelope

When compared to the original options, the additional area of the design envelope and options align to the alternative network joining point and have potential to reduce the network interactions and may also provide additional benefits in relation to the design principles Noise (N3) due to greater divergence from Derby, and Continuity by providing additional space to optimise EMA arrivals from the north.

Whilst discussions with NERL have indicated this change has resolved the conflict and will help ensure continuous climb for EMA departures to the north west, further analysis and tests are required by NERL to confirm which of the two joining points (TNT or W39B) is preferred. These tests will involve further analysis of the route further into the network and alignment to the NERL design principles.

Because this NERL analysis was ongoing in parallel with the creation of the additional design options it was not appropriate to discontinue any options on the basis of misalignment with the Design Principle Programme as described within the viability filter described at section 5.11.2.

Therefore, the design envelope has used the current TNT departure, which is the replicated design option (Option 1A) to represent the 'do minimum' if the current join at TNT is retained.

However, if the alternative joining point at W39B is preferred, the use of the TNT replication would not represent a realistic 'do minimum' option because of its misalignment to the network. Therefore, an alternative 'do minimum' option (Option 13) was created and has been identified within the comprehensive list for use with the W39B joining point.

Both options have been retained for further analysis within the DPE and, subject to the Acceptance/Rejection Criteria in section 4 of the DPE, the IOA in Step 2B.

Further detail on the individual changes can be found in Sections 9 and 14, which relate to the individual design envelopes and options within them.

6.15. Design Option Development – Runway 27 East and South East Departures

Sections 6.6 and 6.13f) highlight the potential benefits for design options from EMA to the east. Whilst the development of routes in this area would require new CAS to be agreed and created by NERL, the inclusion of EMA design options in this area responds to feedback from airlines and NERL requesting the development of options to the east to enable significant fuel and CO_2 savings.

Within their ongoing upper network design, NERL have led an engagement process with GA and the military, which is seeking to agree a way forward to create this airspace and determine what the dimensions and operating hours of this may be. However, these discussions are at a very early stage and no dimensions have been discussed because of the fluidity of both airport and network designs. There is therefore a need for EMA departure design options to retain flexibility in their routing to allow them to join this proposed new CAS. It should be noted that the responsibility for formal engagement and consultation with impacted stakeholders will remain with EMA where any proposed departure or arrivals routes pass through any volume of new airspace below 7,000ft.

The first EMA stakeholder engagement included both a runway 27 east left turn and a 27 east right turn to provide for this flexibility. However, the runway 27 east left turn was discounted between the first and second phases of engagement because of a misalignment with the Design Principle Continuity, by not making best use of runway capacity, and with Design Principle Noise N1 by not spreading the impact of noise. This is described in Table 6 in section 6.4. As a result, the second phase of engagement only covered easterly design options via a runway 27 east right turn. After departure these options turn right to head over south Derby and southern Nottingham before heading towards a network join to the east as described at section 12.

Following the second phase of engagement, we have used feedback to refine departure designs and have worked with NERL to understand the potential for routes to the east. This design work has continued to seek ways of ensuring flexibility to join the network and to look at alternative options for routing in this direction, whilst also ensuring adherence to the 'must have' design principles. This design work has been informed by:

- Preliminary qualitative analysis of the profile flown by the 27 east right turn which suggested that the design options may increase the number of people affected by noise.
- Feedback from NERL on the viability of the 27 south east design options once above 7,000ft.

In relation to the NERL interaction, although the network design in this airspace is less developed (because it falls within FASI-S), the area of controlled airspace where the EMA 27 south east design options terminate is likely to be used for northbound traffic to several airports, including Leeds and Newcastle airports. The use of these options may therefore route EMA traffic in the opposite direction to this predominantly northbound network flow and, whilst this conflict is above 7,000ft, may misalign with the EMA Design Principle Programme. Further detailed design work is required with NERL to understand if safe separation exists or can be achieved through the modification of these options, and this interaction was highlighted in the EMA ACP Hazard Identification workshop (HAZID) as one with potential safety implications which requires further analysis. Whilst this envelope has been retained, the lack of alignment may limit the ability of EMA traffic to obtain continuous climb and may ultimately lead to some or all design options being discounted if a safe solution cannot be found.

As a result of this analysis and the NERL feedback regarding viability of routes to the south east, a modification was made to the runway 27 south east design envelope to provide additional space for design options to route to the east. Given the potential poor noise performance of the 27 east right turn, the provision of these alternatives is consistent with the Design Principle 'Limiting disturbance' (Noise N3) which seeks to limit and where possible reduce noise impact to communities. It is also in line with the Design Principle 'Emissions' and the aims of the AMS (through the Design Principle Programme) which seek to implement routes that limit and, where possible, reduce aviation emissions and fuel burn.

The modifications made are:

- The final part of the runway 27 south east envelope has been widened to the north to accommodate a broader swathe of options that can route to the east, rather than remaining on a south east heading. This additional part of the envelope is illustrated as the green shaded area in Figure 25.
- The introduction of seven additional design options that can route to the east whilst seeking to limit or reduce noise impact. These are all contained within this extended 27 south east envelope and initially follow the track of existing options, but once between 4,000ft and 6,000ft, make a left turn to head towards a potential network join to the east. This flexibility in the turn point has allowed us to maximise the potential noise benefit. All have a 15° southerly offset and route to the south of Loughborough before making the left turn which aligns them with the Design Principle Noise N3. These additional options were subject to the viability filter as described at section 5.11.2, which considers whether they meet the requirements of the design principles Safety, Programme and Continuity and are described fully as options 12 to 15 in section 16 of this DOR.

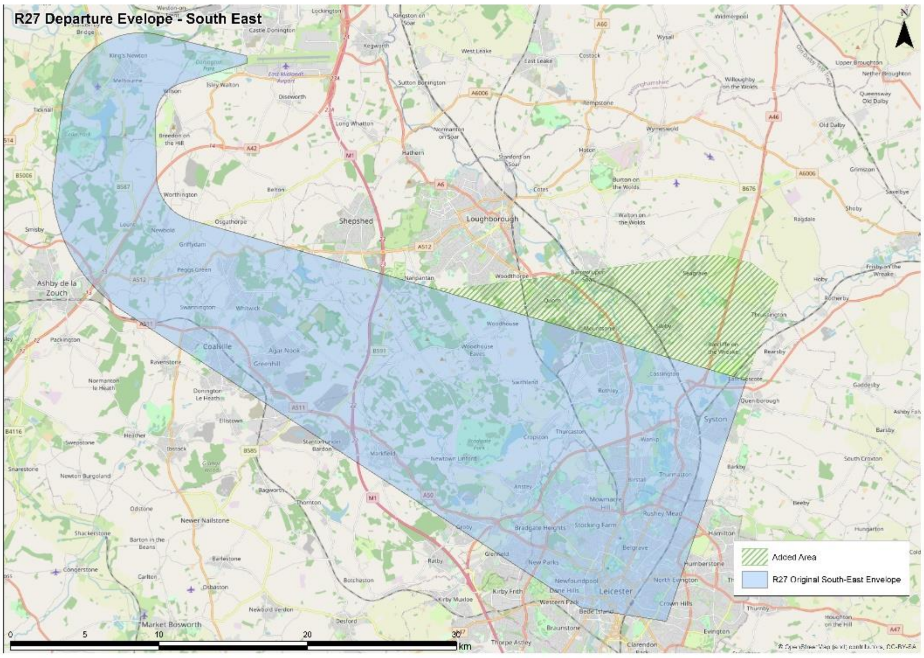


Figure 25: Additional area within Runway 27 South East Envelope

The repurposing of this envelope to provide a flight plannable route to the East was discussed with NERL who indicated this is consistent with their conversations with the MoD, and these options have been taken forward for further analysis within the DPE and IOA.

It should be noted that all the original runway 27 south east design options within this envelope have been retained for analysis in the DPE and IOA. Further work will be carried out to analyse their viability in Step 3A.

6.16. Departure Development Strategy – Step 3A

Whilst we have considered the current path of arrivals from EMA to help inform the position of our design envelopes and the placement of departure design options, we have not designed our departure design options as part of a network with our arrivals.

As a result of this and the comments from the engagement process, we are carrying forward a more comprehensive list of departure design options to the DPE and the IOA. However, as the NERL designs progress and the EMA shortlisted design options are combined into networks, it's possible that some of our design options will either be misaligned or conflict with their choices. This may also be the case for the routes to and from Birmingham airport.

The result is that some design options may need to be further refined or amended in response. We will continue to work across the MTMA and in partnership with NERL and other airports to respond to and resolve any such interactions.

For departures the following interactions will need to be considered at Step 3A:

- Departures to the north: Simulations conducted by NERL have suggested several locations and orientations for the placement of the northern arrival hold above 7,000ft. This may impact the lateral placement of EMA departure options to the north, with modifications required to ensure safe separation exists. The final location will be as a result of collaboration and alignment between NERL and EMA to ensure that departure options remain aligned to the EMA design principles.

- Departures to the west and south west: As detailed in sections 5.9 and 5.10, interactions and potential misalignments were identified in relation to both BHX arrivals and departures and the NATS network within the Stage 2 engagement process. EMA will continue to work with both NERL and BHX to understand and resolve these issues.

- Departures to the south east: As also detailed in section 6.15, further detailed design work is required with NERL to understand if safe and efficient operations can be achieved given the possible misalignment between these options and the network traffic flow. This work will be conducted with the NERL team responsible for FASI-S.

- Departures to the east: Should new airspace to the east become available for use by EMA traffic (as described at section 6.6) we will continue to collaborate with NERL and other stakeholders to agree the dimensions and operating hours for this airspace and how departing traffic from EMA can be safely integrated. This will also influence the scope of any further design work for EMA design options that could route east. Design options this would apply to are all those with 09 East, 27 East right turn and the three design options within 27 south east described in section 6.15.

The further work identified above is anticipated to involve meetings and collaborative design workshops involving EMA, NERL (both FASI-N and FASI-S teams), BHX and other stakeholders as appropriate. In some cases, it may not be possible to resolve the interactions safely or provide the required connectivity to the network which may result in either envelopes or design options being re-classified as Viable but Poor Fit. In such a scenario, our assessment of these design options would be discontinued.

As work within Step 3A of the CAP1616 process progresses we will seek to optimise departures and arrivals into systems that provide connectivity within the MTMA, and that take account of adjacent airports and the emerging FASI-S network. We will then use the process of bilateral discussions with NERL, to agree network connectivity and optimal positions that align with both the EMA design principles and the available airspace within the network, but also consider the cumulative impact of change. This process will also allow us to consider controlled airspace requirements and the needs of the wider aviation community including GA.

6.17. Departure Options Descriptions

The following sections 7 to 18 detail the departure design envelopes and the design options created within them.

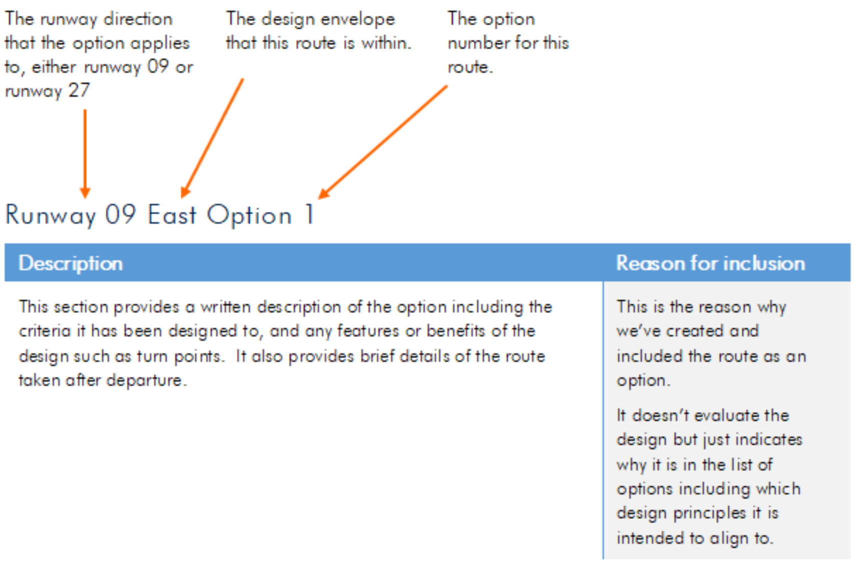
Each section has an introduction to the envelope and the basis for its inclusion which is followed by a map to show the position of the envelope in relation to the airport.

An options summary table is then provided which shows the comprehensive list of options within the design envelope. This includes options from the Viable and Good Fit (numbered list), the 'Viable and Poor Fit' (lettered list) and any 'Unviable' options we have considered but discounted.

There is then a detailed description of each design option. In those design envelopes where a route currently exists, the first described design option relates to the replication of the current conventional route to PBN standards, to provide the 'do minimum' option. Additional options are then provided for alternative routes within the envelope.

For each design option this description also covers what has been designed, and the reason for designing the route (the 'why'). In addition, an explanation of which design principles the route seeks to align with is provided.

The graphic below provides an example of the table used to explain the information contained within it.



Description	Reason for inclusion
This section provides a written description of the option including the criteria it has been designed to, and any features or benefits of the design such as turn points. It also provides brief details of the route taken after departure.	This is the reason why we've created and included the route as an option. It doesn't evaluate the design but just indicates why it is in the list of options including which design principles it is intended to align to.

Figure 26: Example departure design option table

7. SID Runway 09 – East

7.1. Introduction to 09 East Design Envelope

This envelope has been created for traffic routing to the east from runway 09, without initially routing to the south which is a requirement of current operations. The creation of this envelope was identified through airline stakeholder requests for a more direct route than that currently published. Although this direct route is sometimes provided to EMA flights by the NATS upper airspace network at night, this is only on an 'on request' basis and aircraft are required to flight plan and fuel for the longer route via the Daventry (DTY) SID to the south east.

By providing this as a flight plannable route, total flight track length and fuel burn will be significantly reduced in line with the Design Principle Emissions but the implementation of this will require additional Controlled Airspace (CAS) to the East above 7,000ft.

As a result of this potential benefit, and because of their responsibility for creating this airspace, NERL have led engagement conversations with impacted stakeholders including the military and the GA community on the concepts being proposed for this additional CAS to permit departures to the east. These include discussions on the operating hours and the horizontal and vertical dimensions of this airspace to ensure safety for both commercial and non-commercial aviation is assured.

Any proposed changes to either the use or hours of this airspace will be included in coordinated consultation activities between EMA and NERL in Stage 3. Suitable design options that are developed through this process will then be consulted upon more widely in Stage 3 if pursued by EMA. Whilst NERL will be responsible for formal consultation with impacted stakeholders above 7,000ft, the responsibility will remain with EMA where any proposed departure or arrivals routes pass through any volume of new airspace below 7,000ft.

However, at this early stage of the process there is uncertainty as to the exact position of this airspace and any joining points, therefore there is a requirement to maintain flexibility in the proposed options. These options are therefore retained in this comprehensive list of options to be carried forward for analysis in the DPE and IOA.

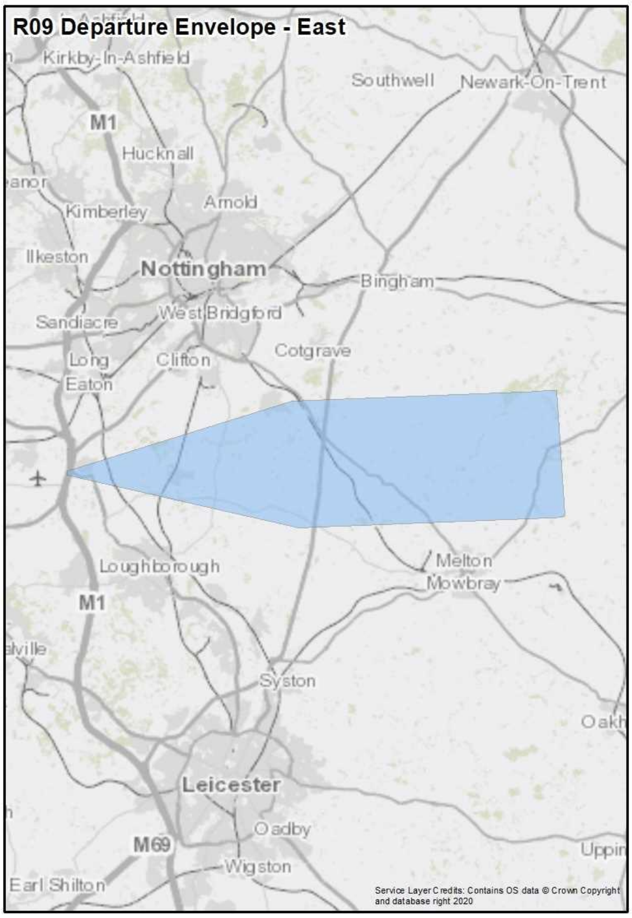
As part of the phase two stakeholder engagement process, feedback was received regarding the impact of overflight on communities close to the extended runway. As described in section 6.12, this resulted in the creation of additional route options with an offset after departure, up to the maximum possible under PANS-OPS of 15°. The aim of this offset is to reduce the impact of noise in alignment with Design Principle Noise N3.

This applies to a number of options within this design envelope and is noted in the 'Reason for Inclusion' section where relevant.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft.

This letterbox is 4.5 Nautical Miles (nm) wide (2.25nm either side of the nominal track) and a minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

7.2. Design Envelope Location Map



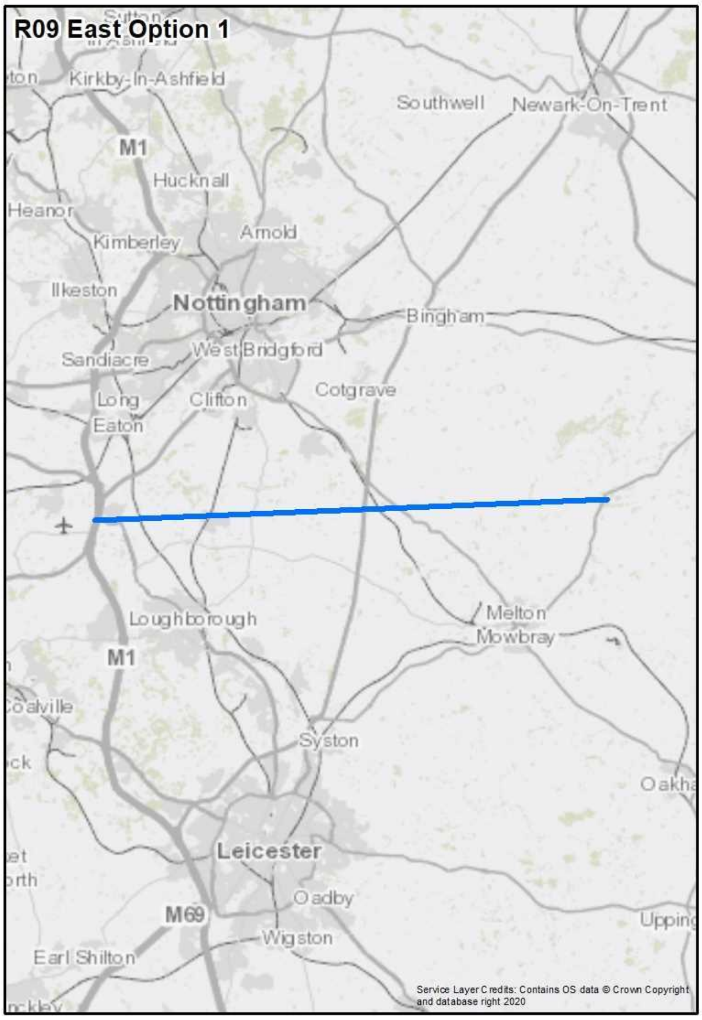
7.3. 09 East Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	This follows the extended runway centreline heading directly east.	A6	Extension of 15° northerly offset before turning back to SID aiming point. Option is partially aligned to: • Safety Option fails to align to: • Programme	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	This takes a more northerly track with a 15° northerly offset from the runway heading before routing east at a tangent to the northernmost edge of the letterbox.	B7	Extension of 15° southerly offset before turning back to SID aiming point. Option is partially aligned to: • Safety Option fails to align to: • Programme		

Viable and Good Fit		Viable but Poor Fit		Unviable	
3	This takes a more southerly track with a 15° southerly offset from the runway heading before routing east at a tangent to the southernmost edge of the letterbox.	C8	Route north to turn east. Option is partially aligned to: • Safety Option fails to align to: • Programme • Continuity		
4	This routes to the south after take-off with a 12.5° southerly offset before turning back north to re-join the extended runway centreline.	D9	Route south to turn east. Option is partially aligned to: • Safety Option fails to align to: • Programme • Continuity		
5	This option is similar to Option 4 except it has 15° southerly offset after take-off.	E10	Extended left-hand wrap-around. Option fails to align to: • Safety • Programme • Continuity		
		F11	Extended right-hand wrap-around. Option fails to align to: • Safety • Programme • Continuity		

7.4. Runway 09 East Option 1

Description	Reason for inclusion
This option provides a direct route to the east and proceeds straight ahead without making any turns. This route has the least track mileage within this envelope as the route flies directly on runway heading to the east. After departure it passes over West Leake and East Leake and terminates north east of Melton Mowbray and north of Stonesby. There would be no speed restrictions applied to the procedure; therefore, the maximum speed of 250kts would apply. This will permit many aircraft to fly this route in a clean configuration (without the use of flaps) which has potential benefits in terms of noise.	Continuity: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



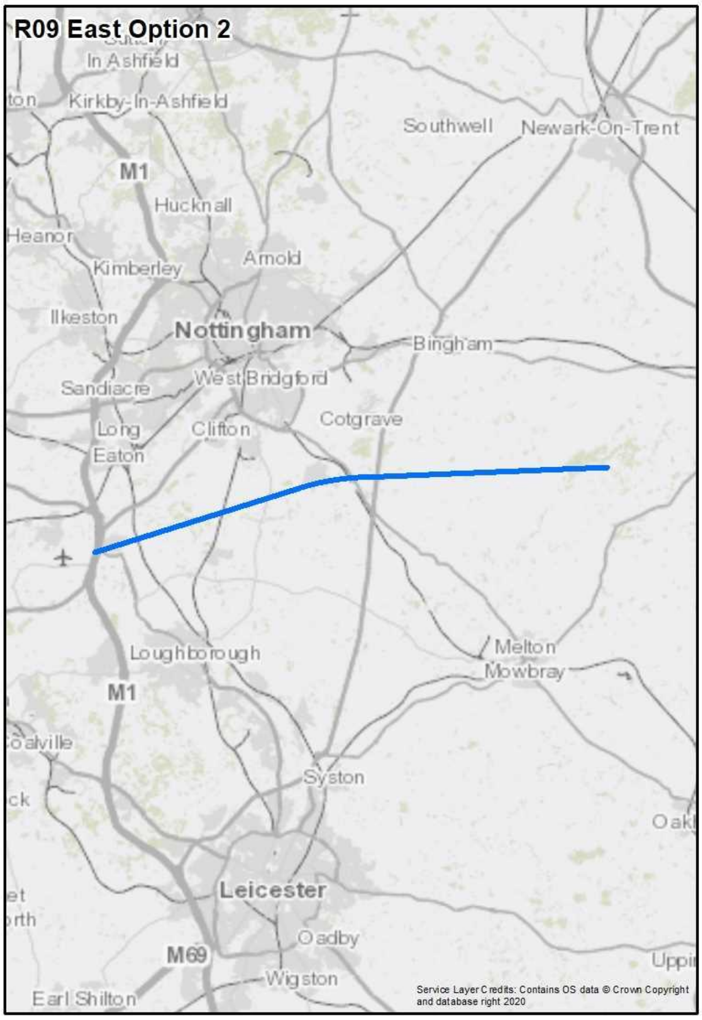
7.5. Runway 09 East Option 2

Description

This option commences with a 15° northerly offset from the runway heading immediately after take-off.

The initial 15° offset to the north results in the route, passing south of Kegworth and it maintains this heading for approximately 8nm to Keyworth where it turns east following the northernmost edge of the design envelope terminating north east of Melton Mowbray, south east of Grantham and north of Eaton.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

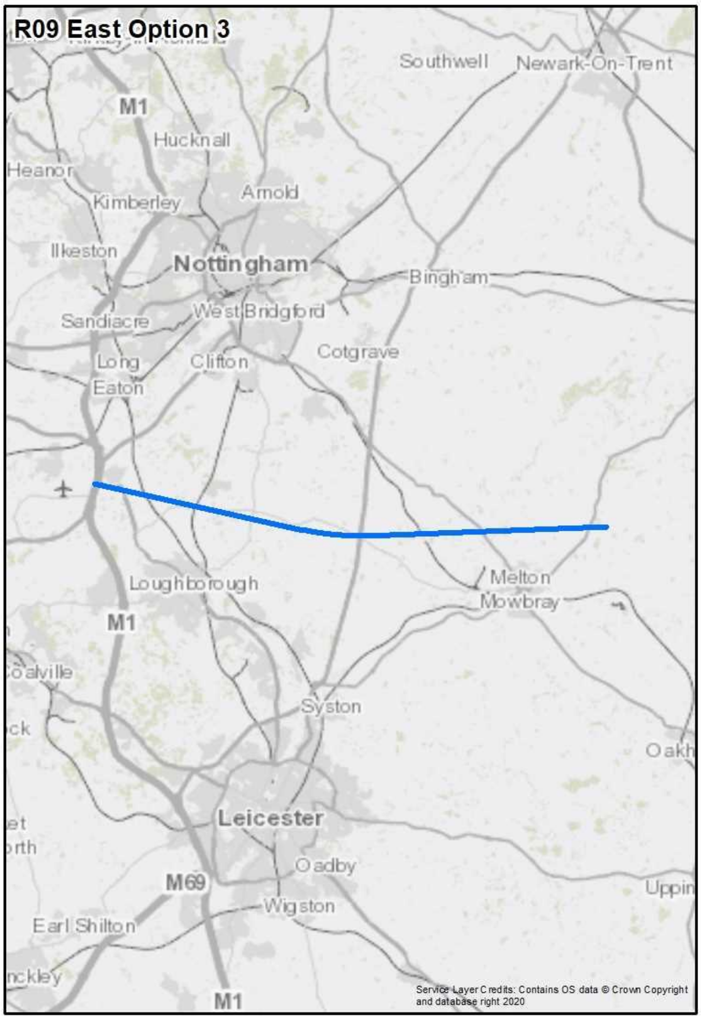
Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations.

Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving.

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

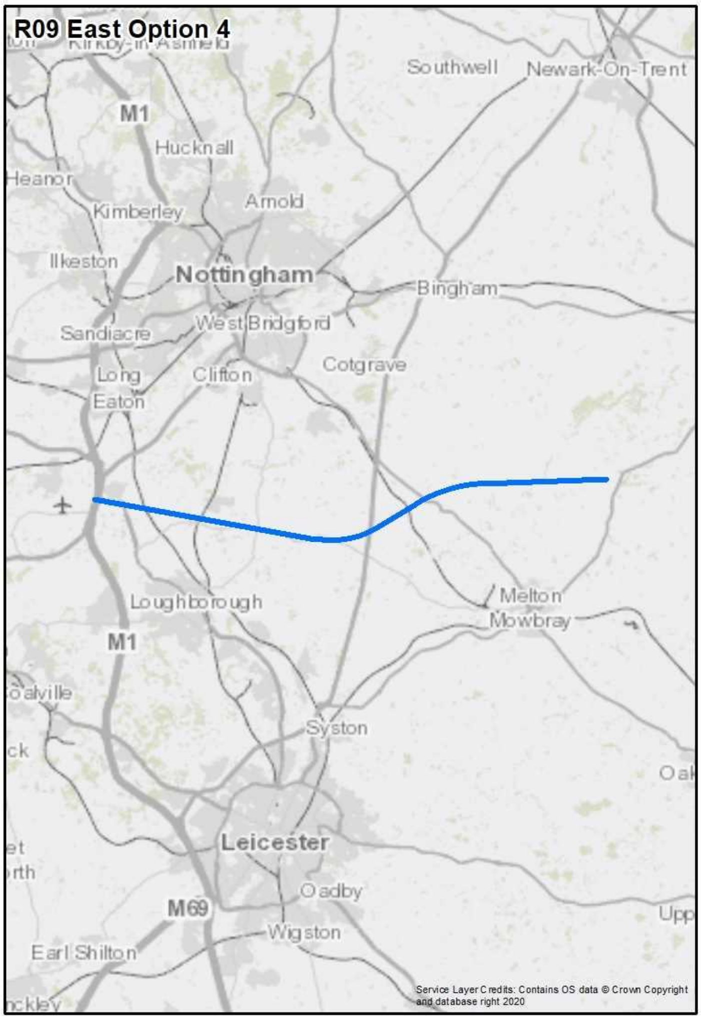
Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

7.6. Runway 09 East Option 3

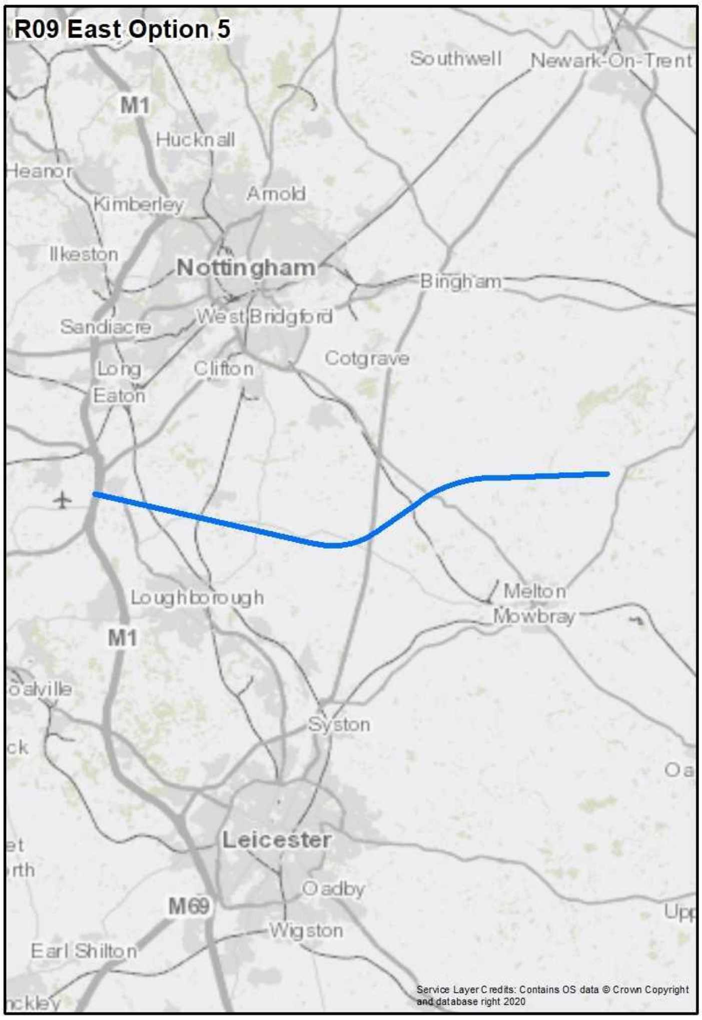
Description	Reason for inclusion
This option commences with a 15° southerly offset from the runway heading immediately after take-off. The initial 15° offset to the south results in the route, passing south of Kegworth and maintains this heading for approximately 8nm to a point beyond Wymeswold where it turns east following the southernmost edge of the design envelope terminating north east of Melton Mowbray and south of Waltham on the Wolds. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Emissions:** A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3:** A 15° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

7.7. Runway 09 East Option 4

Description	Reason for inclusion
After take-off this option diverges by 12.5° to the south of the extended runway centreline. The initial 12.5° offset to the south results in the route, passing south of Kegworth and it maintains this heading for approximately 8nm at which point it turns to a north easterly heading before reverting to an easterly track to intercept the extended runway centreline at Long Clawson. The route maintains the easterly heading until it terminates north east of Melton Mowbray and north of Waltham on the Wolds. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Emissions:** A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3:** A 12.5° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



7.8. Runway 09 East Option 5

Description	Reason for inclusion
This option is similar to Option 4 but with an increased 15° offset to the south of the extended runway centreline rather than 12.5°. The offset to the south results in the route, passing south of Kegworth and it maintains this heading for approximately 8nm to a point beyond Wymeswold. It then turns to a north easterly heading before reverting to an easterly track to intercept the extended runway centreline at Long Clawson. The route maintains the easterly heading until it terminates north east of Melton Mowbray and north of Waltham on the Wolds. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Emissions:** A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3:** A 15° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

7.9. Runway 09 East Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A6	S	P	C

Description: This option departs runway 09 in a north easterly direction, before initiating a gradual right turn continuing south easterly towards Knipton.

Safety: This option is not fully aligned with this design principle as it exceeds the limits of controlled airspace, however there is a reasonable expectation that controlled airspace could be extended in this area. This option has therefore been rated as amber.

Programme: This option fails to align with the environmental end of the AMS and is not fully aligned with the integration end.

> *Integration*: This option is not fully aligned with this AMS end, as additional controlled airspace would be required to maintain safety. However, the impact could be minimal if the controlled airspace is limited to night only.
>
> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north east before turning it east leading to increased fuel burn and emissions. The number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Option	Safety	Programme	Continuity
B7	S	P	C

Description: This option departs runway 09 and proceeds in a south easterly direction, then initiates a gradual left turn after overflying Melton Mowbray, continuing north easterly towards the SID aiming point.

Safety: This option is not fully aligned with this design principle as it exceeds the limits of controlled airspace, however there is a reasonable expectation that controlled airspace could be extended in this area. This option has therefore been rated as amber.

Programme: This option fails to align with the environmental end of the AMS and is not fully aligned with the integration end.

> *Integration*: This option is not fully aligned with this AMS end, as additional controlled airspace would be required to maintain safety. However, the impact could be minimal if the controlled airspace is limited to night only.
>
> *Environment*: This option would involve greater track mileage than is necessary by taking traffic south east before turning it east leading to increased fuel burn and emissions. The number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

C8	S	P	C

Description: This option departs runway 09 and initiates a 90-degree left turn towards west Nottingham, then turning right over northern Nottingham to head east towards Sleaford.

Safety: This option is not fully aligned with this design principle as it exceeds the limits of controlled airspace, however there is a reasonable expectation that controlled airspace could be extended in this area. This option has therefore been rated as amber.

Programme: This option fails to align with the environmental end of the AMS and is not fully aligned with the integration end.

> *Integration*: This option is not fully aligned with this AMS end, as additional controlled airspace would be required to maintain safety. However, the impact could be minimal if the controlled airspace is limited to night only.
>
> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north before turning it east leading to increased fuel burn and emissions. The number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelopes north and north west which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. In addition, it is likely to interact with arrivals to runway 09 from the north.

D9	S	P	C

Description: This option departs runway 09 and initiates a 90-degree right turn heading south, east of Shepshed, before turning left near Loughborough in an easterly direction, south of Melton Mowbray, heading towards the SID aiming point.

Safety: This option is not fully aligned with this design principle as it exceeds the limits of controlled airspace, however there is a reasonable expectation that controlled airspace could be extended in this area. This option has therefore been rated as amber.

Programme: This option fails to align with the environmental end of the AMS and is not fully aligned with the integration end.

> *Integration*: This option is not fully aligned with this AMS end, as additional controlled airspace would be required to maintain safety. However, the impact could be minimal if the controlled airspace is limited to night only.
>
> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north before turning it east leading to increased fuel burn and emissions. The number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the south departure envelope which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. In addition, it is likely to interact with arrivals to runway 09 from the south.

E10	S	P	C

Description: After departing runway 09 this option initiates a left-hand wrap-around, to the north west before proceeding in an easterly direction and routes over the southern elements of Nottingham, Derby and Loughborough, and south of Melton Mowbray.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 09 and the runway 09 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north and west before turning it east leading to increased fuel burn and emissions. The track taken over southern Nottingham, Derby and Loughborough means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelopes north, north west and south which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. In addition, it is likely to interact with arrivals to runway 09 from the north.

F11	S	P	C

Description: On departure from runway 09 this option initiates a right-hand wrap-around turn overflying Loughborough and south Derby, before turning further right to an easterly direction overflying Nottingham and heading towards the SID aiming point.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with the runway 09 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic south and west before turning it east leading to increased fuel burn and emissions. The track taken over Nottingham, Derby and Loughborough means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelopes north, north west and south which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. In addition, it is likely to interact with arrivals to runway 09 from the north.

8. SID Runway 09 – North

8.1. Introduction to 09 North Design Envelope

This envelope has been created for traffic routing to the north from runway 09. The envelope is based around the existing POL 2P SID and after departure, route options turn to the left to head north in the direction of Pole Hill.

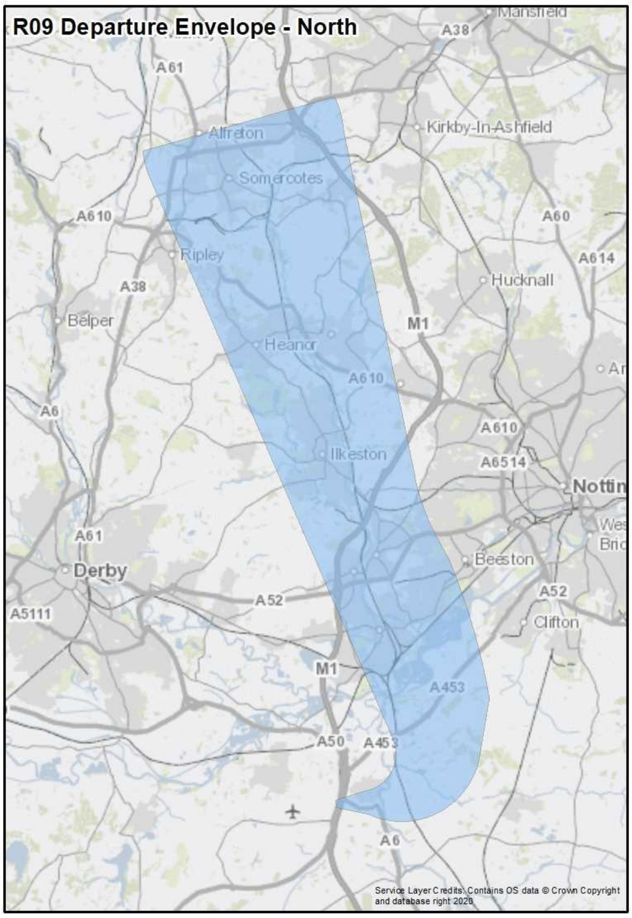
As part of the phase two stakeholder engagement process, feedback was received regarding the impact of overflight on communities close to the extended runway. As described in section 6.12, this resulted in the creation of additional route options with an offset after departure, up to the maximum possible under PANS-OPS of 15°. The aim of this offset is to reduce the impact of Noise in alignment with Design Principle Noise N3.

This applies to a number of options within this design envelope and is noted in the 'Reason for Inclusion' section where relevant.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft.

This letterbox is 4.5 Nautical Miles (nm) wide (2.25nm either side of the nominal track) and a minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

8.2. Design Envelope Location Map



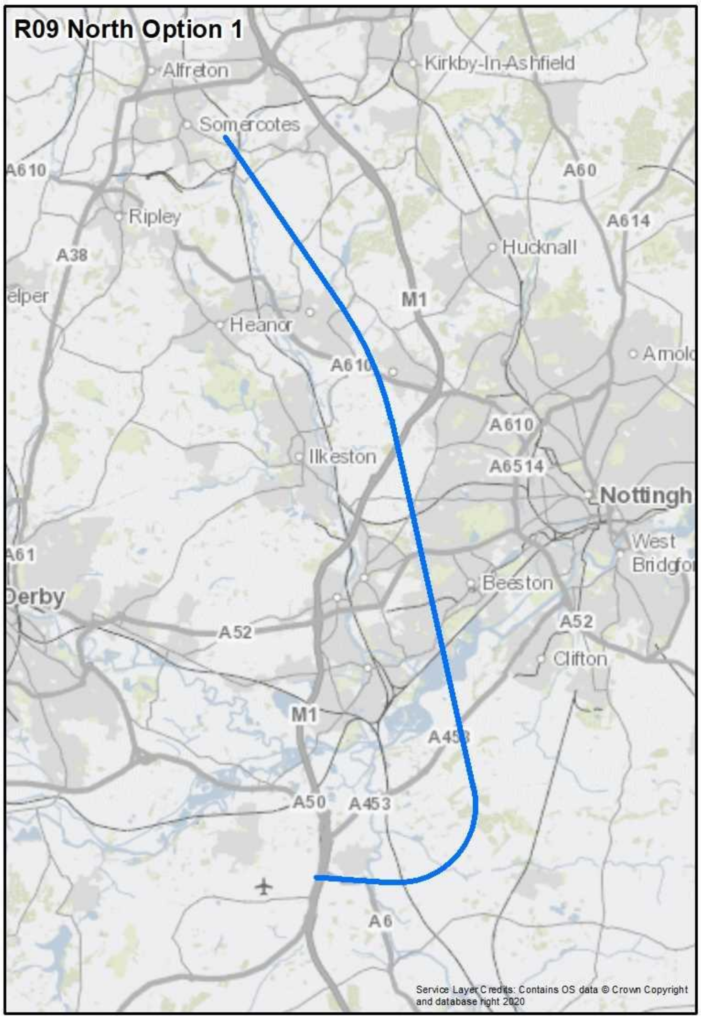
8.3. 09 North Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	This is a re-creation of the current POL SID based on CAP778 recommended turn criteria and speeds.	A7	North east heading to make a gradual left-hand turn to the east of Nottingham. Option fails to align to: • Safety • Programme	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
1A	This is a replication of the current POL SID, included as a 'do minimum' option. The initial turn commences at the same point as the existing SID (which is slightly earlier than Option 1).	B8	An immediate 180° left turn, to then turn north overflying north east Derby. Option fails to align to: • Programme • Continuity		

2	Similar to Option 1 but with an earlier initial left-hand turn.	C9	An extended right-hand wrap-around until heading north overflying the east of Derby. Option fails to align to: • Safety • Programme • Continuity		
3	Similar to Option 2 but the route stays to the west side of the design envelope.	D10	Route proceeds north-north east, turning north west over the centre of Nottingham. Option fails to align to: • Programme		
4	Similar to the replicated Option 1 but the route straightens up, after the initial left turn to end on the east side of the design envelope.	E11	A right-hand wrap-around commencing approximately 3nm to east of EMA. Option fails to align to: • Safety • Programme • Continuity		
5	An initial offset of 5° to the south of the runway heading to avoid Kegworth, followed by a left-hand turn north and terminating in the middle of the design envelope.				
6	An initial offset of 15° to the south of the runway heading to avoid Kegworth, followed by a left-hand turn north and terminating in the middle of the design envelope.				

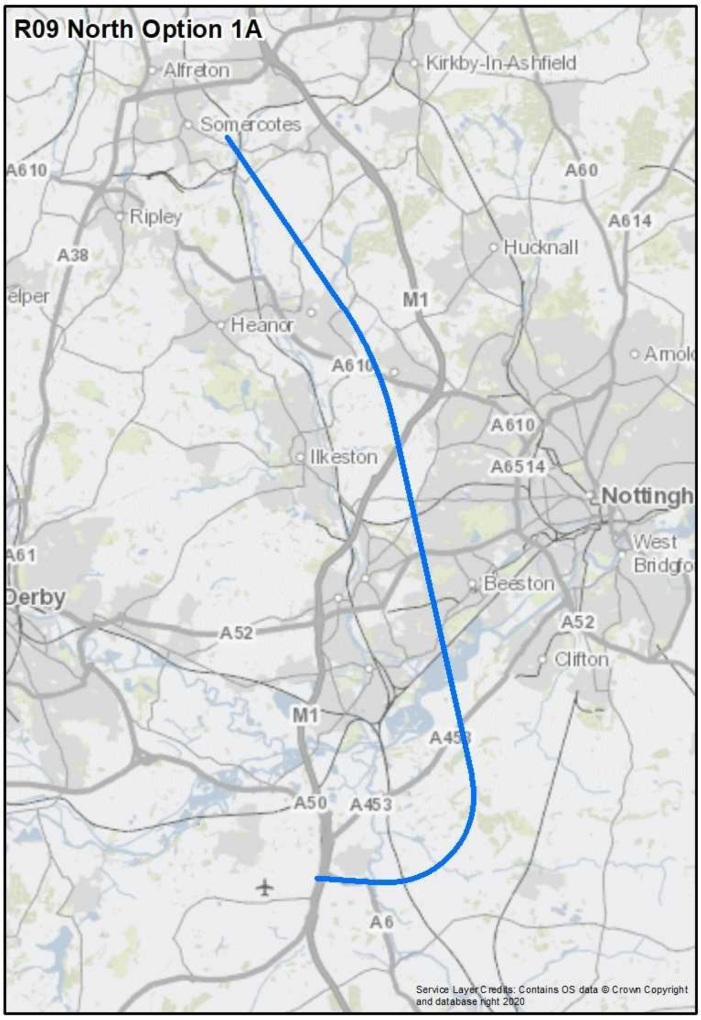
8.4. Runway 09 North Option 1

Description	Reason for inclusion
Option 1 is a re-creation of the current POL SID based on CAP778 recommended turn criteria and speeds. It has an initial offset of 10° to the south followed by a left turn to the north. The rate of turn of is dictated by following the design speed recommended within CAP778 and the design uses fly-by waypoints to create an approximate replication of the existing conventional departure. As a replicated route it follows a similar track over the ground as the current POL SID routing to the east of Long Eaton and west of Hucknall to connect to the NATS network. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



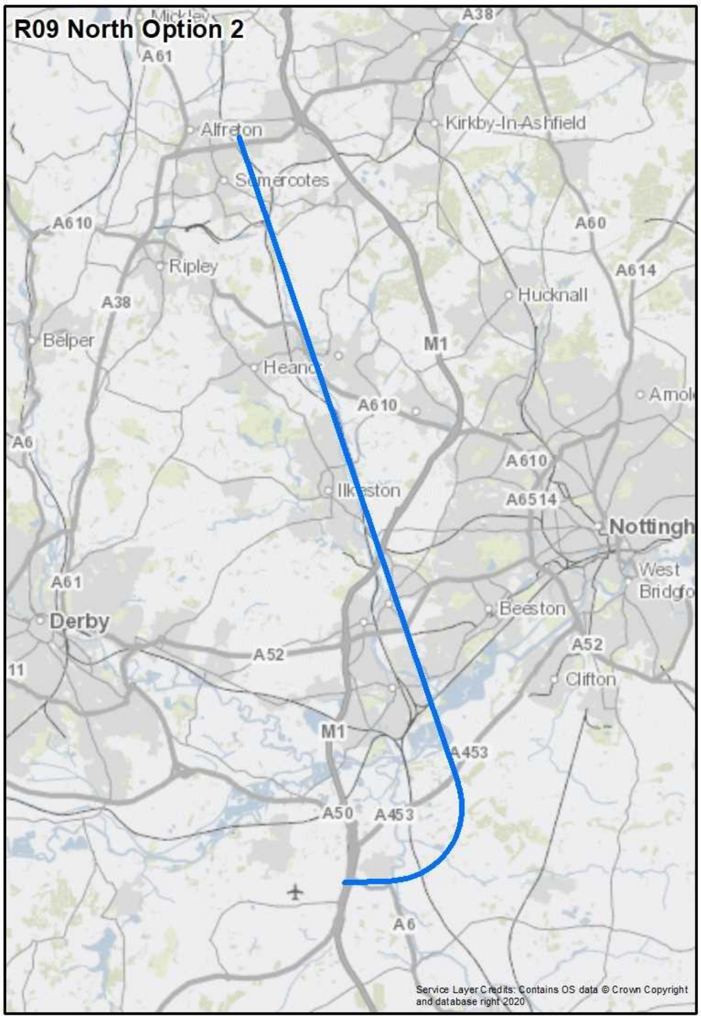
8.5. Runway 09 North Option 1A

Description	Reason for inclusion
Option 1A is an RNAV 1 replication of the current POL SID included as a 'do minimum' option. It has an initial offset of 10° to the south followed by a left turn to the north. However, the commencement of the first turn is the same as the current POL SID, i.e. 1.5nm beyond the DER. By commencing the turn at this point a higher speed of 220kts is required. At the apex of the initial turn Option 1A is approximately 200m north west of Option 1. The design uses fly-by waypoints to create an approximate replication of the existing conventional departure. As a replicated SID it then follows a similar track over the ground as the current POL routing to the east of Long Eaton and west of Hucknall to connect to the NATS network.	Aligns to a 'do minimum' option as a replication of the current SID. **Noise N3:** A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



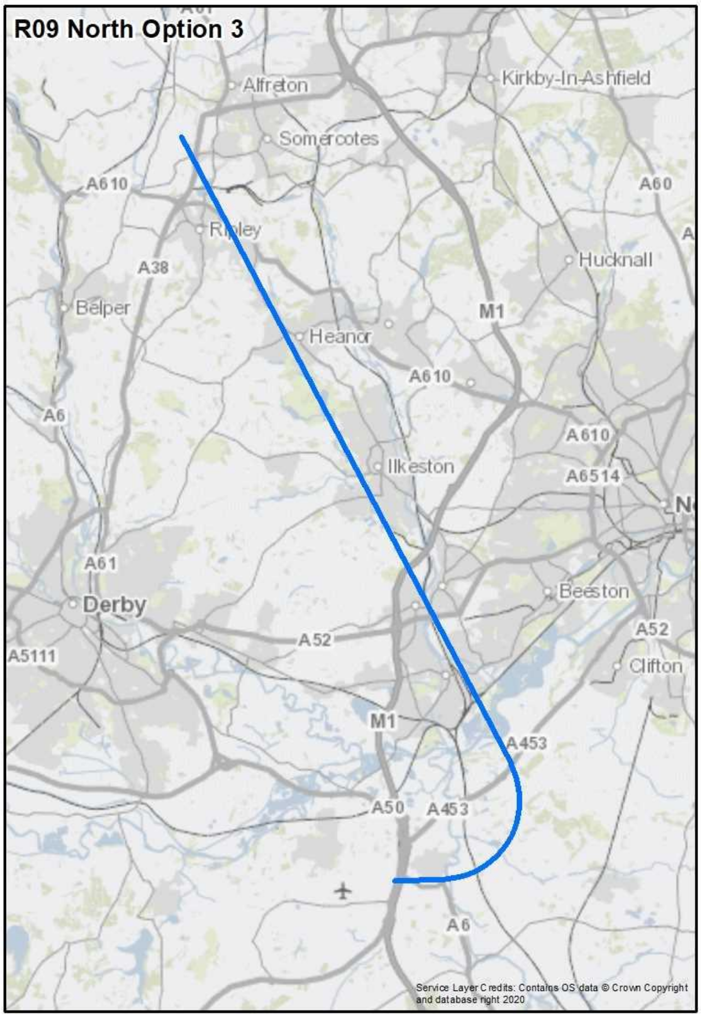
8.6. Runway 09 North Option 2

Description	Reason for inclusion
This option follows the extended runway centreline initially, with no offset, with a left turn at 1nm from the DER which is as close as allowed according to CAP 778. It then routes north taking a slightly shorter route to the termination point, whilst seeking to follow the railway line between Long Eaton and Ilkeston. The route overflies the southern edge of Kegworth, before passing close to the Ratcliffe on Soar power station, Long Eaton and the Toton rail depot. It routes east of Ilkeston before terminating close to Hilcote. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the slightly shorter track length is intended to minimise fuel burn and emissions. **Noise N2**: Seeks to follow the railway line between Long Eaton and Ilkeston, including the Toton rail depot which is expected to have higher level of ambient noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



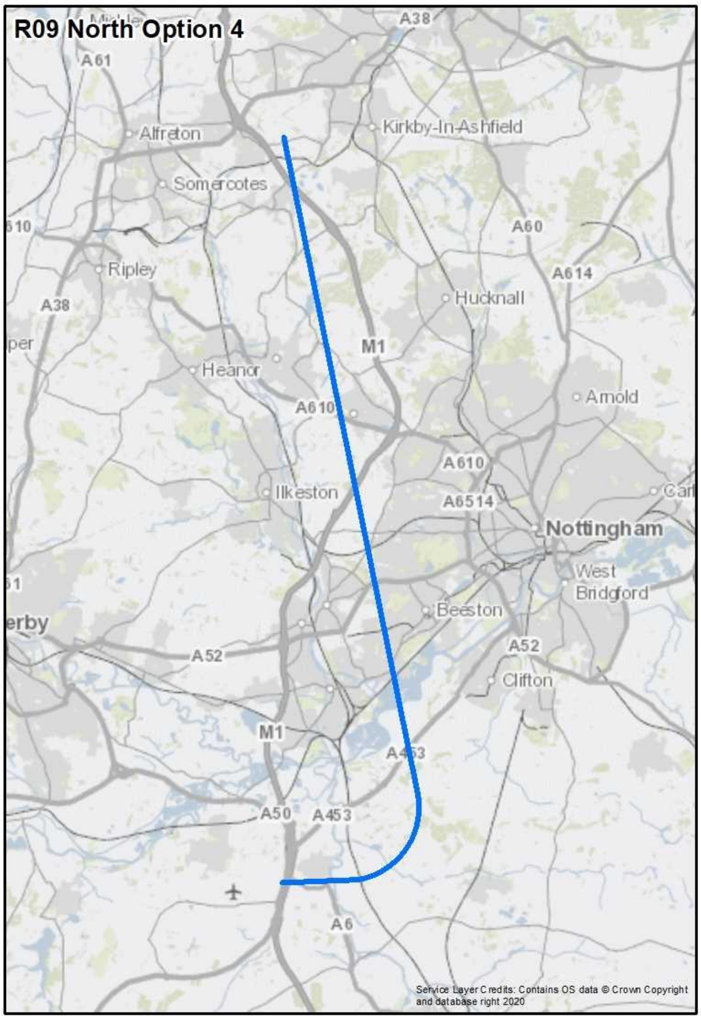
8.7. Runway 09 North Option 3

Description	Reason for inclusion
This option follows the extended runway centreline initially with no offset, with a left turn at 1nm from the DER which is as close as allowed according to CAP 778. The route overflies the southern edge of Kegworth, before passing close to the Ratcliffe on Soar power station, Long Eaton and the Toton rail depot. It routes west of Ilkeston before terminating close to Alfreton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the slightly shorter track length is intended to minimise fuel burn and emissions. **Noise N2**: Seeks to follow the railway line between Long Eaton and Ilkeston, including the Toton rail depot which is expected to have higher level of ambient noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



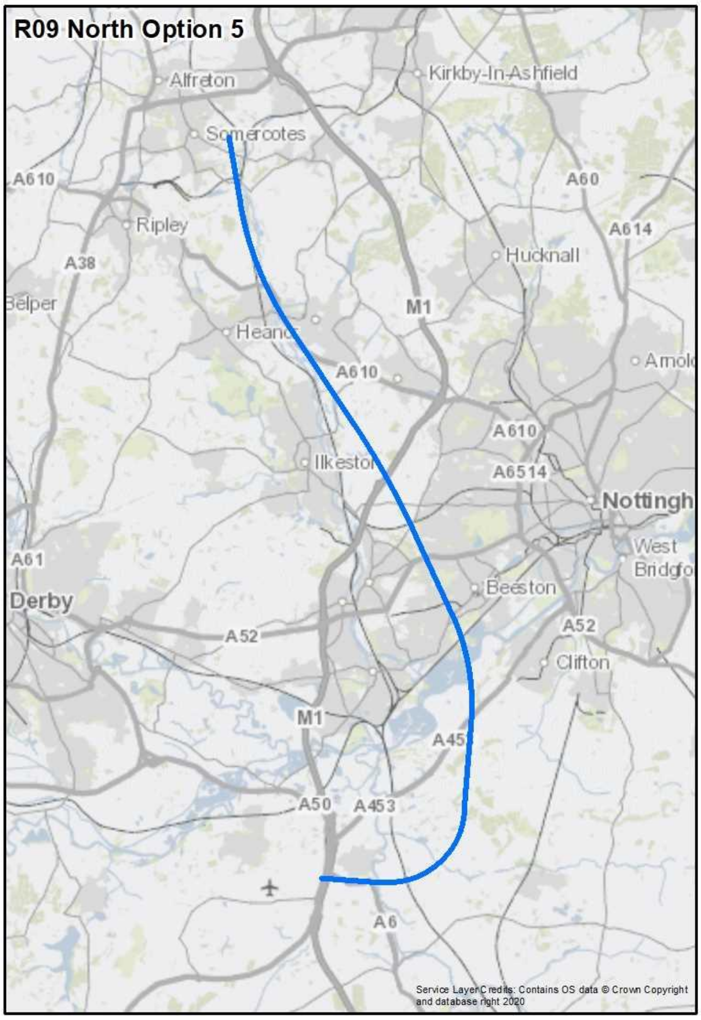
8.8. Runway 09 North Option 4

Description	Reason for inclusion
This option is similar to the replicated Option 1 but the route straightens up, after the initial left turn to end on the east side of the design envelope. After departure it follows the extended runway centreline with no offset, with a left turn at 1nm from the DER which is as close as allowed according to CAP 778. The route overflies the southern edge of Kegworth, before turning north passing between the Ratcliffe on Soar power station and Clifton and routing to the east of Long Eaton and west of Hucknall. The route terminates close to the M1 Junction 28 at South Normanton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the slightly shorter track length is intended to minimise fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



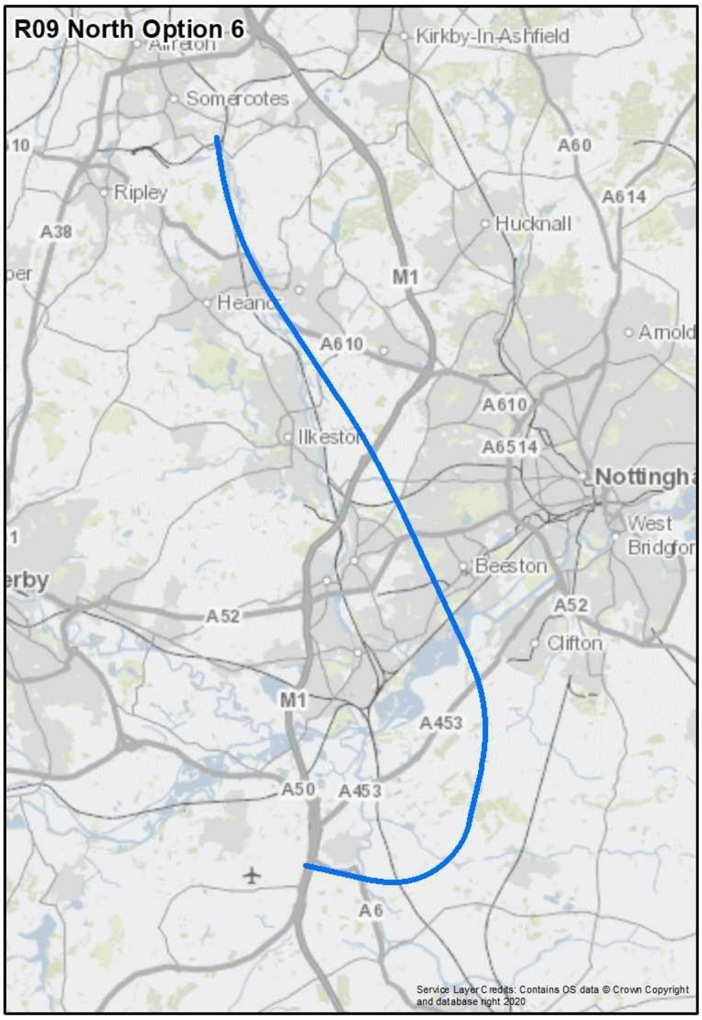
8.9. Runway 09 North Option 5

Description	Reason for inclusion
This option has an initial offset by 5° to the south of the extended runway centreline seeking to avoid Kegworth. The route turns left at 1nm from the DER which is as close as allowed according to CAP 778. The initial 5° offset to the south results in the route, passing just south of Kegworth and it then turns north passing between the Ratcliffe on Soar power station and Clifton, passing between Long Eaton and Beeston before making a second left turn north west. It routes between Ilkeston and Giltbrook before turning north and terminating between Alfreton and South Normanton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Seeks to avoid direct overflight of communities north west of Nottingham including Ilkeston, Giltbrook, Eastwood and Alfreton. The 5° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Kegworth. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



8.10. Runway 09 North Option 6

Description	Reason for inclusion
This option has an initial offset of 15° to the south of the extended runway centreline which is the maximum permissible under PANS-OPS rules. The route turns left at 1nm from the DER which is as close as allowed according to CAP 778. The initial 15° offset to the south results in the route, passing south of Kegworth and this greater offset also takes the route slightly further east than other options before the first turn north, passing between the Ratcliffe on Soar power station and Clifton. It passes between Long Eaton and Beeston before making a second left turn north west between Ilkeston and Giltbrook before turning north and terminating between Alfreton and South Normanton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** Seeks to avoid direct overflight of communities north west of Nottingham including Ilkeston, Giltbrook, Eastwood and Alfreton. A 15° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



8.11. Runway 09 North Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A7	S	P	C

Description: On departure from runway 09 this option heads in a north easterly direction, then initiates a gradual left-hand turn to the east of Nottingham onto a north north westerly heading.

Safety: This option fails to align with this design principle, because it would exceed controlled airspace dimensions with no material benefit and come into conflict with parachute activity at Syerston.

Programme: This option fails to align with the integration and environmental ends of the AMS.

> *Integration*: This option would require additional airspace to mitigate the safety risk of operating in Class G airspace. There is an expectation that this additional airspace would be required 24x7 and therefore would adversely impact other airspace users, particularly GA traffic and parachute activity at Syerston.
>
> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north east before turning it north leading to increased fuel burn and emissions. The track taken would avoid central Nottingham which may result in some noise benefit in comparison to other options.

Trade-offs: Whilst there may be a benefit in the number of people impacted by noise, the resultant safety impact, requirement for additional CAS, impact on GA and parachute operations at Syerston and additional fuel burn and emissions mean there is no trade-off to be made to justify an amber rating.

Option	Safety	Programme	Continuity
B8	S	P	C

Description: On departure from runway 09 this option makes an immediate 180-degrees left-hand turn to proceed in a westerly direction. A turn to the right is made to the east of Derby onto a northerly heading towards the SID aiming point.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north and west before turning it east leading to increased fuel burn and emissions. The track taken over Long Eaton and Derby means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit. There is also the potential for interactions with arrivals from the north which would adversely impact either continuous climb or continuous descents with the resultant impact on noise and fuel burn.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it is likely to interact with arrivals to runway 09 from the north and would have a prolonged interaction with the west and north west departure envelopes. When combined, this would limit the ability to achieve one minute departure splits and not enable best use of runway capacity.

C9	S	P	C

Description: On departure from runway 09 this option initiates a wide right-hand wrap-around to pass to the west of EMA in a northerly direction, overflying east Derby and heading north towards the SID aiming point.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 09 and the runway 09 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic south and west before turning it north leading to increased fuel burn and emissions. The track taken over Derby means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the south departure envelope which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. The potential interaction with arrivals would impact the arrivals traffic flow, which again would not enable best use of runway capacity.

D10	S	P	C

Description: After departing runway 09 this option routes in a north easterly direction before turning left over central Nottingham and routing north towards the SID aiming point.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north and east before turning it north leading to increased fuel burn and emissions. The track taken over central Nottingham means that a significant number of people are likely to be impacted by noise below 4,000ft, meaning that when compared to other options, this does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

E11	S	P	C
Description: On departure from runway 09 this option initiates a tight right-hand wrap-around to pass to the west of EMA and routing between Derby and Long Eaton before heading north towards the SID aiming point. Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 09 and the runway 09 Missed Approach Procedure (MAP). Programme: This option fails to align with the environmental end of the AMS. *Environment:* The number of people impacted by noise for this option in comparison to other options does not show a material benefit. The emissions generated by this option have been assessed as being greater when compared with other options. *Trade-offs*: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating. Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the south departure envelope which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. The potential interaction with arrivals would impact the arrivals traffic flow, which again would not enable best use of runway capacity.			

9. SID Runway 09 – North West

9.1. Introduction to 09 North West Design Envelope

This envelope has been created for traffic routing to the north west from runway 09. The envelope is based around the existing TNT 3P SID towards the Trent (TNT) DVOR, and after departure, route options turn to the left to head north west.

The north western options engaged upon in this envelope were designed around the replication of the current SID which enables connectivity to the NATS Upper Airspace Network in the vicinity of TNT. However, and as detailed in section 6.13, following bilateral engagement and feedback from NERL and the results of simulation exercises to progress their network designs, it was determined that a number of the EMA runway 09 north west options may not be aligned to the developing NERL network options. This was because of a potential interaction above 7,000ft between the original EMA departure options heading in a north west direction and inbounds to Manchester (MAN) descending on a similar heading between TNT and the DAYNE hold. For runway 09 this potential misalignment related to options that terminated or headed to a point north and east of the TNT DVOR.

This resulted in a NERL proposal to relocate the network joining point for the EMA 09 North West Envelope to a new position approximately 5nm to the west of TNT at the position 'W39B'. Whilst the majority of options were compatible with both this proposal and the original joining point at TNT, the final part of the routes and termination points for Options 5 and 9 were amended following Stage 2 engagement. This change was intended to improve performance for EMA departures in relation to:

- Network connectivity: Consistent with the 'Simplification' end of the AMS and the need for EMA options to align to the traffic flows within the NATS network, the change to the position of Option 5 and Option 9 will avoid these routes interacting with routes of other airports above 7,000ft.
- Environmental performance: In line with the design principles relating to Emissions and Noise N3, the revised position is more likely to guarantee continuous climb for departures.

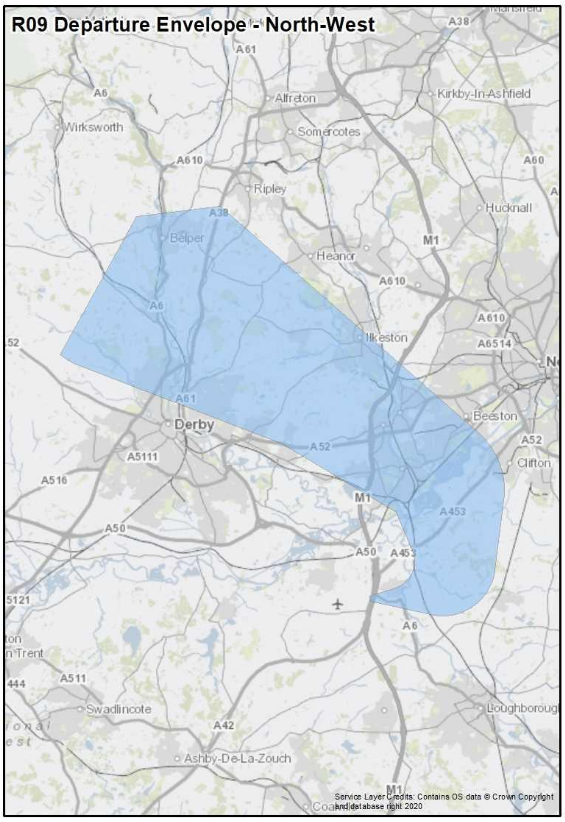
Whilst discussions with NERL indicated this change resolved the conflict and will help ensure continuous climb for EMA departures to the north west, further analysis and tests are required by NERL to confirm which of the two joining points (TNT or W39B) was preferred. However, because the distance between the 7,000ft termination point of the revised options, and either of the joining points is in excess of 10nm, all options, including the realigned Options 5 and 9 are aligned to the new network. Therefore, no options were discounted and all options were retained for further analysis within the DPE and IOA.

In addition, as part of the phase two stakeholder engagement process, feedback was received regarding the impact of overflight on communities close to the extended runway. As described in section 6.12, this resulted in the creation of additional route options with an offset after departure, up to the maximum possible under PANS-OPS of 15°. The aim of this offset is to reduce the impact of Noise in alignment with Design Principle Noise N3.

This applies to a number of options within this design envelope and is noted in the 'Reason for Inclusion' section where relevant.

All options terminate at 7,000ft at a letterbox that is 4.5nm wide (2.25nm either side of the nominal track) and a minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

9.2. Design Envelope Location Map



9.3. 09 North West Option Summary Table

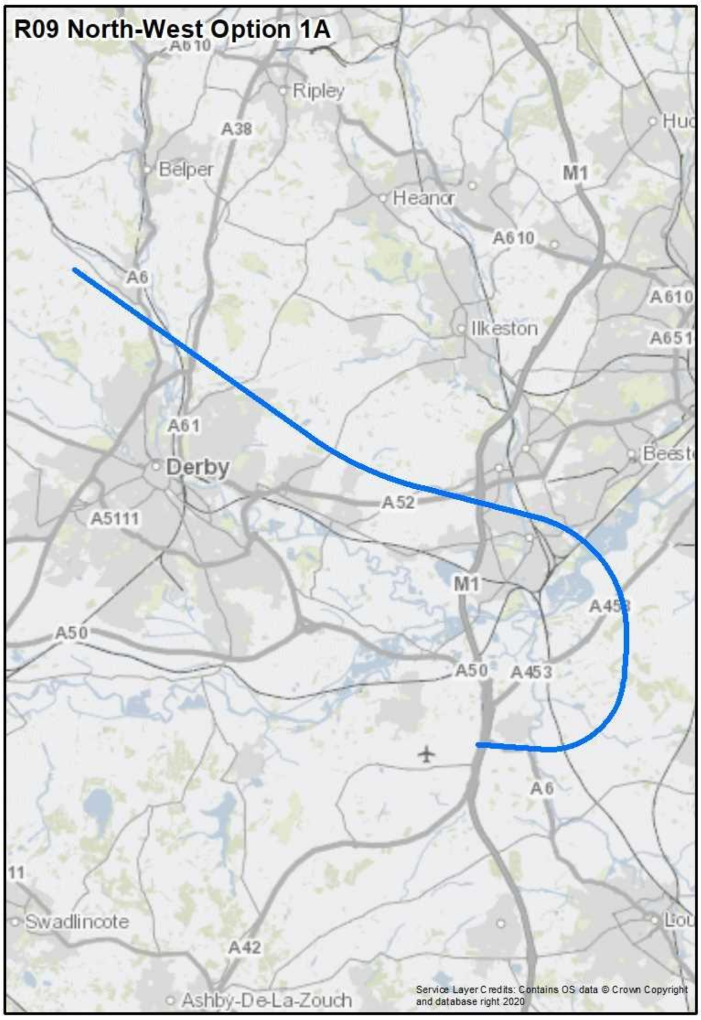
Viable and Good Fit		Viable but Poor Fit		Unviable	
1A	This is an RNAV replication of the current TNT departure included as a 'do minimum' option.	A12	Initial east-south east heading, turning north over central Notting before turning north west. Option fails to align to: • Programme	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	This is similar to Option 1 but proceeds straight ahead, rather than having a southerly offset. Once on a north westerly heading it maintains a straight track.	B13	Gradual right-hand wrap-around to then pass to the west of Derby. Option fails to align to: • Safety • Programme • Continuity		

3	This proceeds straight ahead with no offset before making two left-hand turns to achieve a west-north west heading and terminating to the south of the design envelope.	C14	An extended north east track to then warp around the east and north of Nottingham. Option fails to align to: • Safety • Programme		
4	This proceeds straight ahead with no offset before making two left-hand turns to achieve northerly north west heading, terminating in the centre of the design envelope close to Belper.				
5	A 10° southerly offset prior to two left turns, routing over the southern half of Long Eaton and terminating in the centre of the design envelope close to Duffield.				
6	A 10° southerly offset prior to two left turns. It is similar to Option 5 but the final turn results in a termination point north of Duffield.				
7	A 10° southerly offset followed by a later left turn at 2Nm, terminating south east of Belper.				
8	Similar to Option 7 but with a 15° southerly offset and terminating close to Lower Killburn.				
9	Similar to Option 5 but with a 15° southerly offset prior to two left turns, terminating in the centre of the design envelope close to Duffield.				

10	Similar to Option 6 but with a 15° southerly offset prior to two left turns terminating at a point north of Duffield.				
11	Similar to Option 7 but with a 15° southerly offset followed by a later left turn at 2Nm, terminating south east of Belper.				

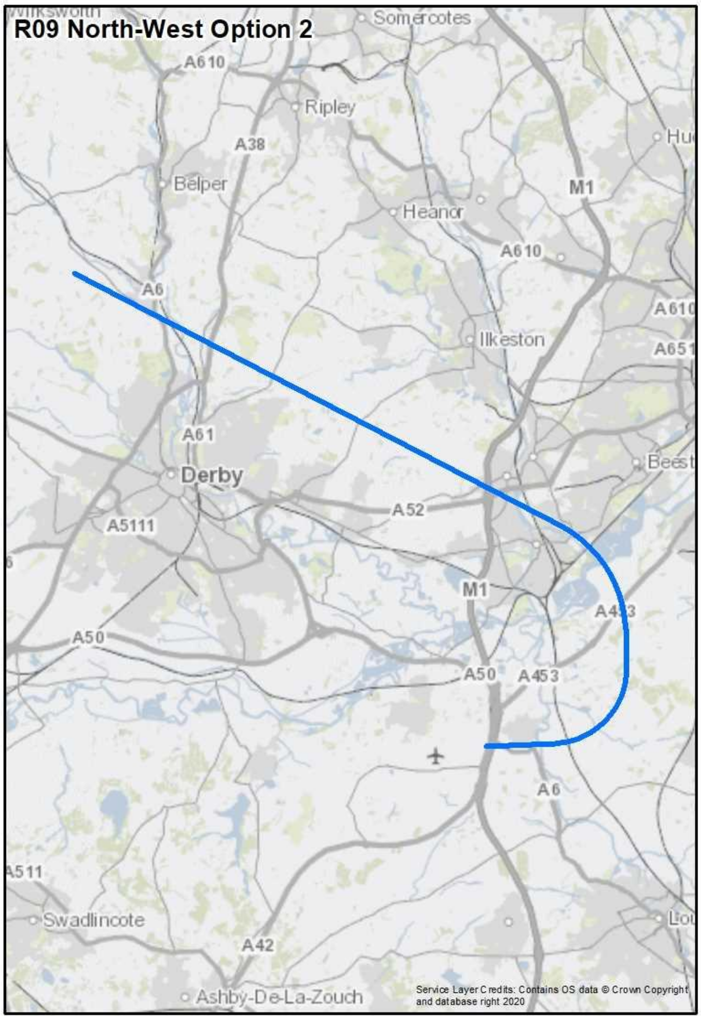
9.4. Runway 09 North West Option 1A

Description	Reason for inclusion
Option 1A is an RNAV 1 replication of the current TNT SID departure and is included as a 'do minimum' option. The initial turn is replicated as closely as possible to the existing SID but cannot be replicated exactly due to requirements in CAP 778 for two waypoints to be created for turns in excess of 120° (rather than a single point). As a replicated route it follows a similar track over the ground as the current SID. After take-off the route has a 7° southerly offset from the runway heading, to pass to the south of Kegworth. The track then turns north east of West Leake and then north west passing to the north of Long Eaton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Aligns to a 'do minimum' option. Aligns to the CAP778 speed recommendations. **Noise N3:** A 7° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



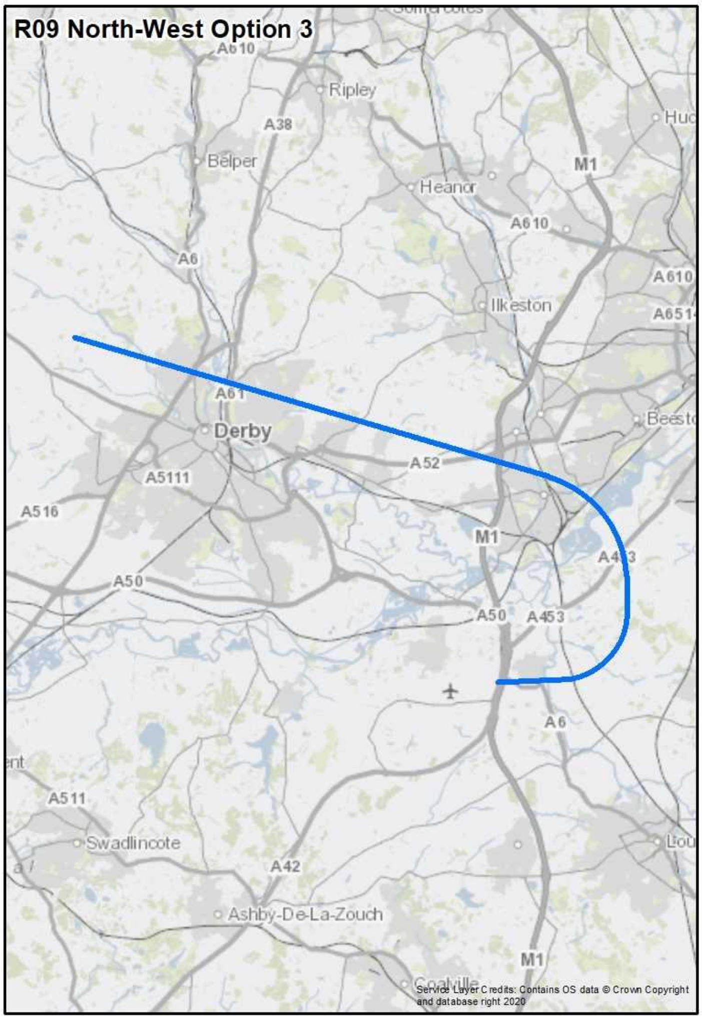
9.5. Runway 09 North West Option 2

Description	Reason for inclusion
Option 2 proceeds straight ahead after take-off with no offset and commences the initial left turn 1.4nm from the DER, the closest that is supported by CAP 778 and PANS-OPS when followed by a turn in excess of 120°. The route overflies the southern edge of Kegworth, before turning left and passing between the Ratcliffe on Soar power station and Clifton. It then turns onto a north west heading passing just north of the M1 junction 25, to the north east of Derby and terminates west of Duffield. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, this has a slightly shorter track length, intended to minimise fuel burn and emissions. **Noise N3**: Aims to reduce the impact of noise by routing north of Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



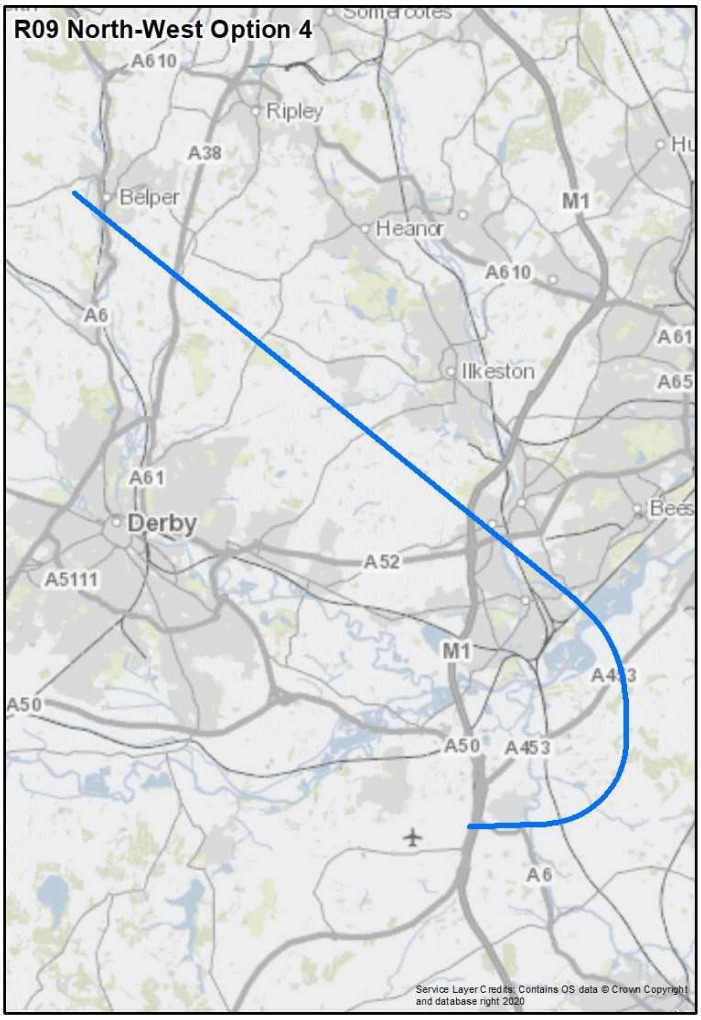
9.6. Runway 09 North West Option 3

Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset and commences the initial left turn 1.4nm from the DER, the closest that is supported by CAP 778 and PANS-OPS when followed by a turn in excess of 120°. The route overflies the southern edge of Kegworth, before turning left and passing between the Ratcliffe on Soar power station and Clifton. It then turns onto a north west heading passing just south of the M1 junction 25 and maintains this heading passing over northern Derby and terminates at the southern edge of the design envelope close to Kirk Langley. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** The is the shortest track length to join the network, intended to minimise fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



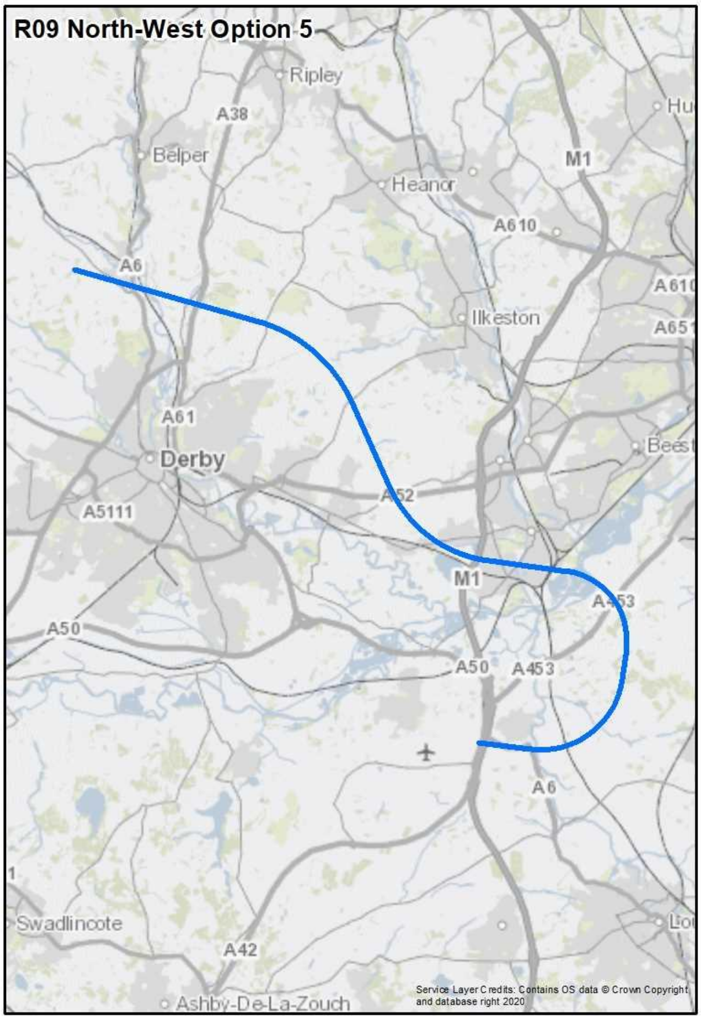
9.7. Runway 09 North West Option 4

Description	Reason for inclusion
Option 4 proceeds straight ahead after take-off with no offset and commences the initial left turn 1.4nm from the DER, the closest that is supported by CAP 778 and PANS-OPS when followed by a turn in excess of 120°. The route overflies the southern edge of Kegworth, before turning left and passing between the Ratcliffe on Soar power station and Clifton. It then turns onto a north west heading passing south of Ilkeston, terminating west of Belper close to Blackbrook. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise by routing south of Ilkeston and north of Derby through an area of lower population density. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



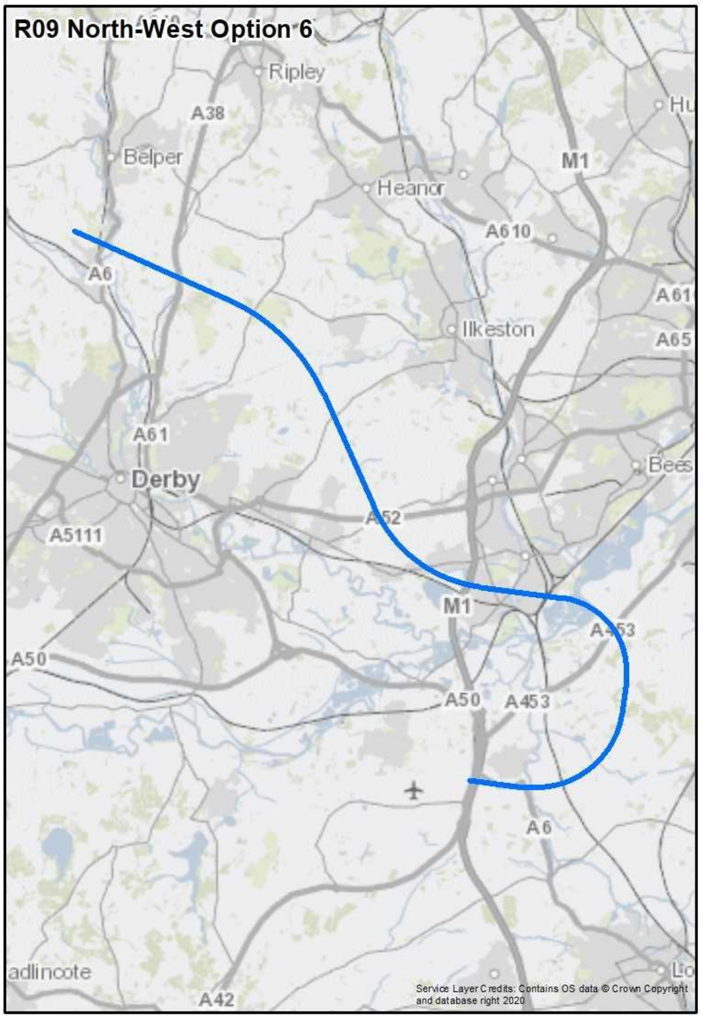
9.8. Runway 09 North West Option 5

Description	Reason for inclusion
This option has an initial offset of 10° to the south from the runway heading and has been created to reduce the impact of noise on Long Eaton. The final element of the route was modified after engagement following feedback from NERL to ensure it is orientated in the correct direction to join the NERL network. The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the north made at 1nm after the DER passing between the Ratcliffe on Soar power station and Clifton. This takes it onto westerly heading where it overflies the southern portion of Long Eaton. A right turn to the north west is made to ensure the route passes between Ilkeston and Derby with final left turn occurring north of Derby with the route terminating close to Duffield. The initial turns have been limited to 190KIAS to enable the tightest turn possible to achieve a more southerly route over Long Eaton. The route is PANS-OPS compliant but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	**Programme:** In line with the ends of the AMS, the route was modified was modified following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network. **Noise N3:** A 10° southerly offset seeks to avoid overflight of communities close to the extended runway centreline. In addition, a tighter first turn seeks to reduce the overflight of Long Eaton. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



9.9. Runway 09 North West Option 6

Description	Reason for inclusion
This option has an initial offset of 10° to the south from the runway heading and has been created to reduce the impact of noise on Long Eaton. It is identical to Option 5 until reaching west of West Hallam at which point this route takes a slightly more northerly track. The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the north made at 1nm after the DER passing between the Ratcliffe on Soar power station and Clifton. This takes it onto westerly heading where it overflies the southern portion of Long Eaton. A right turn to the north west is made to ensure the route passes between Ilkeston and Derby with final left turn occurring north of Derby with the route terminating north of Duffield. The initial turns have been limited to 190KIAS to enable the tightest turn possible to achieve a more southerly route over Long Eaton. The route is PANS-OPS compliant, but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	**Noise N3:** A 10° southerly offset seeks to avoid overflight of communities close to the extended runway centreline. In addition, a tighter first turn seeks to reduce the overflight of Long Eaton. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



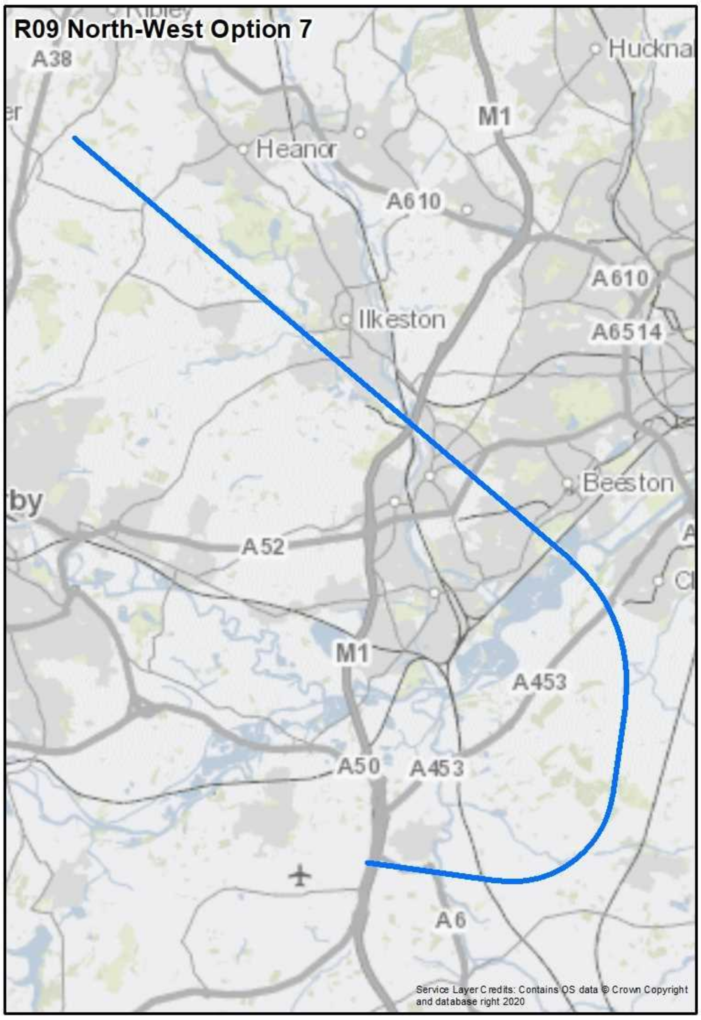
9.10. Runway 09 North West Option 7

Description

This option has an initial offset of 10° to the south from the runway heading and has been created in response to airline stakeholder feedback to consider a wider turn whilst still endeavouring to reduce the impact of noise on Long Eaton.

The initial 10° offset to the south results in the route, passing south of Kegworth, with a left turn onto a northerly heading commencing at 2nm beyond the DER, passing close to East Leake and Clifton. The route then turns north west passing north of Long Eaton and south west of Ilkeston and terminates east of Belper close to Denby village.

The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

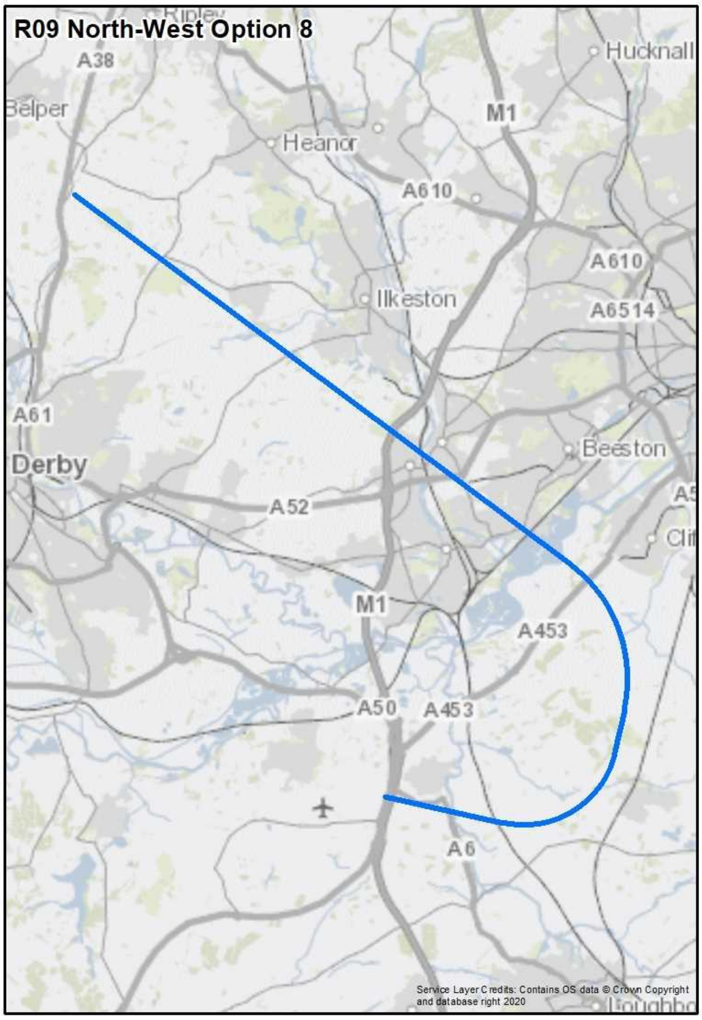
Noise N1: Spreads the impact of noise by taking a wider track on the first turn aimed at reducing the concentration of noise from other routes that take a similar left turn.

Noise N3: A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline in response to stakeholder feedback.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

9.11. Runway 09 North West Option 8

Description	Reason for inclusion
This option is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth whilst also using the later first turn of Option 7. The initial 15° offset to the south results in the route, passing south of Kegworth and the route then makes a left turn north at 2nm beyond the DER passing between West Leake and East Leake, and south west of Clifton. The route then turns north west passing north of Long Eaton and south of Ilkeston. The route terminates south east of Belper close to Lower Kilburn. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N1: Spreads the impact of noise by taking a wider track on the first turn aimed at reducing the concentration of noise from other routes that take a similar left turn. Noise N3: A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



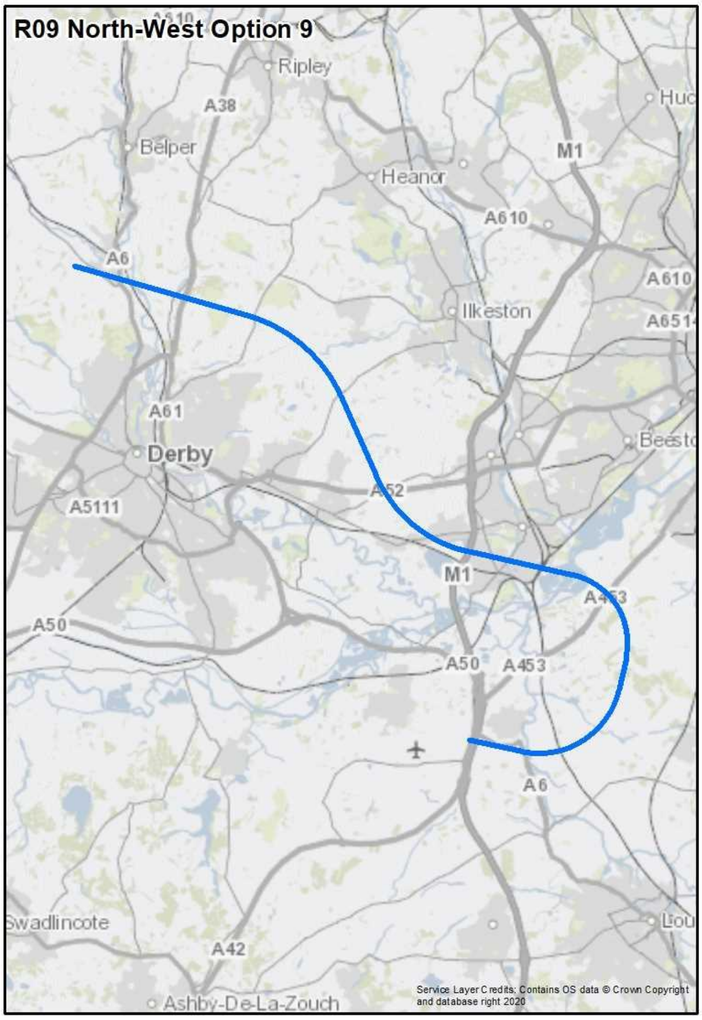
9.12. Runway 09 North West Option 9

Description

This option is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth. The final element of the route was modified after engagement following feedback from NERL to ensure it is orientated in the correct direction to join the NERL network. It is similar to Option 5 but uses a greater offset.

The initial 15° offset to the south results in the route, passing south of Kegworth with the first turn to the north made at 1nm after the DER passing between the Ratcliffe on Soar power station and Clifton. This takes it onto westerly heading where it overflies the southern portion of Long Eaton. A right turn to the north west is made to ensure the route passes between Ilkeston and Derby with final left turn occurring north of Derby with the route terminating close to Duffield.

The initial turns have been limited to 190KIAS to enable the tightest turn possible to achieve a more southerly route over Long Eaton. The route is PANS-OPS compliant, but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.



Reason for inclusion

Programme: In line with the ends of the AMS, the route was modified was modified following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network.

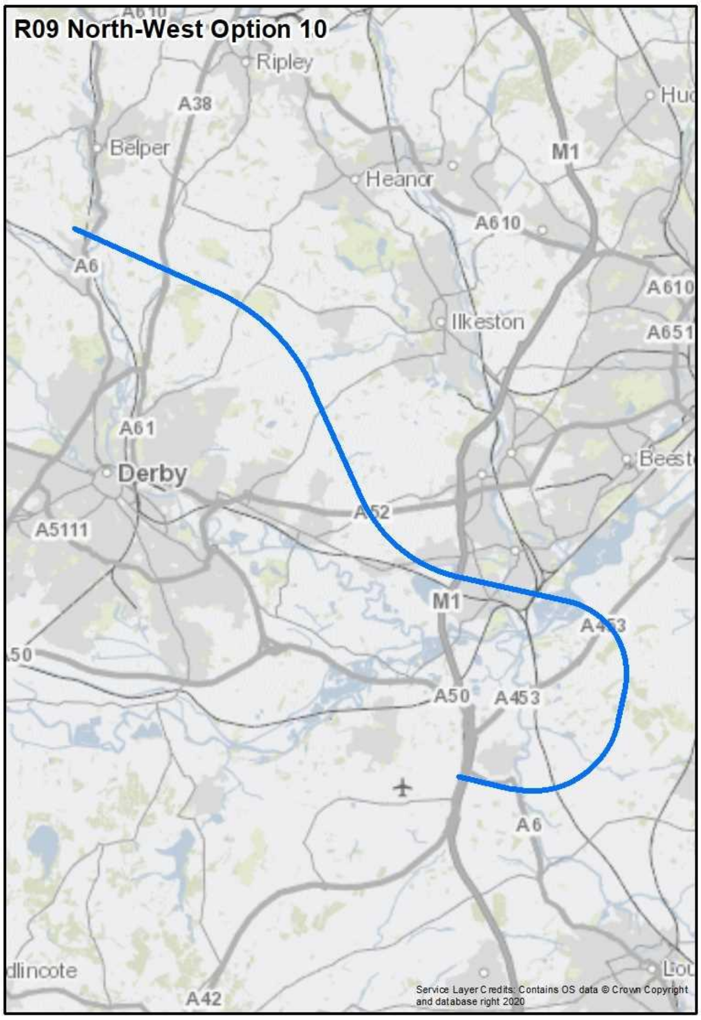
Noise N3: A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and Kegworth in response to stakeholder feedback.

In addition, a tighter first turn seeks to reduce the overflight of Long Eaton.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

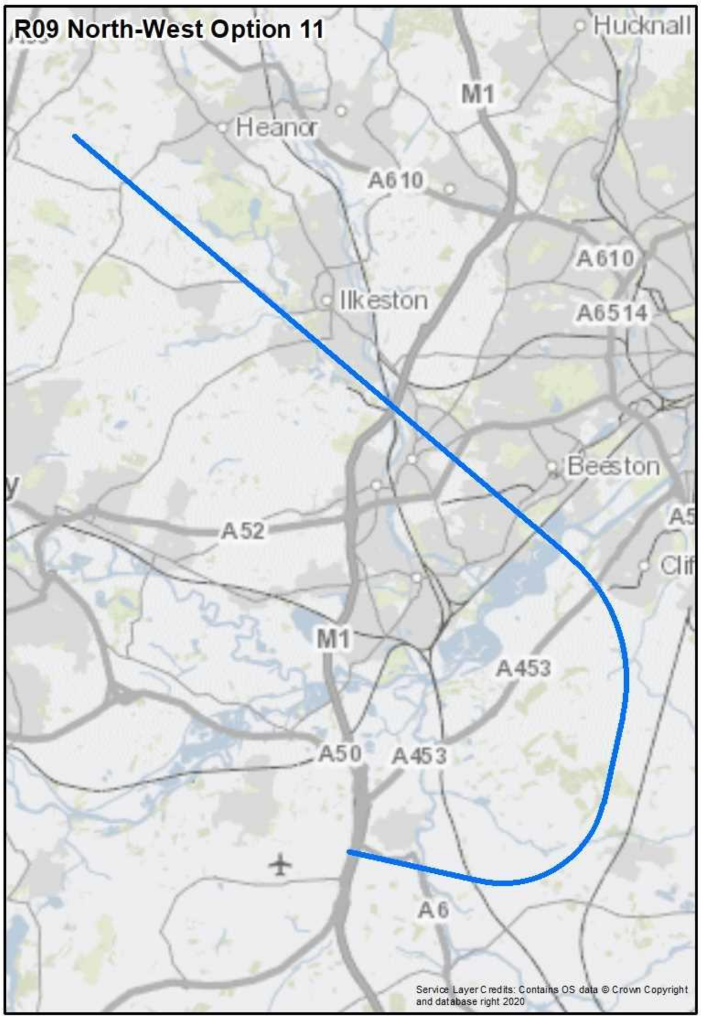
9.13. Runway 09 North West Option 10

Description	Reason for inclusion
This option is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth. It is similar to Option 6, but with a greater offset. The initial 15° offset to the south results in the route, passing south of Kegworth with the first turn to the north made at 1nm after the DER passing between the Ratcliffe on Soar power station and Clifton. This takes it onto westerly heading where it overflies the southern portion of Long Eaton. A right turn to the north west is made to ensure the route passes between Ilkeston and Derby with final left turn occurring north of Derby with the route terminating north of Duffield. The initial turns have been limited to 190KIAS to enable the tightest turn possible to achieve a more southerly route over Long Eaton. The route is PANS-OPS compliant, but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	Noise N3: A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline in response to stakeholder feedback. In addition, a tighter first turn seeks to reduce the overflight of Long Eaton. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



9.14. Runway 09 North West Option 11

Description	Reason for inclusion
This option is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth. It is similar to Option 7, but with a greater offset. The initial 15° offset to the south results in the route, passing south of Kegworth, with a left turn onto a northerly heading commencing at 2nm beyond the DER, passing close to East Leake and Clifton. The route then turns north west passing north of Long Eaton and south west of Ilkeston and terminates east of Belper close to Denby village. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N1: Spreads the impact of noise by taking a wider track on the first turn aimed at reducing the concentration of noise from other routes that take a similar left turn. Noise N3: A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and Kegworth in response to stakeholder feedback. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



9.15. Runway 09 North West Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A12	S	P	C

Description: On departure from runway 09 this option proceeds in an east-south east direction for approximately 3nm and then makes a 90-degree left-hand turn north, followed by a left turn over central Nottingham to head in a north westerly direction towards the SID aiming point.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic north and east before turning it north leading to increased fuel burn and emissions. The track taken over central Nottingham means that a significant number of people are likely to be impacted by noise below 4,000ft, meaning that when compared to other options, this does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Option	Safety	Programme	Continuity
B13	S	P	C

Description: After departure from runway 09 this option initiates a180-degree right turn around EMA to head in a north westerly direction, passing west of Derby.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 09 and the runway 09 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic south and west before turning it north leading to increased fuel burn and emissions. The track taken over Derby means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would interact with the south departure envelope which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. The potential interaction with arrivals would impact the arrivals traffic flow, which again would not enable best use of runway capacity.

C14	S	P	C

Description: On departure from runway 09 this option proceeds in a north easterly direction, then initiates a gradual left-hand turn to the east of Nottingham onto a north north westerly heading.

Safety: This option fails to align with this design principle, because it would exceed controlled airspace dimensions with no material benefit and come into conflict with parachute activity at Syerston.

Programme: This option fails to align with the environmental end of the AMS.

> *Integration:* This option would require additional airspace to mitigate the safety risk of operating in Class G airspace. There is an expectation that this additional airspace would be required 24x7 and therefore would adversely impact other airspace users, particularly GA traffic and parachute activity at Syerston.
>
> *Environment:* This option would involve greater track mileage than is necessary by taking traffic north east before turning it north leading to increased fuel burn and emissions. The track taken would avoid central Nottingham which may result in some noise benefit in comparison to other options.

Trade-offs: Whilst there may be a benefit in the number of people impacted by noise, the resultant safety impact, requirement for additional CAS, impact on GA and parachute operations at Syerston and additional fuel burn and emissions mean there is no trade-off to be made to justify an amber rating.

10.SID Runway 09 – South

10.1. Introduction to 09 South Design Envelope

This single envelope has been created by joining previous envelopes to the south west, south, and south east for traffic routing in these directions from runway 09. The southern design envelope is based around the existing BPK 2P and DTY 4P SIDs which route towards the Brookmans Park and Daventry DVORs with new options also being created towards potential upper airspace joining points around the TOBID reporting points within the NATS upper airspace network, enabling a shorter route for traffic to the south and south west.

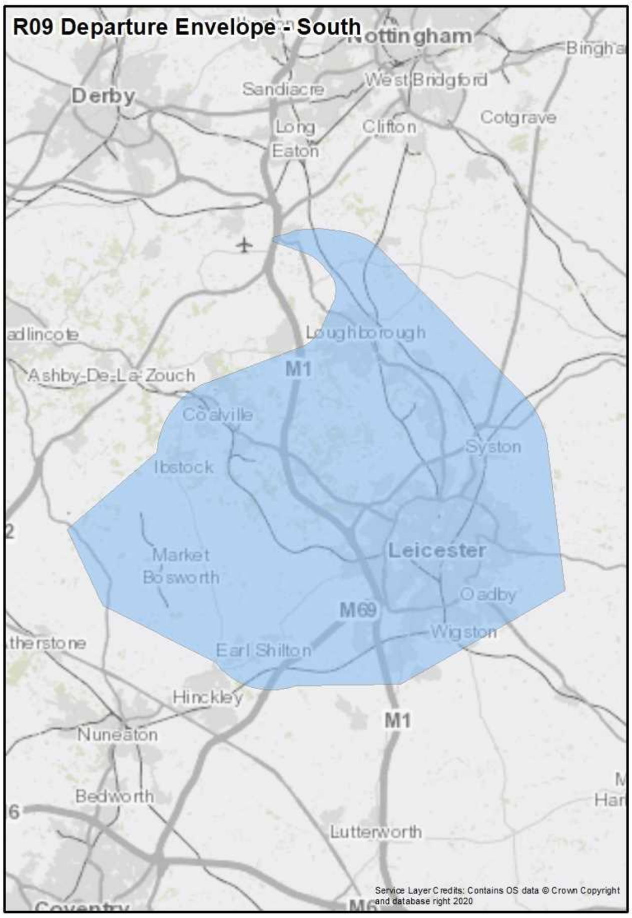
In addition, as part of the phase two stakeholder engagement process, feedback was received regarding the impact of overflight on communities close to the extended runway. As described in section 6.12, this resulted in the creation of additional route options with an offset after departure, up to the maximum possible under PANS-OPS of 15°. The aim of this offset is to reduce the impact of noise in alignment with Design Principle Noise N3.

This applies to a number of options within this design envelope and is noted in the 'Reason for Inclusion' section where relevant.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft.

The letterboxes are centred on where the current Daventry and Brookmans Park SIDs exit EMA's controlled airspace and where the most direct route to TOBID exits EMA's controlled airspace. The letterboxes are 4.5nm wide (2.25nm either side of the nominal track).

10.2. Design Envelope Location Map



10.3. 09 South Option Summary Table

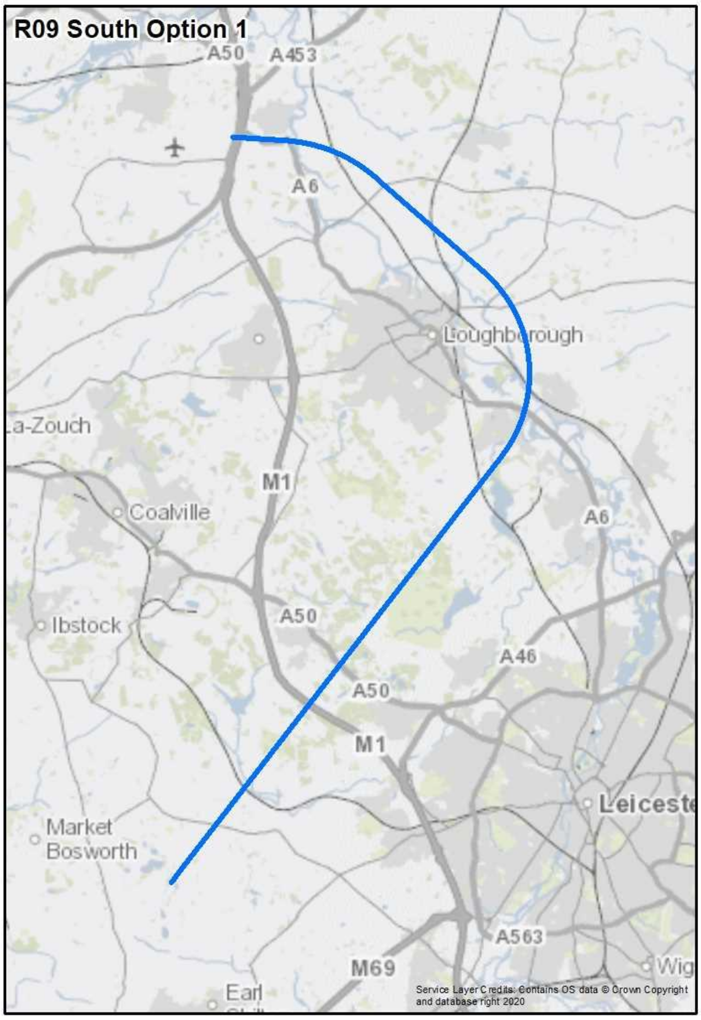
Viable and Good Fit		Viable but Poor Fit		Unviable	
1	This is an RNAV re-creation of the current DTY 4P SID with a southerly offset but with an initial turn at 1nm beyond the DER which is earlier than the current SID.	A18	An extended easterly track before turning back south west. Option fails to align to: • Programme • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
1A	An RNAV1 replication of the current DTY 4P SID with a southerly offset included as a 'do minimum' option. The initial turn is at 2nm post the DER which is as per the existing SID.	B19	A left-hand wrap-around to achieve a southerly heading. Option fails to align to: • Safety • Programme • Continuity		

2	This proceeds straight ahead with no offset before turning right to head south toward Hinkley.	C20	A northerly offset or north west heading before turning back to the south west. Option fails to align to: • Programme • Continuity		
3	This proceeds straight ahead with no offset before turning right to head south and terminating to the south east of Market Bosworth and north west of Earl Shilton.	D21	An extended northerly offset of approximately 9nm before turning south west and routing over Leicester. Option fails to align to: • Safety • Programme • Continuity		
4	This proceeds straight ahead with no offset before turning right to head south over Loughborough and terminating to the south west of Leicester.				
5	This proceeds straight ahead with no offset for a greater distance than other options before turning south and routing to the east of Loughborough and terminating to the south east of Leicester.				
6	An RNAV replication of the current BPK 2P SID that has a 10° southerly offset before turning south east to route to the east of Loughborough and Leicester.				
7	This has a 10° southerly offset before making a tight turn south west and then back south, terminating midway between Leicester and Tamworth.				

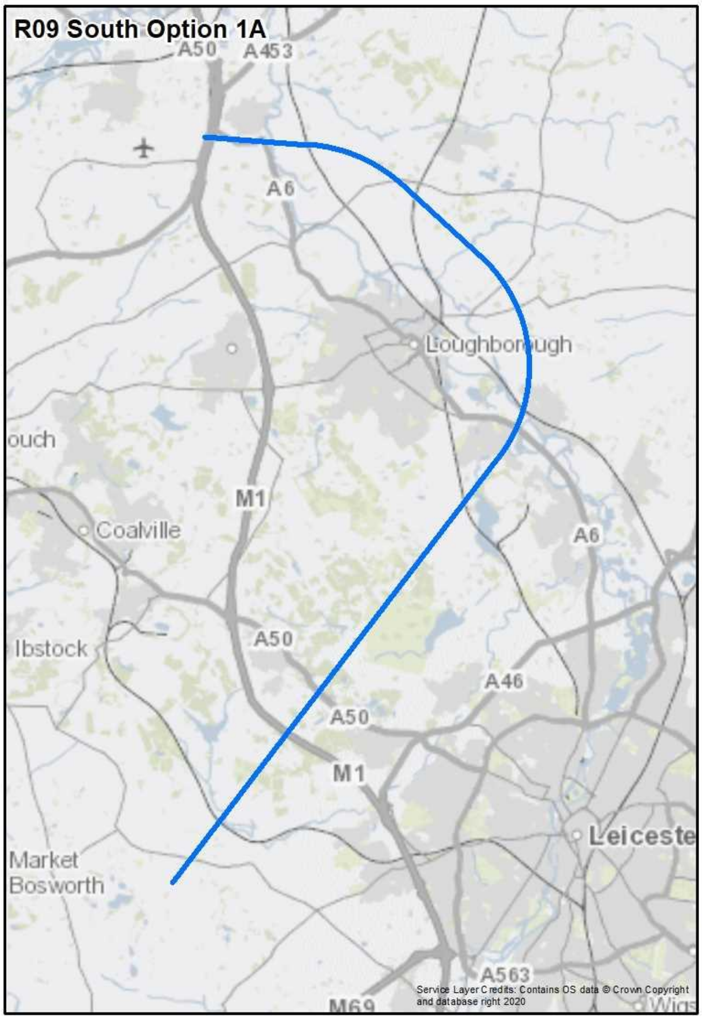
8	This has a 10° southerly offset, and routes south east before turning south west to the east of Loughborough and north west of Leicester, terminating east of Market Bosworth.				
9	This has a 10° southerly offset before turning south east to route to the east of Loughborough and then turns right again to the north west of Leicester terminating west of Leicester close to Desford.				
10	This proceeds straight ahead with no offset before turning right to head south over Loughborough and then turning south west to terminate to the west of Market Bosworth.				
11	This proceeds straight ahead with no offset before turning right to head south over Loughborough (as per Option 10) but turns further to the west and terminating to the north west of Market Bosworth.				
12	This proceeds straight ahead with no offset before turning right to head south over Loughborough (as per Option 10) but straightens up sooner to achieve a more south-south west heading and terminating to the south of Market Bosworth, close to Sutton Cheney.				

13	This proceeds straight ahead with no offset but with a later first turn than other options to avoid Loughborough. The right turn takes it east and south of Loughborough and terminates north of Market Bosworth close to Nailstone.				
14	This has a 15° southerly offset before turning right to join the path of Option 3 and terminating to the south east of Market Bosworth and north west of Earl Shilton.				
15	This has a 15° southerly offset, before making a turn south west and then back south similar to Option 7. It terminates just south west of Market Bosworth.				
16	This has a 15° southerly offset, and takes the wider turn to avoid Loughborough, similar to Option 8. It passes to the east of Loughborough, joining Option 8 south of Loughborough close to Woodhouse.				
17	This has a 15° southerly offset prior joining the same track as Option 9 to the east of Sutton Bonington.				

10.4. Runway 09 South Option 1

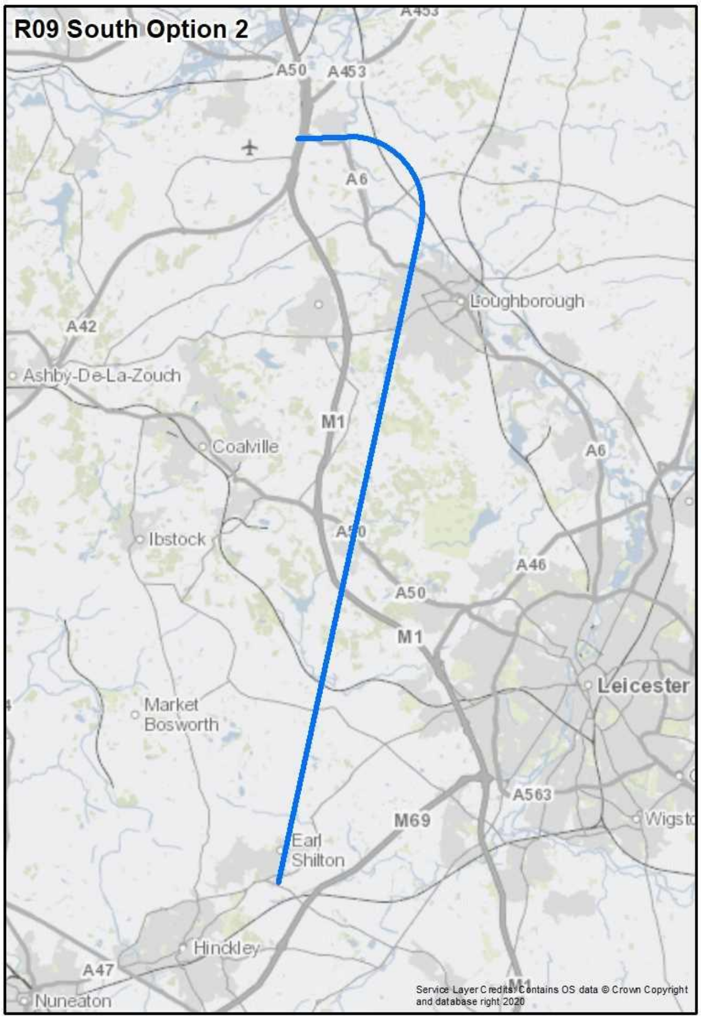
Description	Reason for inclusion
This is an RNAV re-creation of the current DTY 4P SID with a southerly offset but with an initial turn at 1nm beyond the DER which is earlier than the current route. An initial 7° southerly offset leads to the first turn which commences 1nm after the DER which is PANS-OPS compliant but earlier than the current SID. It utilises fly-by waypoints to create an approximate replication of the existing SID. As a replicated route it follows a similar track over the ground as the current route, turning right after departure to route east of Loughborough, before turning right to the south west and terminating in the vicinity of Mallory Park, west of Leicester. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	**Continuity**: The earlier first turn has been included to aid runway capacity by reducing the departure delay for following aircraft. **Noise N3:** A 7° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. The route also avoids overflight of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

10.5. Runway 09 South Option 1A

Description	Reason for inclusion
Option 1A is an RNAV 1 replication of the current Daventry 4P SID with a southerly offset included as a 'do minimum' option. An initial 7° southerly offset leads to the first turn which commences in the same place as the current SID, 2nm beyond the DER, and it uses fly-by waypoints to create an approximate replication of the existing SID. As a replicated route it follows a similar track over the ground as the current route, turning right after departure to route east of Loughborough, before turning right to the south west and terminating in the vicinity of Mallory Park, west of Leicester. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	Aligns to a 'do minimum' option. **Noise N3:** A 7° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. The route also avoids overflight of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

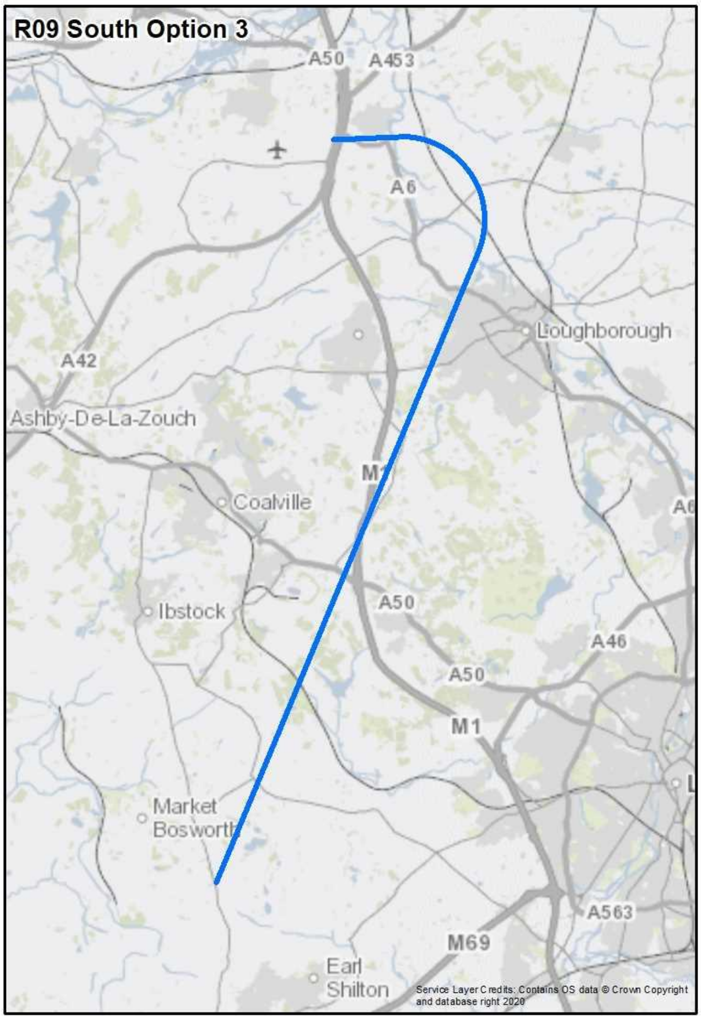
10.6. Runway 09 South Option 2

Description	Reason for inclusion
Option 2 proceeds straight ahead after take-off with no offset and commences the single right turn south at 1.07nm beyond the DER. The route overflies the southern edge of Kegworth, before turning right and passing between Sutton Bonington and East Leake before routing over western Loughborough and terminating north east of Hinckley near Earl Shilton. The CAP 778 recommended speed of 210kts has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



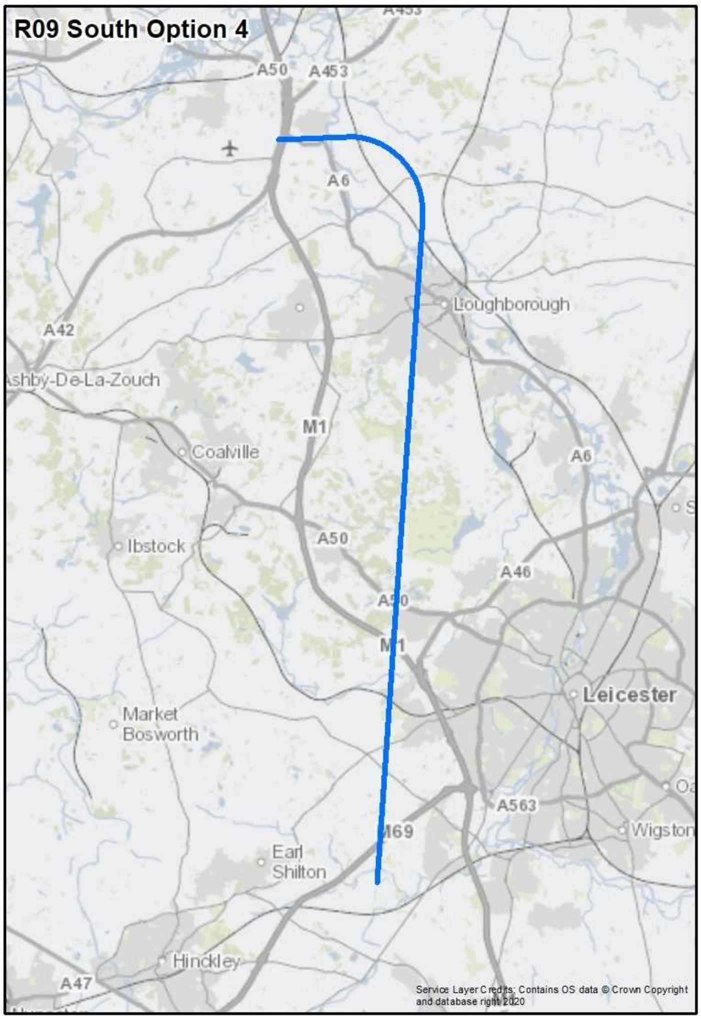
10.7. Runway 09 South Option 3

Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset and commences the single right turn south at 1.2nm beyond the DER. This turn is slightly tighter than Option 2 with the aim of reducing overflight of Loughborough. The route overflies the southern edge of Kegworth, before turning right and passing between Sutton Bonington and East Leake before routing over the western edge of Loughborough and terminating north of Hinckley near Mallory Park. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Noise N2**: Runs parallel to the M1 motorway which already has a high level of ambient noise. **Noise N3**: The tight right turn aims to reduce the impact of noise by routing to the western edge of Loughborough. The route also avoids overflight of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



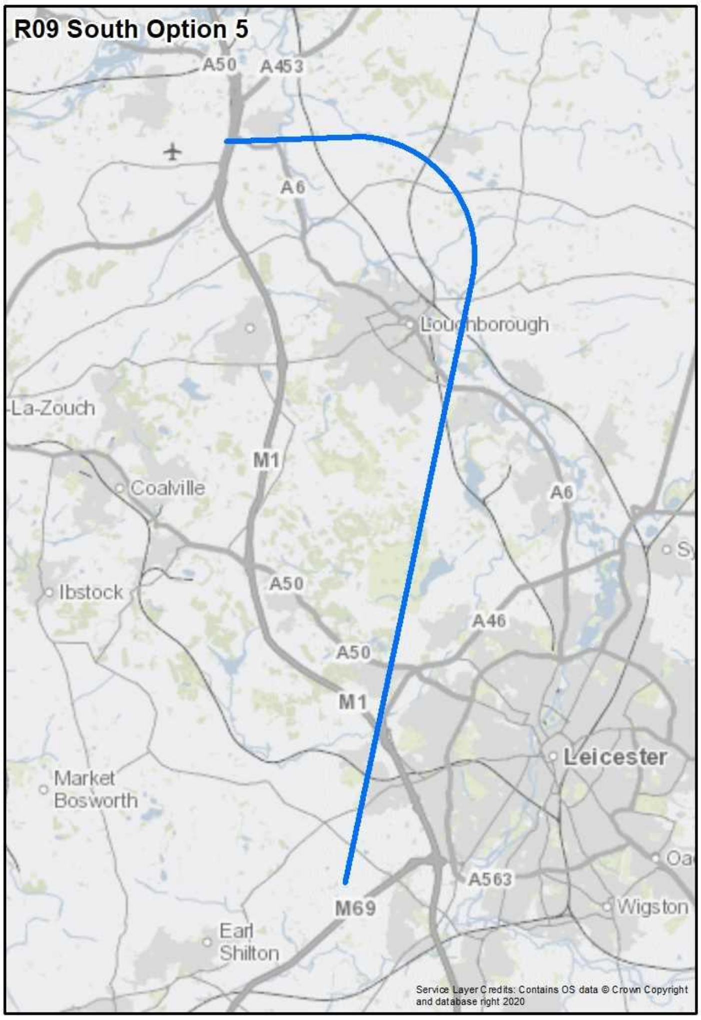
10.8. Runway 09 South Option 4

Description	Reason for inclusion
Option 4 proceeds straight ahead after take-off with no offset and commences the single right turn south at 1.4nm beyond the DER to head almost directly south. This route overflies Loughborough but has been orientated to avoid Leicester. The route overflies the southern edge of Kegworth, before turning right and passing between Sutton Bonington and East Leake and overflying the centre of Loughborough. It remains on this track and terminates south west of Leicester. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Noise N2:** Overflies the centre of Loughborough which is expected to have higher level of ambient noise. **Noise N3**: The route turns slightly to the south west to avoid overflight of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



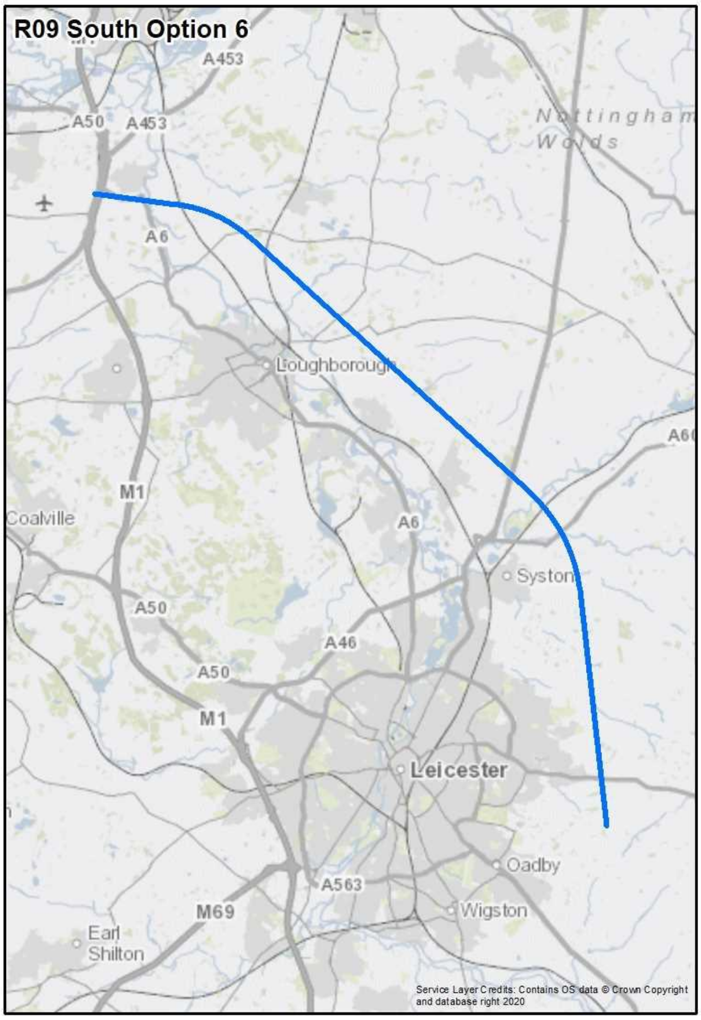
10.9. Runway 09 South Option 5

Description	Reason for inclusion
Option 5 proceeds straight ahead with no offset for approximately 2.4Nm beyond the DER before making the first turn. This is greater than the existing SID and this extended easterly track allows the route to pass to the east and south east of Loughborough, rather than overflying it. After departure the route overflies the southern edge of Kegworth before making its initial turn close to West Leake onto a south-south west heading. The route then passes west of Leicester before terminating south west of Leicester close to Enderby. The first turn takes place when the aircraft is above 3,000ft and has therefore been designed to be flown at 250 KIAS as per the recommendation in CAP 778.	**Noise N3:** A wider turn further from the DER provides a route that avoids the overflight of Loughborough. In addition, the design speed of 250kts will allow aircraft to climb higher more quickly, with the potential to reduce the impact of noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



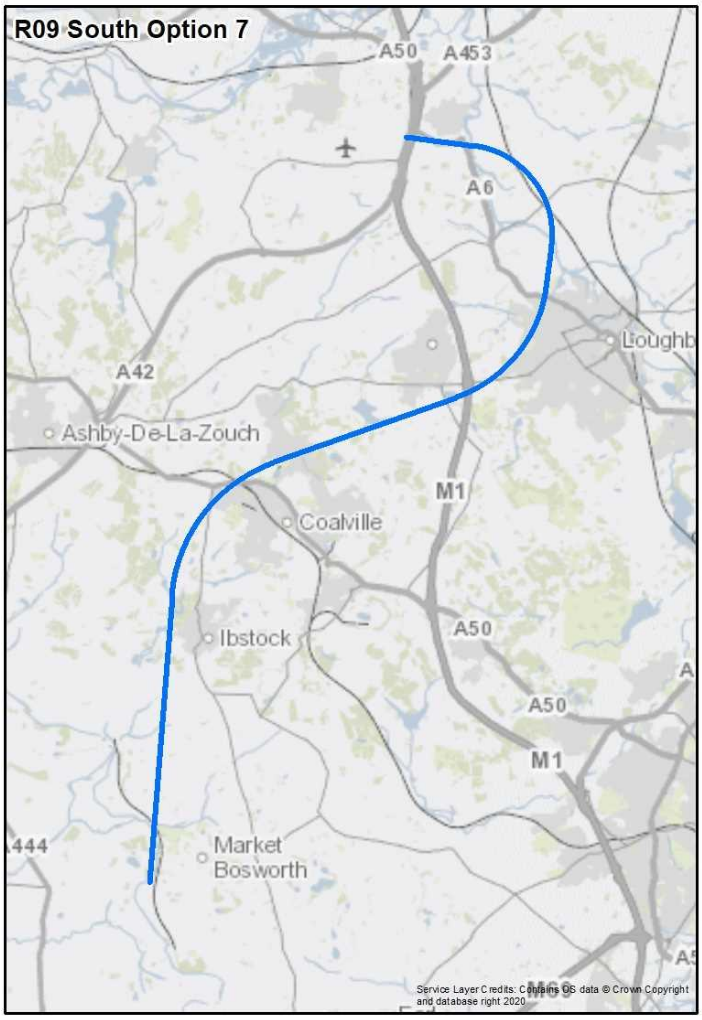
10.10. Runway 09 South Option 6

Description	Reason for inclusion
Option 6 is a replication of the existing Brookmans Park (BPK 2P) departure that has a 10° southerly offset, and which has been included as a 'do minimum' option that also avoids large built up areas. The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the south east made at 1.7nm beyond the DER, thereby passing to the north east of Loughborough and Syston. It then turns south and terminates to the east of Leicester, close to Houghton on the Hill.	Aligns to a 'do minimum' option for the BPK SID. **Noise N3:** A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. Aims to reduce the impact of noise by avoiding the overflight of Loughborough and Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



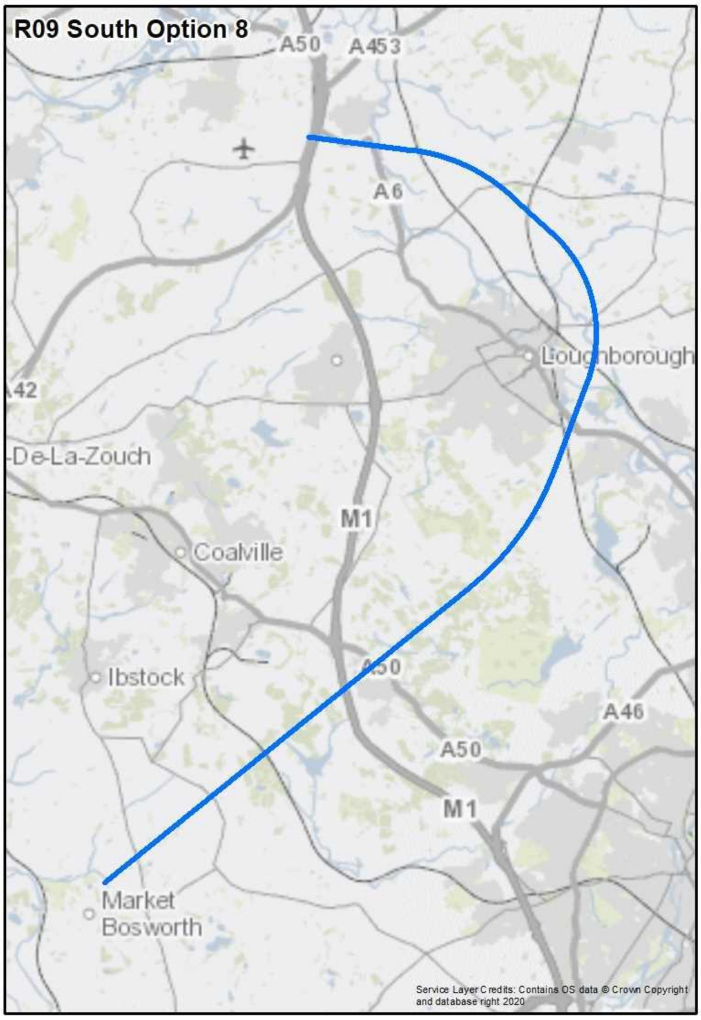
10.11. Runway 09 South Option 7

Description	Reason for inclusion
Option 7 has an initial offset of 10° to the south from the runway heading and has been created with a loop back turn to reduce the overflight of central Loughborough and reduce the impact of noise. It also has benefits in reducing the interaction between departures to the south and arrivals from the south to runway 09. The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the south west commenced 1.2nm beyond the DER. The route overflies Sutton Bonington and the north western edge of Loughborough before routing south of Shepshed. A left turn takes the route south around the north west of Coalville, past the west side of Ibstock to terminate south west of Market Bosworth. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity:** By looping round and heading west before turning south the route aims to minimise interaction with arrivals. **Noise N3:** A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. Aims to minimise the impact of noise on Loughborough, and Coalville. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



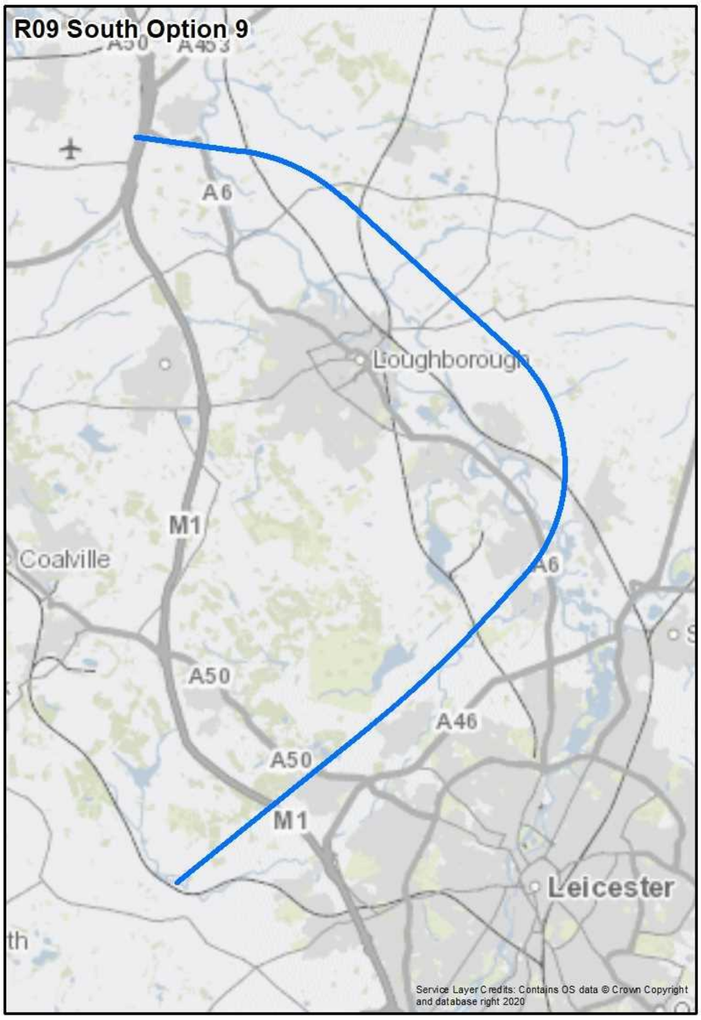
10.12. Runway 09 South Option 8

Description	Reason for inclusion
Option 8 has a 10° southerly offset and follows the early part of the current BPK 2P departure but turns south west earlier to route north of Leicester. The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the south east made at 1.7nm beyond the DER, passing to the north east of Loughborough. It then makes a second turn onto a south west heading routing south east of Loughborough and passing between Leicester and Coalville and terminating north east of Market Bosworth. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. Aims to reduce the impact of noise by avoiding the overflight of Loughborough and routing between Coalville and Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



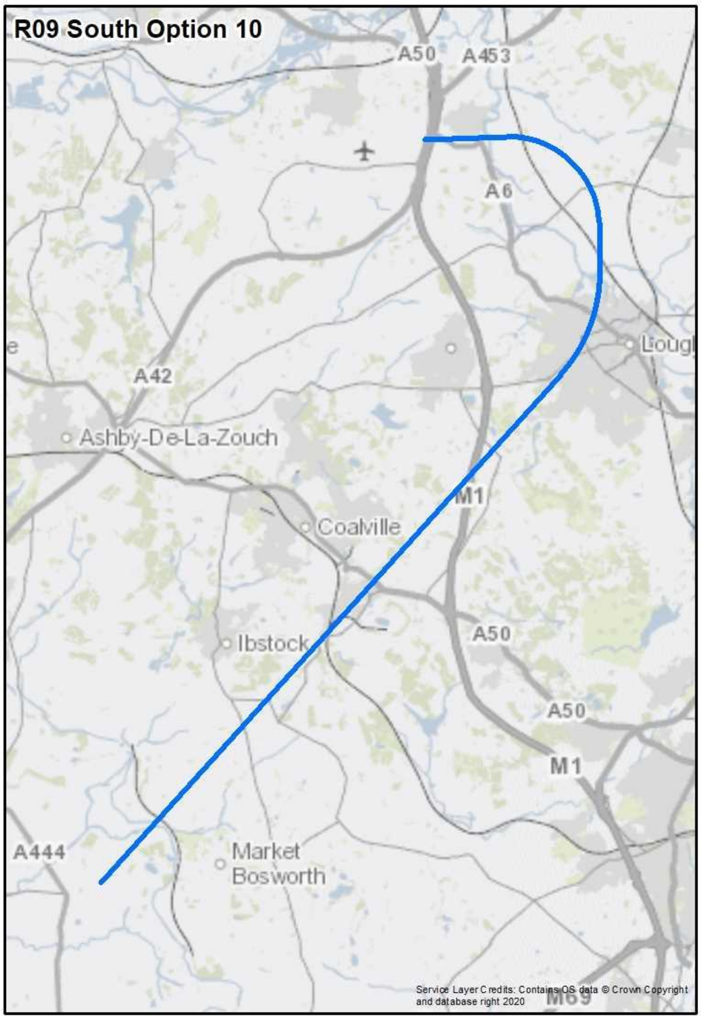
10.13. Runway 09 South Option 9

Description	Reason for inclusion
Option 9 has a 10° southerly offset and follows the early part of the current BPK 2P departure but turns south west earlier to route north of Leicester. The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the south east made at 1.7nm beyond the DER, passing to the north east of Loughborough. It continues south east until approximately Barrow-upon-Soar where it turns right onto a south west heading routing north west of Leicester and terminating near Desford. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** A 10° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth. Aims to reduce the impact of noise by avoiding the overflight of Loughborough and Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



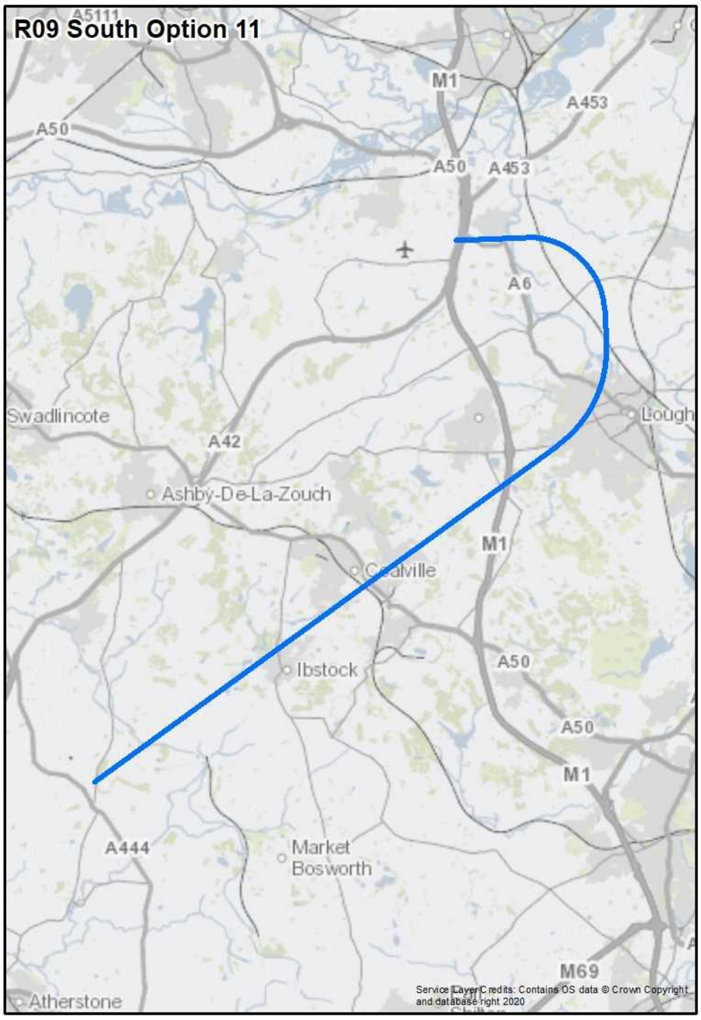
10.14. Runway 09 South Option 10

Description	Reason for inclusion
Option 10 has been created to provide a fuel efficient route to the south west. The route proceeds straight ahead after take-off and overflies the southern edge of Kegworth with no offset and commences a first 90° right turn to the south at 1.4nm beyond the DER. As the route passes over northern Loughborough it turns right onto a south west heading passing over central Loughborough, south of Coalville and terminates to the west of Market Bosworth. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Noise N2:** Overflies the centre of Loughborough which is expected to have higher level of ambient noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



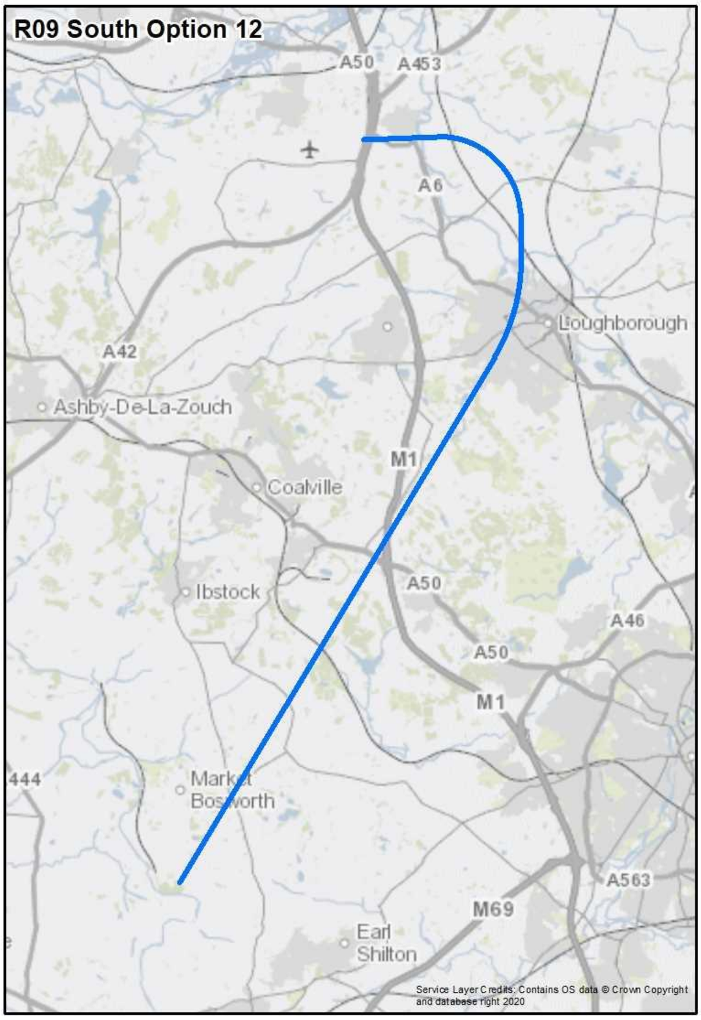
10.15. Runway 09 South Option 11

Description	Reason for inclusion
Option 11 has been created to provide an alternative fuel efficient route to the south west and is similar to Option 10 but terminates slightly further north. The route proceeds straight ahead after take-off and overflies the southern edge of Kegworth with no offset and commences a first 90° right turn to the south at 1.4nm beyond the DER. As the route passes over northern Loughborough it turns right onto a south west heading passing over central Loughborough, the south eastern portion of Coalville and the north west of Ibstock. The route terminates to the north west of Option 10 close to Twyford. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Noise N2:** Overflies the centre of Loughborough which is expected to have higher level of ambient noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



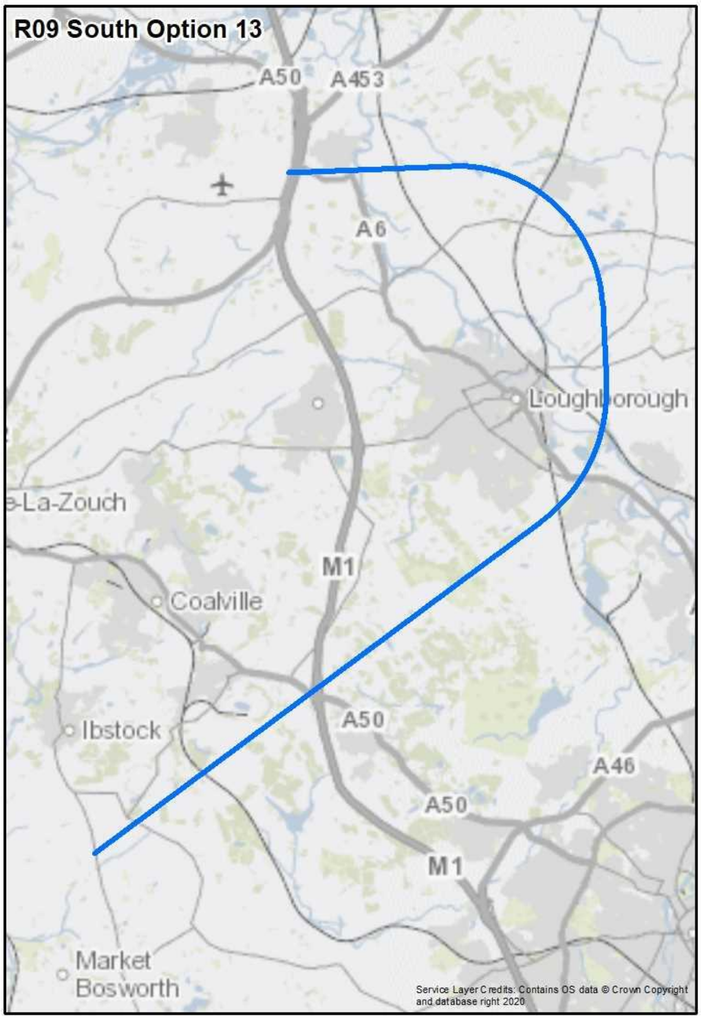
10.16. Runway 09 South Option 12

Description	Reason for inclusion
Option 12 has been created to provide an alternative fuel efficient route to the south west and is similar to Option 10 and 11 but terminates slightly further south. The route proceeds straight ahead after take-off and overflies the southern edge of Kegworth with no offset and commences a first 90° right turn to the south at 1.4nm beyond the DER. As the route passes over northern Loughborough it turns right onto a south west heading passing over central Loughborough, close to Markfield and terminating south of Market Bosworth. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Noise N2:** Overflies the centre of Loughborough which is expected to have higher level of ambient noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

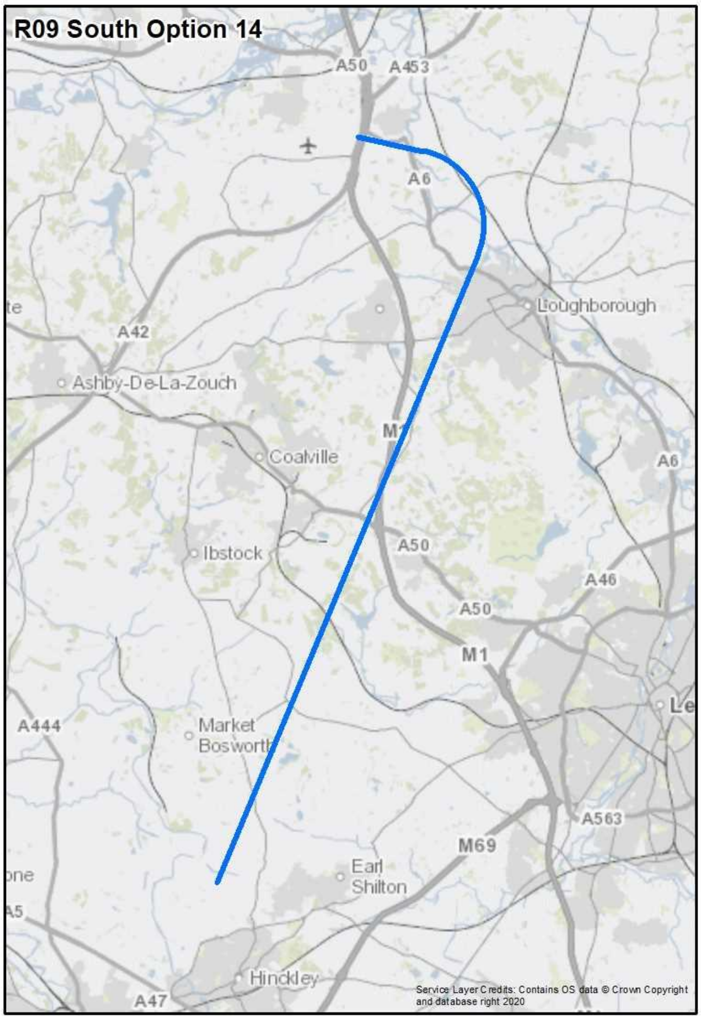


10.17. Runway 09 South Option 13

Description	Reason for inclusion
Option 13 proceeds straight ahead with no offset for approximately 2.5nm beyond the DER before making the first turn. This is greater than the existing SID and this extended easterly track allows the route to pass to the east and south east of Loughborough, rather than overflying it. After departure the route overflies the southern edge of Kegworth before making its first right turn close to West Leake onto a southerly heading. A second turn takes the route south east of Loughborough and south of Coalville to terminate close to Nailstone. The first turn takes place when the aircraft is above 3,000ft and has therefore been designed to be flown at 250 KIAS as per the recommendation in CAP 778.	Noise N3: A wider turn further from the DER provides a route that avoids the overflight of Loughborough and Coalville. In addition, the design speed of 250kts will allow aircraft to climb higher more quickly, with the potential to reduce the impact of noise. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

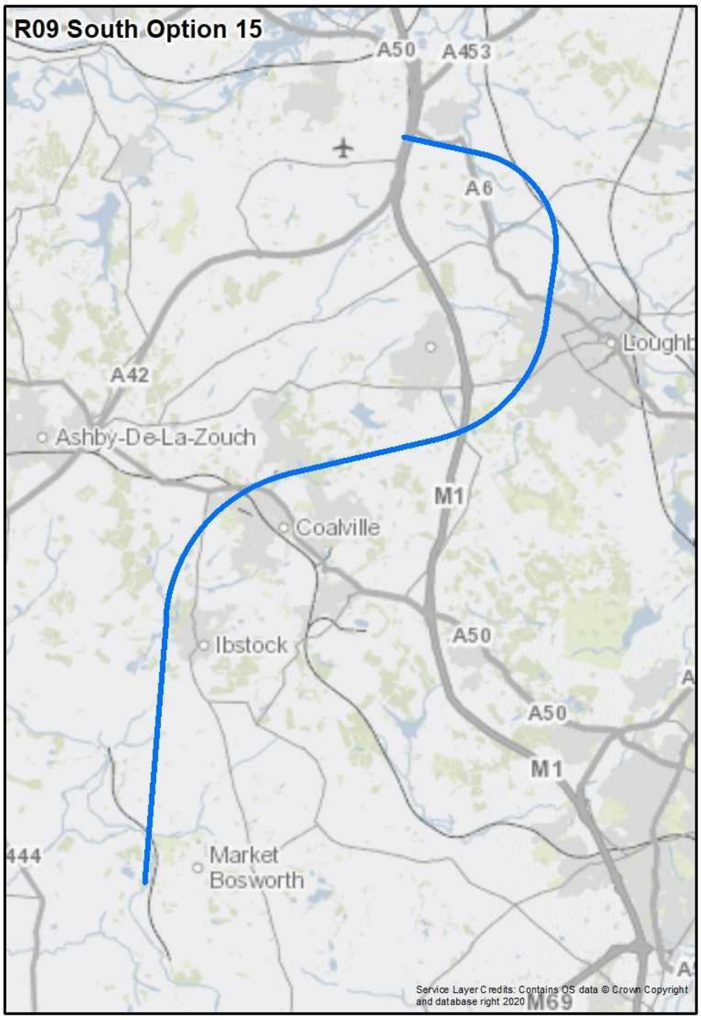


10.18. Runway 09 South Option 14

Description	Reason for inclusion
Option 14 is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth. The remainder of the route is similar to Option 3. The initial 15° offset to the south results in the route, passing south of Kegworth with the first turn to the right turn onto a southerly heading commencing at approximately 1.2nm beyond the DER. This takes it between Sutton Bonington and East Leake before routing over the western edge of Loughborough and terminating north of Hinckley near Mallory Park The CAP 778 recommended speed of 210 KIAS has been applied to the first turn. 	**Continuity**: The first turn has been included to aid runway capacity and optimise departure spacing for following aircraft. **Emissions**: When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Noise N2**: Runs parallel to the M1 motorway which already has a high level of ambient noise. **Noise N3**: A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. In addition, the tight right turn aims to reduce the impact of noise by routing to the western edge of Loughborough. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

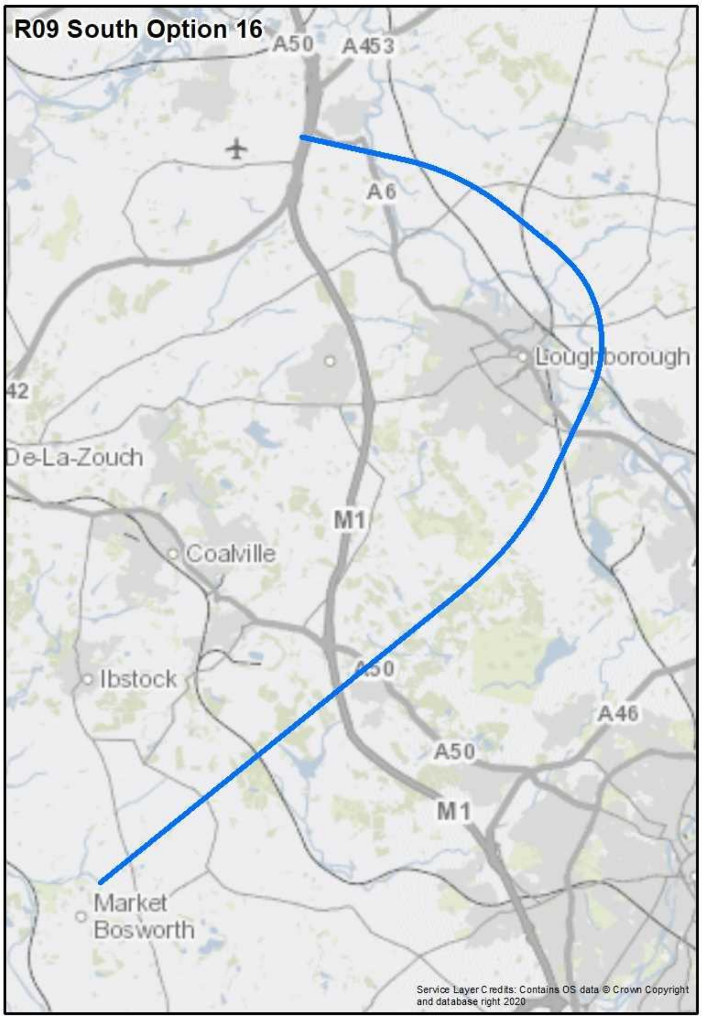
10.19. Runway 09 South Option 15

Description	Reason for inclusion
Option 15 is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth. The remainder of the route is similar to Option 7. The initial 15° offset to the south results in the route, passing south of Kegworth with the first turn to the right turn commenced 1.4nm beyond the DER. The route then tracks south, commencing a second right turn as soon as possible onto a westerly heading, routing south of Shepshed. A left turn takes the route south around the north west of Coalville, past the west side of Ibstock to terminate south west of Market Bosworth. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity:** By looping round and heading west before turning south the route aims to minimise interaction with arrivals. **Noise N3:** A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. Aims to minimise the impact of noise on Loughborough, and Coalville. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



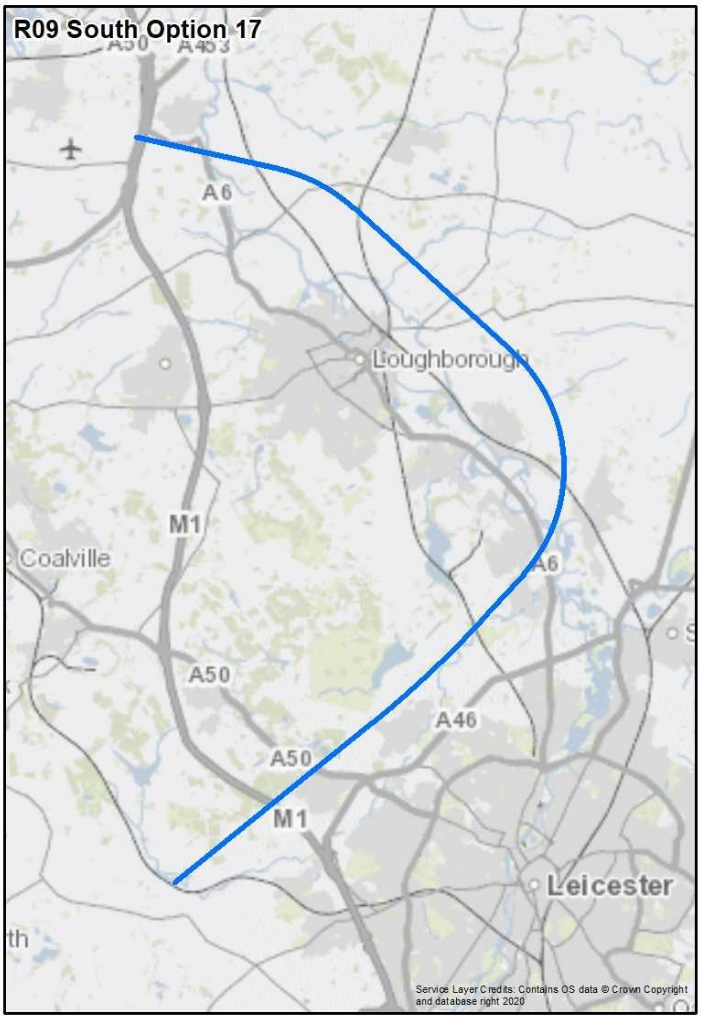
10.20. Runway 09 South Option 16

Description	Reason for inclusion
Option 16 is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth whilst also avoiding Loughborough. The remainder of the route is similar to Option 8. The initial 15° offset to the south results in the route, passing south of Kegworth with the first turn to the south east made at 1.7nm beyond the DER, passing to the north east of Loughborough. It then makes a second turn onto a south west heading routing south east of Loughborough and passing between Leicester and Coalville and terminating north east of Market Bosworth. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. Aims to reduce the impact of noise by avoiding the overflight of Loughborough and routing between Coalville and Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



10.21. Runway 09 South Option 17

Description	Reason for inclusion
Option 17 is responding to stakeholder feedback to use the maximum 15° southerly offset to reduce the impact of noise on Kegworth whilst also avoiding Loughborough. The remainder of the route is similar to Option 9. The initial 15° offset to the south results in the route passing south of Kegworth with the first turn to the south east made at 1.7nm beyond the DER, passing to the north east of Loughborough. It continues south east until approximately Barrow-upon-Soar where it turns right onto a south west heading routing north west of Leicester and terminating near Desford. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** A 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline and to avoid Kegworth in response to stakeholder feedback. Aims to reduce the impact of noise by avoiding the overflight of Loughborough and Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



10.22. Runway 09 South Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A18	S	P	C

Description: On departure from runway 09 this option proceeds directly east for approximately 5nm before making a right-hand turn to route in a south westerly direction between Loughborough and Leicester towards Market Bosworth.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic east before turning it south leading to increased fuel burn and emissions. Whilst the option avoids large towns and settlements, the track taken does not show a material benefit in comparison to other options.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option may have a benefit in reducing the interaction with arrivals from the south (by gaining altitude to climb above the inbounds) but would create an interaction with the east departure envelope. This would limit the ability to achieve one minute departure splits and not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B19	S	P	C

Description: On departure from runway 09 this option initiates a left-hand wrap-around, proceeding in a westerly direction and then turning south aiming towards Hinckley.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 09 and the runway 09 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic south and west before turning it north leading to increased fuel burn and emissions. The track taken over southern Nottingham and southern Derby means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the west, north west and north departure envelopes which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity. The potential interaction with arrivals would impact the arrivals traffic flow, which again would not enable best use of runway capacity.

C20	S	P	C

Description: On departure from runway 09 this option proceeds north east, then initiates a wide right-hand turn to the east of Loughborough, before proceeding in a south westerly direction towards Market Bosworth.

<u>Programme</u>: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic north east before turning it south west leading to increased fuel burn and emissions. The track taken over south Nottingham means the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

<u>Continuity</u>: This option fails to align with this design principle, because it would interact with the east, west, north west, and north departure envelopes which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity.

D21	S	P	C

Description: On departure from runway 09 this option proceeds east until the A46 and then making a right-hand turn in a south westerly direction.

<u>Safety</u>: This option fails to align with this design principle, because it would exceed controlled airspace dimensions with no material benefit and come into conflict with parachute activity at Syerston.

<u>Programme</u>: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic east before turning it south west leading to increased fuel burn and emissions. Whilst the option avoids large towns and settlements, the track taken does not show a material benefit in comparison to other options.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

<u>Continuity</u>: This option may have a benefit in reducing the interaction with arrivals from the south (by gaining altitude to climb above the inbounds) but would create an interaction with the east departure envelope. This would limit the ability to achieve one minute departure splits and not enable best use of runway capacity.

11. SID Runway 09 – West

11.1. Introduction to 09 West Design Envelope

This is a new envelope created to provide traffic with the potential to route directly to the west, thereby avoiding additional track miles by routing north west or south west before turning west. Because this is a new envelope, there is no 'do minimum' option within the envelope.

At phase one engagement, two design envelopes were presented for runway 09 west: one routing to the north of the airport with a left turn, and one to the south with a right turn. However, negative stakeholder feedback and analysis of traffic to the south determined that this could adversely impact communities within that area, which are expected to be impacted by other envelopes carrying the greater share of EMA's traffic (southerly departures make up a large proportion of EMA traffic). Therefore, in line with the Sharing the Load design principle, consideration of the right turn routes was discontinued between the first and second phases of engagement.

Whilst there is a benefit to EMA departures in respect of the remaining routes, bilateral meetings with both NERL and BHX following Stage 2 stakeholder engagement identified potential interactions and misalignments to the NERL network for traffic routing in this direction.

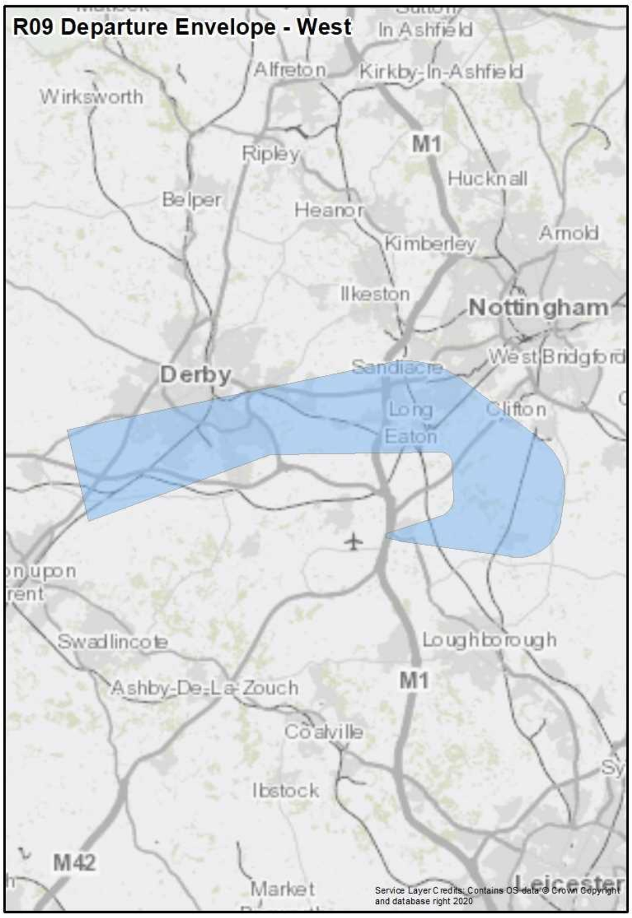
- BHX: Departures to the west create a potential interaction with flights to and from BHX to the west of Burton upon Trent. In particular these options may interact with arrivals from the CHASE hold, and arrivals that are being vectored in a left-hand pattern for runway 15 at BHX. Whilst BHX operations were identified as a constraint to EMA operations, this is not a published procedure but is used to create a more fuel efficient operation for their arrivals. Detailed design work is required with NERL and BHX to understand if safe separation exists or can be achieved through the modification of the EMA options in this area.
- NERL: The concept of FUA remains a strategic priority for NERL and is being pursued as part of initiatives that align to the AMS. However, as described in section 6.13e) the military primacy in danger areas/restricted areas will remain unchanged. In relation to these design envelopes, once above 7,000ft all departure options would be seeking a route through the network that is directly west. There is currently no network joining point in this area, and this would ultimately result in aircraft transiting the North Wales Military Training Area (NWMTA) and thereafter a number of Danger Areas in the vicinity of Cardigan Bay. Whilst neither are notified as H24, conversations will be required with NERL and the military to understand the viability of any routes in this area.

These interactions have also been highlighted in the EMA ACP HAZID as having potential safety implications which requires further analysis. However, this envelope and the design options have been retained within the DOR as part of the comprehensive list of options. Analysis on both aspects is outlined within the DPE and IOA, and further work to understand and resolve these issues will form part of detailed design work in Stage 3A.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient.

This letterbox is 4.5nm wide (2.25nm) and a minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

11.2. Design Envelope Location Map



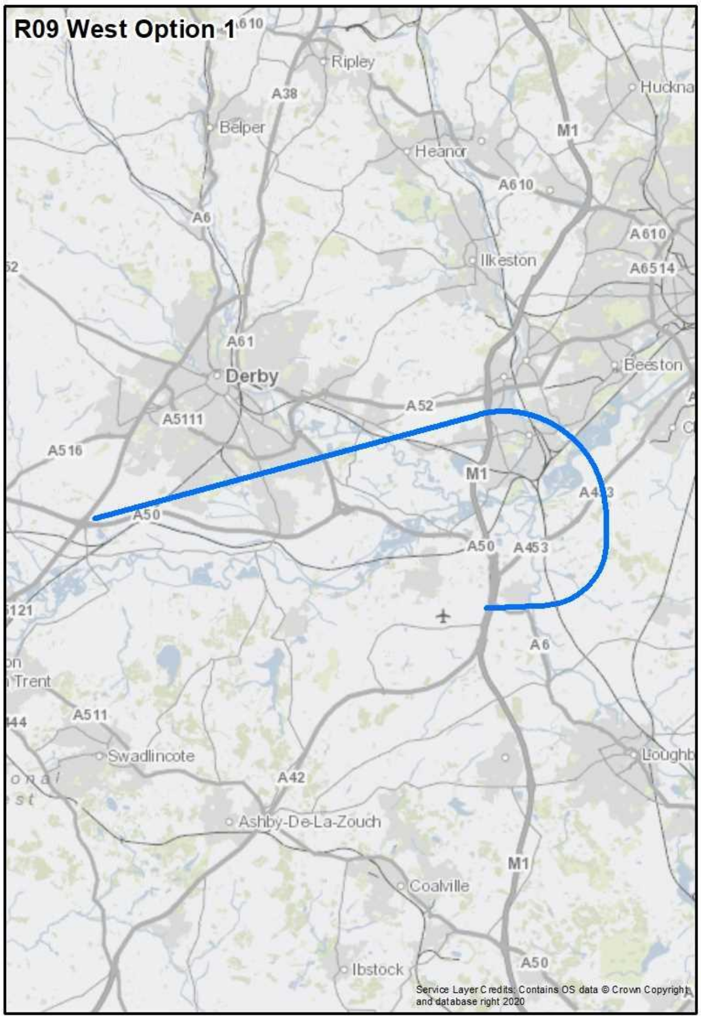
11.3. 09 West Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	A left-hand wrap-around which routes over southern Derby and terminates close to the junction between the A38 and A50.	A8	Extended runway heading before turning north and then west, terminating north of the junction between the A38 and A50. Option fails to align to: • Programme	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	A left-hand wrap-around which avoids Derby and terminates at the southern edge of the design envelope.	B9	This proceeds in a north easterly direction before initiating a gradual left-hand wrap-around turn to the east and north of Nottingham and then south west. Option fails to align to:		

			• Safety • Programme		
3	A left-hand wrap-around which routes over southern Derby but terminates close to Burnaston to the north of the design envelope.	C10	An immediate left turn to the north proceeding over Nottingham, before turning west and the south west over Derby. Option fails to align to: • Programme • Continuity		
4	A 10° southerly offset with a delayed turn north then west and terminating over southern Derby.				
5	A 10° southerly offset with an early turn north then west and terminating just south of Derby.				
6	A 10° southerly offset with an early turn north, and then west earlier than options 4 or 5, and terminating at the southern edge of the design envelope.				
7	A 10° southerly offset for 4.2Nm, before turning north then west, and terminating over southern Derby.				

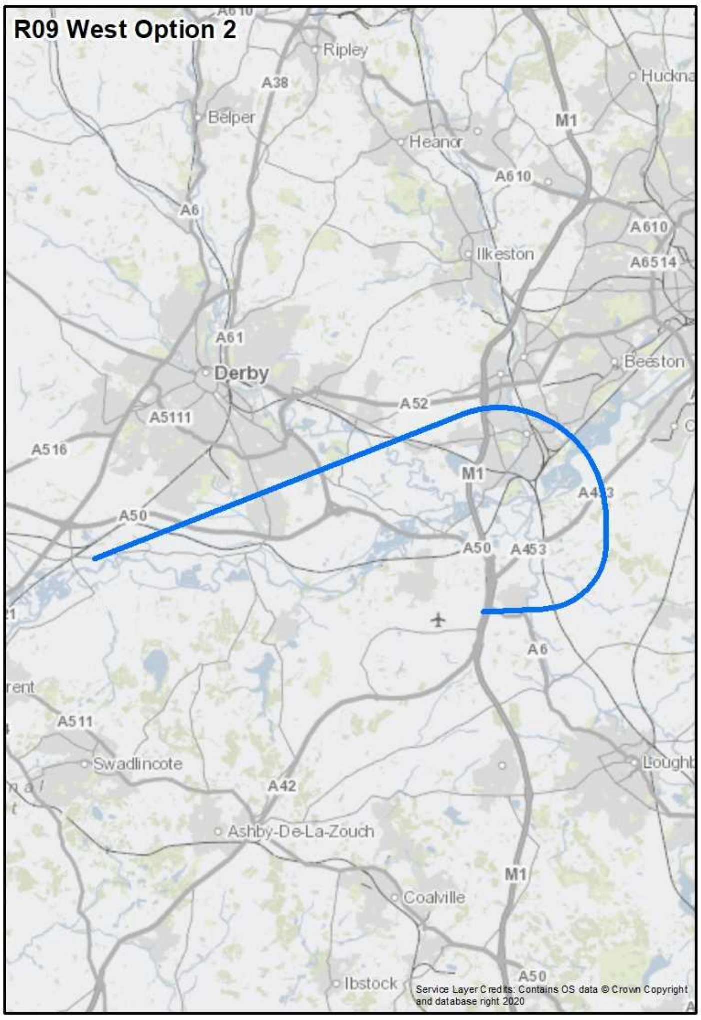
11.4. Runway 09 West Option 1

Description	Reason for inclusion
Option 1 proceeds straight ahead after take-off with no offset and then turns north then west. The route overflies the southern edge of Kegworth, before making a 90° turn to the north at 1.4nm past the DER, passing between the Ratcliffe on Soar power station and Clifton. It then turns left as tightly as permitted by CAP 778, passing over Long Eaton and the Toton rail depot to achieve a westerly heading before routing over south Deby and terminating close to the junction between the A38 and A50, south west of Findern. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



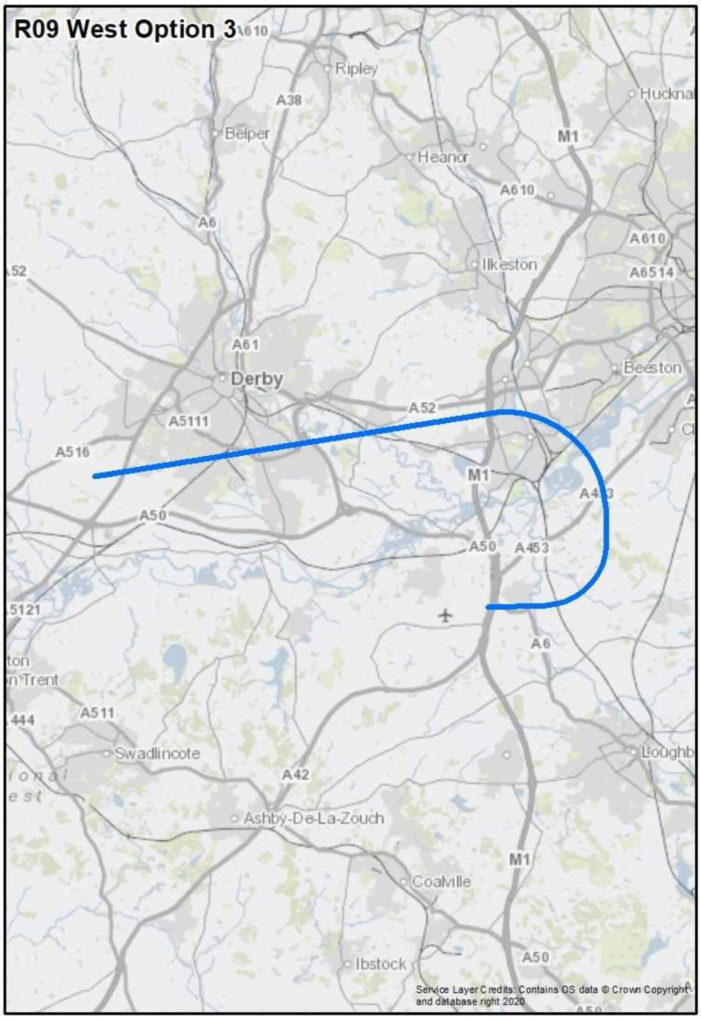
11.5. Runway 09 West Option 2

Description	Reason for inclusion
Option 2 proceeds straight ahead after take-off with no offset and then turns north then west. It is similar to Option 1 until crossing the M1 just south of Junction 25 from where it takes a more southerly route. The route overflies the southern edge of Kegworth, before making a 90° turn to the north at 1.4nm past the DER, passing between the Ratcliffe on Soar power station and Clifton. It then turns left as tightly as permitted by CAP 778, passing over Long Eaton and the Toton rail depot to achieve a westerly heading before just south of Derby and terminating south west of Findern. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Noise N3:** The more southerly track provides a route that avoids overflight of Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



11.6. Runway 09 West Option 3

Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset and then turns north then west. It is similar to Option 1 until crossing the M1 just south of Junction 25 from where it takes a more northerly route. The route overflies the southern edge of Kegworth, before making a 90° turn to the north at 1.4nm past the DER, passing between the Ratcliffe on Soar power station and Clifton. It then turns left as tightly as permitted by CAP 778, passing over Long Eaton and the Toton rail depot to achieve a westerly heading passing over Derby and terminating close to Etwall, approximately 1nm further north of Option 1. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

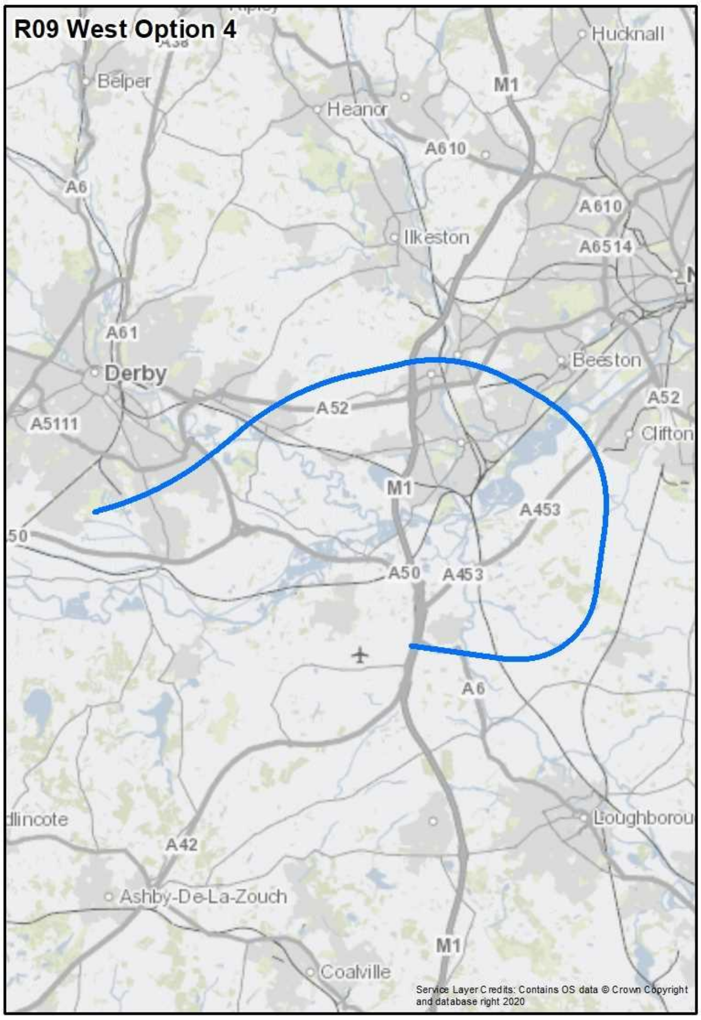


11.7. Runway 09 West Option 4

Description

Option 4 has a 10° southerly offset and has a delayed first turn in comparison to other options, which results in a wide track over southern Nottingham.

The initial 10° offset to the south results in the route, passing south of Kegworth which is maintained for 2nm beyond the DER before commencing a left turn to the north. Once on a northerly heading the route passes close to Clifton before commencing a wide left turn north of Long Eaton, passing over Stapleford, before achieving more south westerly heading. The route terminates close to the south of Derby, near to Sinfin.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations.

Noise N2: Overflies the south west edge of Nottingham which is expected to have higher level of ambient noise.

Noise N3: A 10° southerly offset to reduce the impact on communities close to the extended runway centreline and to avoid Kegworth.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

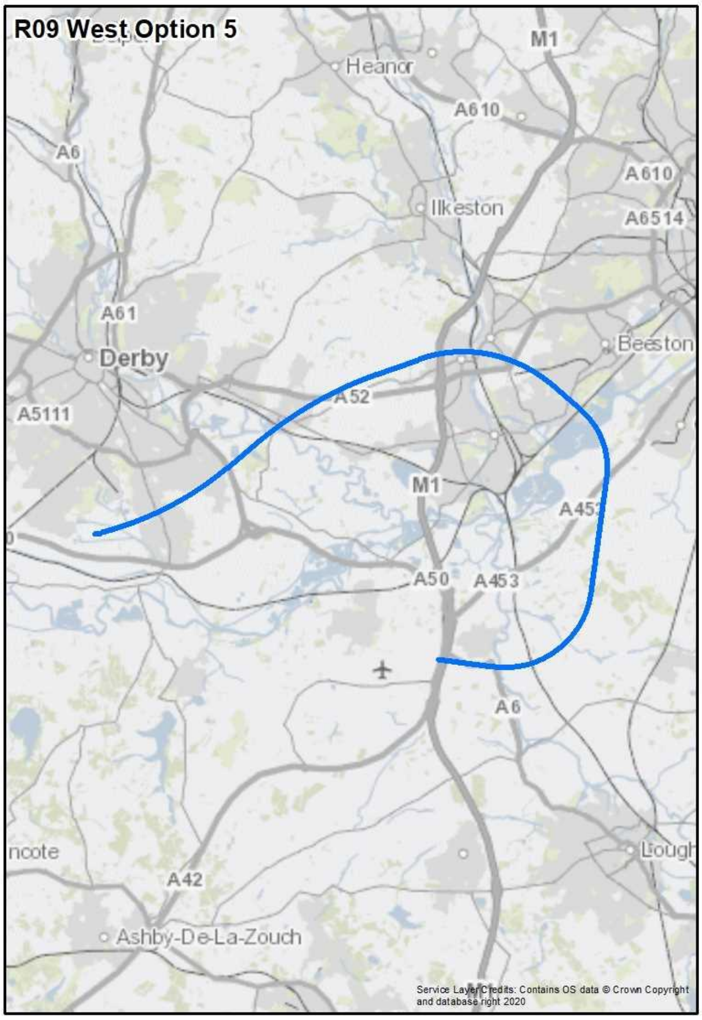
11.8. Runway 09 West Option 5

Description

Option 5 has a 10° southerly offset but with an earlier and tighter first turn than Option 1 which results in a track closer to Long Eaton.

The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the north commencing at 1nm beyond the DOR. Once on a northerly heading the route passes between the Ratcliffe on Soar power station and Clifton before commencing a left turn just east of Long Eaton, passing over Stapleford, before achieving more south westerly heading. The route terminates close to the south of Derby and south of Sinfin.

The initial two turns have been limited to 190KIAS to enable the tightest turns possible. The route is PANS-OPS compliant, but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.



Reason for inclusion

Continuity: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations.

Emissions: Designed with an early initial turn to help minimise the track length and fuel burn.

Noise N3: A 10° southerly offset aims to reduce the impact on communities close to the extended runway centreline and to avoid Kegworth.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

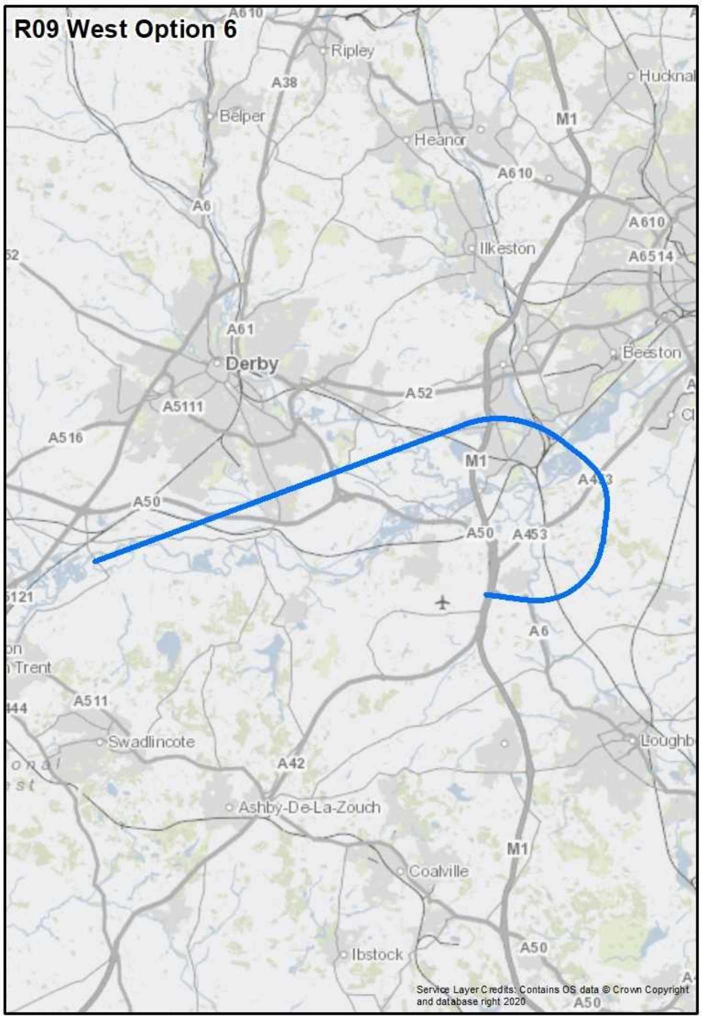
11.9. Runway 09 West Option 6

Description

Option 6 has a 10° southerly offset with the same tighter first turn as Option 5 but using multiple turns to create a route aimed at reducing noise impact.

The initial 10° offset to the south results in the route, passing south of Kegworth with the first turn to the north at 1nm beyond the DOR. It passes between the Ratcliffe on Soar power station and Clifton before commencing a second left turn before Long Eaton and a third shortly after to head in a south westerly direction. The route terminates between Willington and Repton to the south of the junction between the A38 and A50.

The initial two turns have been limited to 190KIAS to enable the tightest turns possible. The route is PANS-OPS compliant, but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations.

Emission: The shortest track length of the West options.

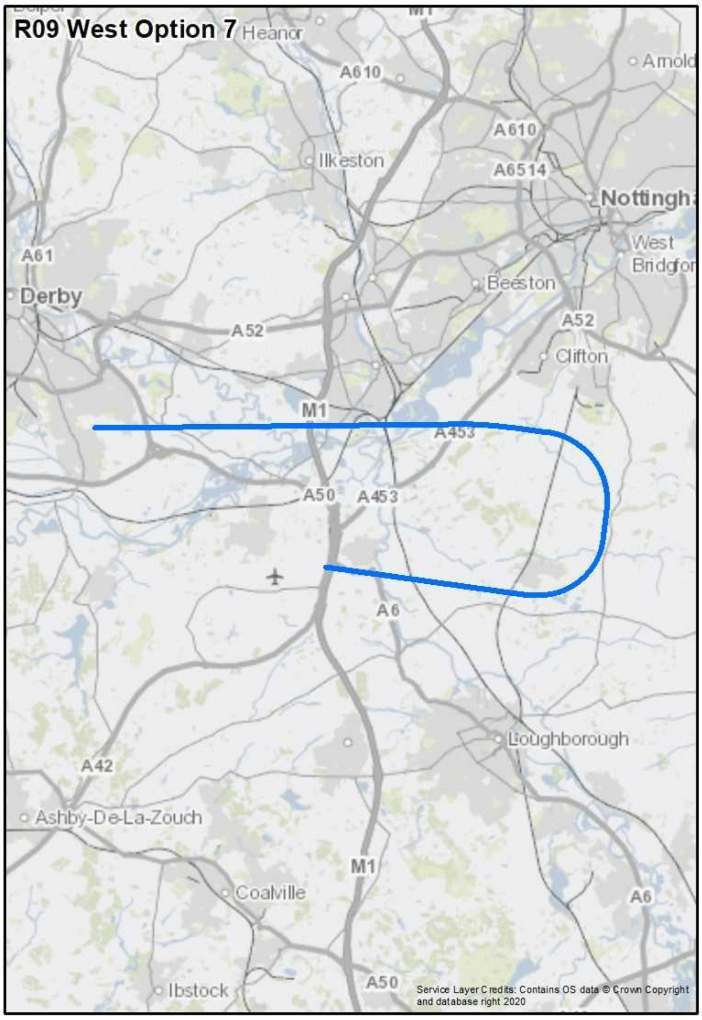
Noise N3: A 10° southerly offset aims to reduce the impact on communities close to the extended runway centreline and to avoid Kegworth.

Aims to reduce the impact of noise by routing south of Derby.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

11.10. Runway 09 West Option 7

Description	Reason for inclusion
Option 7 has a 10° southerly offset but with an extended route east initially to help avoid the overflight of major urban areas. This option commences with a 10° offset from the runway heading passing to the south of Kegworth which is maintained for an extended distance of 4.2nm. Once past East Leake it makes a 90° left turn to the to the north and runs parallel to the A60 before commencing a second 90° left turn to achieve a westerly heading and passing just to the south of Long Eaton. The route terminates to the south east of Derby in the vicinity of Boulton Moor. The route does manage but to achieve avoid the overflight of major urban areas but the initial easterly track is extended and the initial two turns have been limited to 190KIAS to enable the tightest turns possible. The route is PANS-OPS compliant, but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	**Noise N3:** A 10° southerly offset aims to reduce the impact on communities close to the extended runway centreline and to avoid Kegworth. An extended track to the east before turning to gain a westerly heading, aiming to gain altitude and reduce noise impact. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



11.11. Runway 09 West Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A8	S	P	C

Description: On departure from runway 09 this option proceeds in an easterly direction to turn left prior to crossing the A46 and heading in a northerly direction. A second left turn around Nottingham City Airport and heading in a west-south west direction to the SID aiming point.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment*: This option would involve greater track mileage than is necessary by taking traffic east and north before turning west leading to increased fuel burn and emissions. The track taken over central Nottingham means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Option	Safety	Programme	Continuity
B9	S	P	C

Description: On departure from runway 09 this option proceeds in a north easterly direction before initiating a gradual left-hand wrap-around turn, to the east and north of Nottingham, before continuing in a south westerly direction, north of Derby, towards the SID aiming point.

Safety: This option fails to align with this design principle, because it may exceed controlled airspace and come into conflict with parachute activity at Syerston.

Programme: This option fails to align with the integration and environmental ends of the AMS.

> *Integration*: This option may require additional airspace to mitigate the safety risk of operating at the boundary of Class G airspace. There is an expectation that this additional airspace would be required 24x7 and therefore would adversely impact other airspace users, including GA traffic and parachute activity at Syerston.
>
> *Environment*: This option would involve greater track mileage than is necessary by taking traffic north east before turning it east leading to increased fuel burn and emissions. The track taken avoids central Nottingham which may result in some noise benefit in comparison to other options.

Trade-offs: Whilst there may be a benefit in the number of people impacted by noise, the resultant safety impact, requirement for additional CAS, impact on GA and parachute operations at Syerston and additional fuel burn and emissions mean there is no trade-off to be made to justify an amber rating.

C10	S	P	C

Description: On departure from runway 09 this option makes a 90-degree left-hand turn, proceeding north over Nottingham, before conducting a second 90-degree left-hand turn to a westerly direction. The option then initiates a gradual left turn to a south westerly heading to pass over north west Derby.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic north before turning it west leading to increased fuel burn and emissions. The track taken over central Nottingham and Derby means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the north departure envelope which would limit the ability to achieve one minute departure splits and not enable best use of runway capacity.

12. SID Runway 27 – East

12.1. Introduction to 27 East Design Envelope

This envelope has been created for traffic routing to the east from runway 27, without initially routing to the south via the DTY SID which is a requirement of current operations. The creation of this envelope was identified through airline stakeholder requests for a more direct route than that currently published. Although this direct route is sometimes provided to EMA flights by the NATS upper airspace network at night, this is only on an 'on request' basis and aircraft are required to flight plan and fuel for the longer route via the south east.

By providing this as a flight plannable route, track length and fuel burn will be significantly reduced in line with the Design Principle Emissions but the implementation of this will require additional Controlled Airspace (CAS) to the east above 7,000ft.

As a result of this potential benefit, and because of their responsibility for creating this airspace, NERL have led engagement conversations with impacted stakeholders including the military and the GA community on the concepts being proposed for this additional CAS to permit departures to the east. These include discussions on the operating hours and the horizontal and vertical dimensions of this airspace to ensure safety for both commercial and non-commercial aviation is assured.

Any proposed changes to either the use or hours of this airspace will be included in coordinated consultation activities between EMA and NERL in Stage 3. Suitable design options that are developed through this process will then be consulted upon more widely in Stage 3 if pursued by EMA. Whilst NERL will be responsible for formal consultation with impacted stakeholders above 7,000ft, the responsibility will remain with EMA where any proposed departure or arrivals routes pass through any volume of new airspace below 7,000ft.

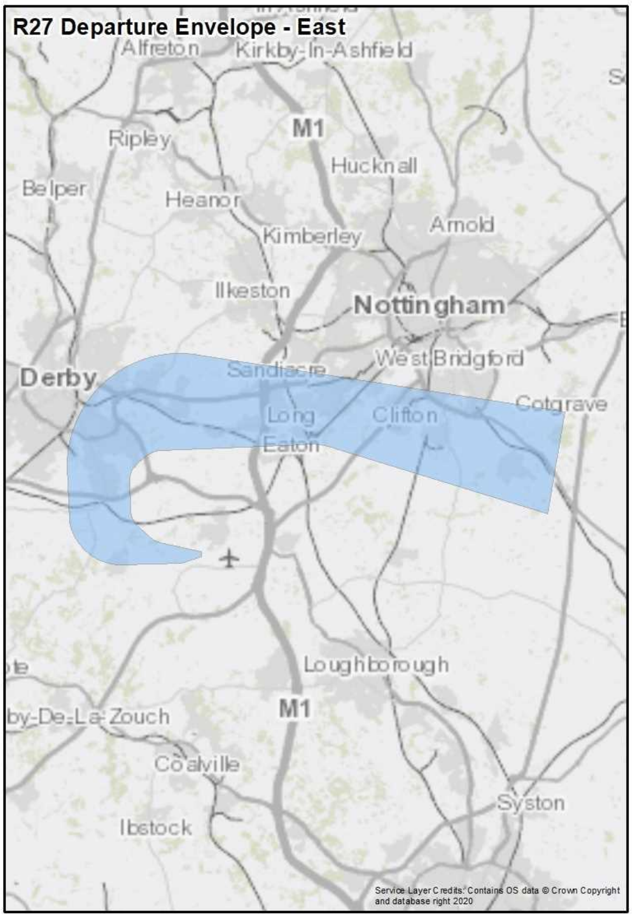
However, at this early stage of the process there is uncertainty as to the exact position of this airspace and any joining points, therefore there is a requirement to maintain flexibility in the proposed options. These options are therefore retained in this comprehensive list of options to be carried forward for analysis in the DPE and IOA.

The original intention was to have two design envelopes for runway 27 east: one routing to the north of the airport with a right turn, and one to the south with a left turn. However, stakeholder feedback and analysis of traffic to the south determined that this could adversely impact communities within that area, which are expected to be impacted by other envelopes carrying the greater share of EMA's traffic (southerly departures make up a large proportion of EMA traffic). Therefore, in line with the Sharing the Load design principle, the left turn routes to the south were discontinued between the first and second phases of engagement.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft.

This letterbox is 4.5 nm wide (2.25nm either side of the nominal track) and a minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

12.2. Design Envelope Location Map



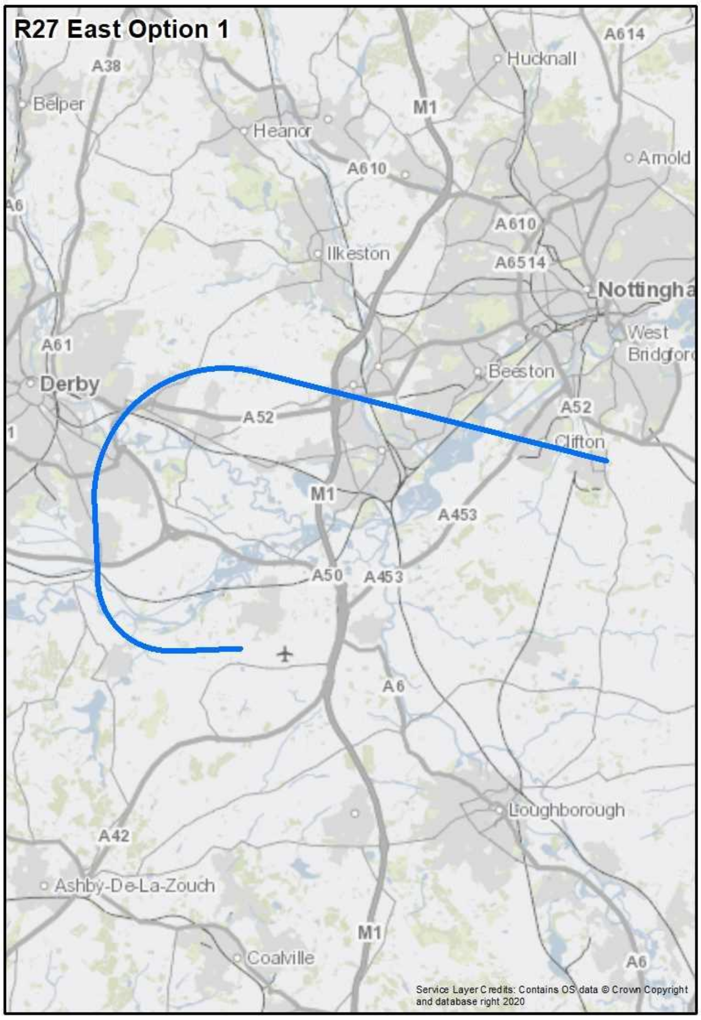
12.3. 27 East Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	An RNAV1 right-hand wrap-around route without an offset that flies over east Derby before turning east over Long Eaton.	A7	An extended departure to the west before turning north and then west to pass to the north of Derby. Option partially aligns to: • Programme Option fails to align to: • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	An RNAV1 right-hand wrap-around route without an offset over east Derby in the same way as option 1 but terminating slightly further south	B8	An immediate turn north and then west once north of Derby. Option fails to align to: • Programme • Continuity		

3	An RNAV1 right-hand wrap-around route without an offset over east Derby in the same way as option 1 but with a more northerly heading, terminating north of Ruddington.				
4	A single 180° continuous right turn based upon RNP1 with RF criteria terminating just east of Ruddington.				
5	A tight RNAV1 right-hand wrap-around terminating to the south east of Nottingham.				
6	A 15° northerly offset for 1.3nm prior to two RNAV1 right-hand turns forming a wrap-around terminating south east of Nottingham.				

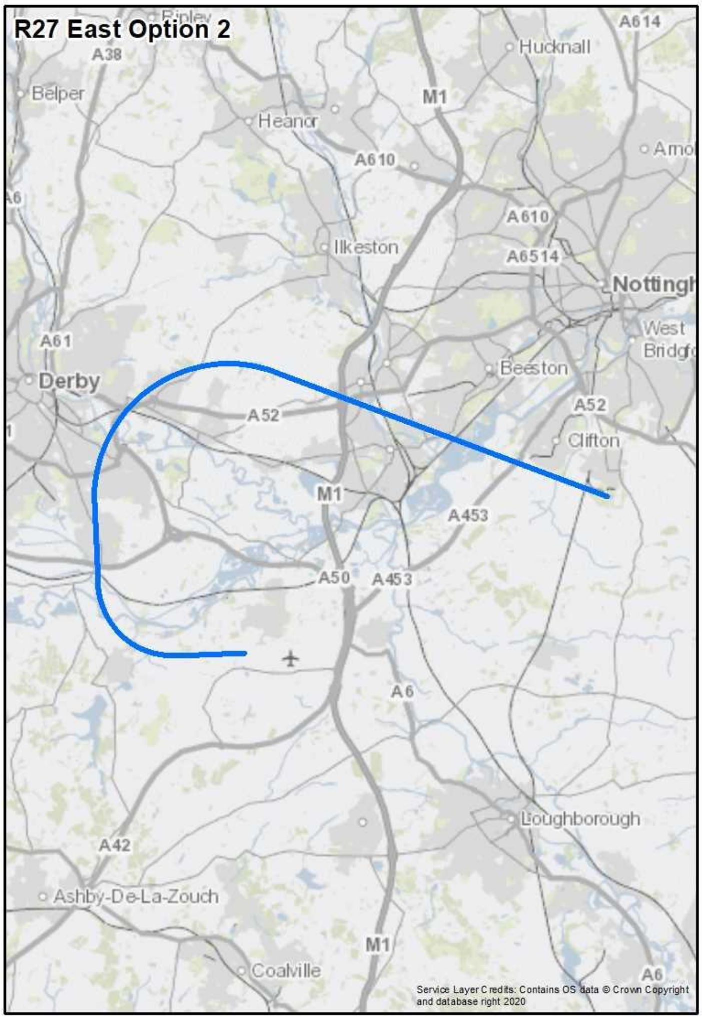
12.4. Runway 27 East Option 1

Description	Reason for inclusion
Option 1 proceeds straight ahead after take-off with no offset before making two right-hand turns to head east. The route follows a runway heading for 1.4nm before initiating a 90° right turn to the north just to the north east of Melbourne. The option then routes over south east Derby before commencing a second right turn to achieve an east-south east heading, terminating just to the east of Ruddington on the southern edge of Nottingham. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID to the east when on westerly operations. **Emissions:** A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



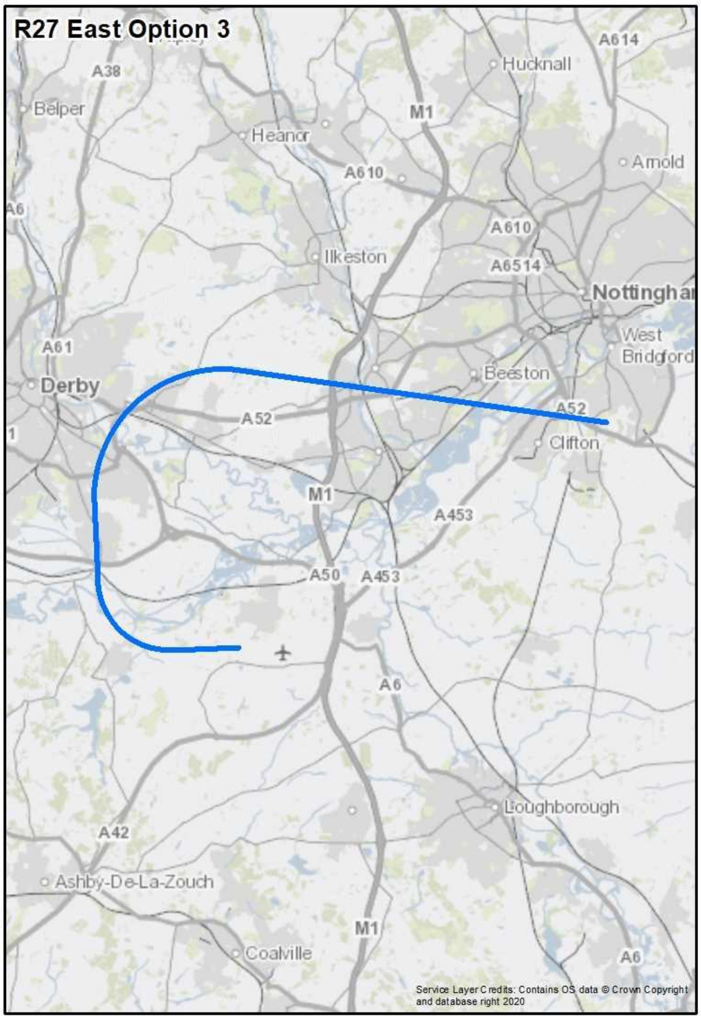
12.5. Runway 27 East Option 2

Description	Reason for inclusion
Option 2 proceeds straight ahead after take-off with no offset before making two right-hand turns to head east. It is similar to Option 1 but terminates slightly further south. The route follows a runway heading for 1.4nm before initiating a 90° right turn to the north just to the north east of Melbourne. The option then routes over south east Derby before commencing a second right turn to achieve an east-south east heading, terminating just to the south of Ruddington. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID to the east when on westerly operations. **Emissions**: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Noise N1**: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Technology**: RNAV is the lowest PBN specification and therefore usable by all aircraft.



12.6. Runway 27 East Option 3

Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset before making two right-hand turns to head east. It is similar to Option 1 but terminates slightly further north. The route follows a runway heading for 1.4nm before initiating a 90° right turn to the north just to the north east of Melbourne. The option then routes over south east Derby before commencing a second right turn to achieve an east-south east heading, terminating just to the south of Ruddington. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID to the east when on westerly operations. Routed further north than some options to reduce interaction with arrivals. **Emissions**: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Noise N1**: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Technology**: RNAV is the lowest PBN specification and therefore usable by all aircraft.



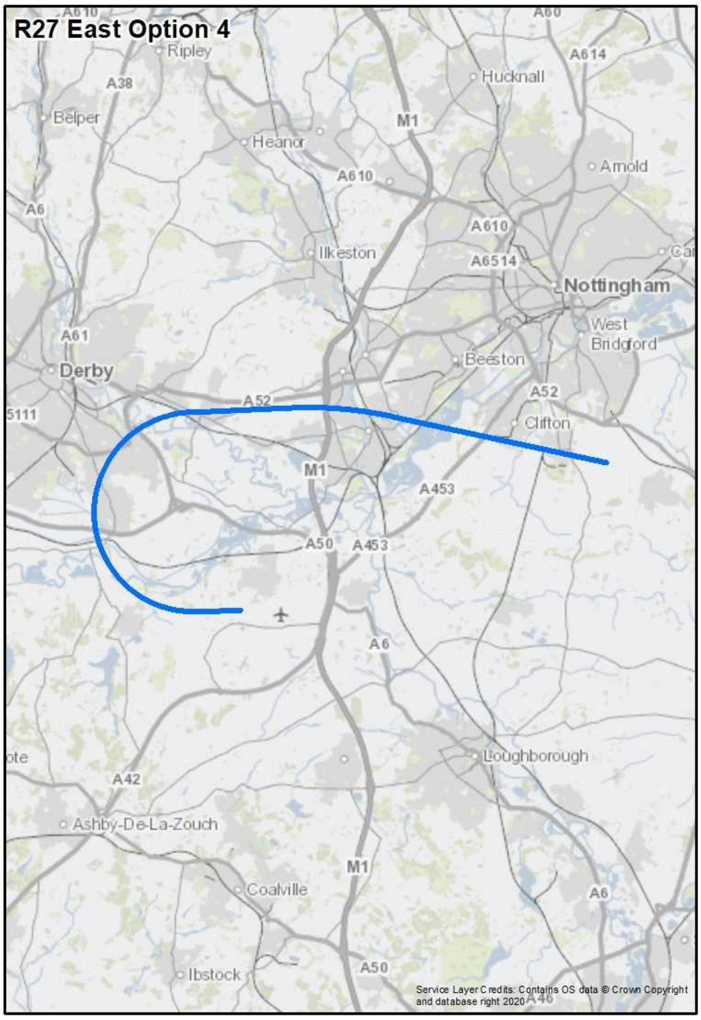
12.7. Runway 27 East Option 4

Description

Option 4 differs to the majority of options in that it is a RNP1 departure using RF turns, rather than RNAV1 with fly-by waypoints. It was created to offer an alternative option to see if an RF turn could minimise the impact of noise on Derby. It proceeds straight ahead after take-off with no offset, and then makes a single right turn to head east.

The initial departure is along the extended runway centreline for 1nm prior to commencing a 180° RF turn to achieve an east heading. This minimises the overflight of south east Derby and the route then continues east with a small right turn to the north of Long Eaton to terminate to the east of Ruddington.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations.

Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving.

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

Noise N3: Designed as an RNP departure using RF turn to deliver a track that minimises the overflight of Derby.

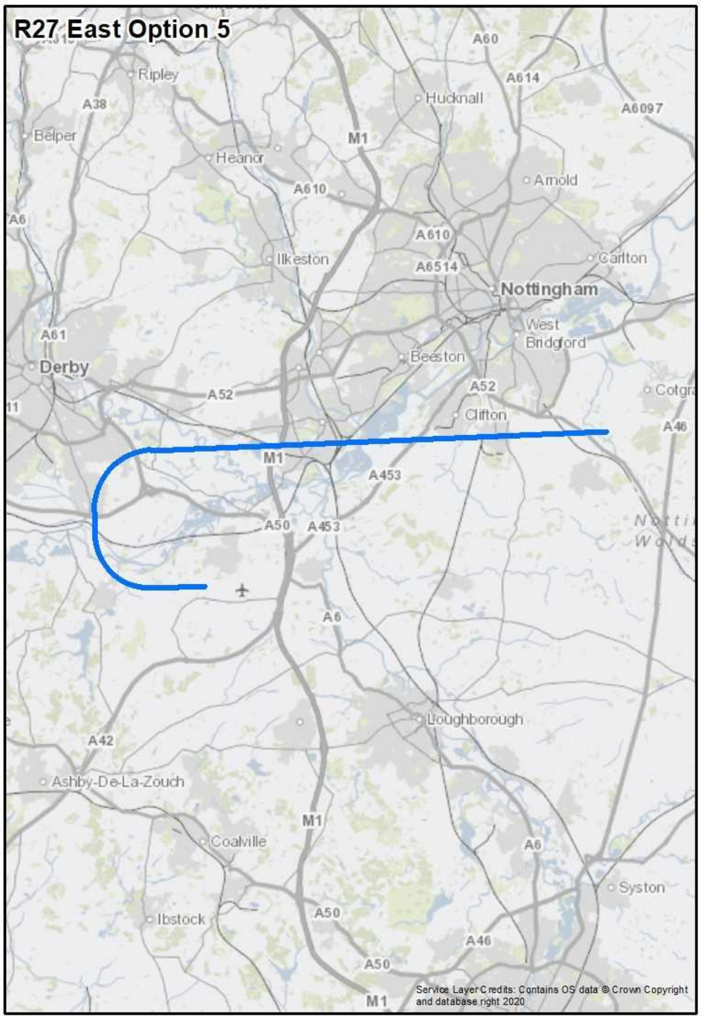
12.8. Runway 27 East Option 5

Description

Option 5 is a tight RNAV1 right-hand wrap-around with no offset, which has been created to see if a combination of RNAV1 turns could minimise the impact of noise on Derby. This is achieved by applying a 200KIAS speed restriction to achieve tighter turns than if the CAP 778 recommended 210KIAS was to be applied.

The route follows a runway heading for 1.4nm before initiating a 90° right turn to the north, restricted to 200KIAS, to achieve a northerly heading. A second 90° turn, also restricted to 200KIAS, commences just as the route crosses the A50 south of Derby and results in a direct track east over Long Eaton and Ruddington to terminate south east of Nottingham.

The 200KIAS turns are PANS-OPS compliant but should this become a preferred option then it should be assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations.

Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving.

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

Noise N3: The speed restriction and tighter turns aim to reduce the impact of noise by routing south of Derby.

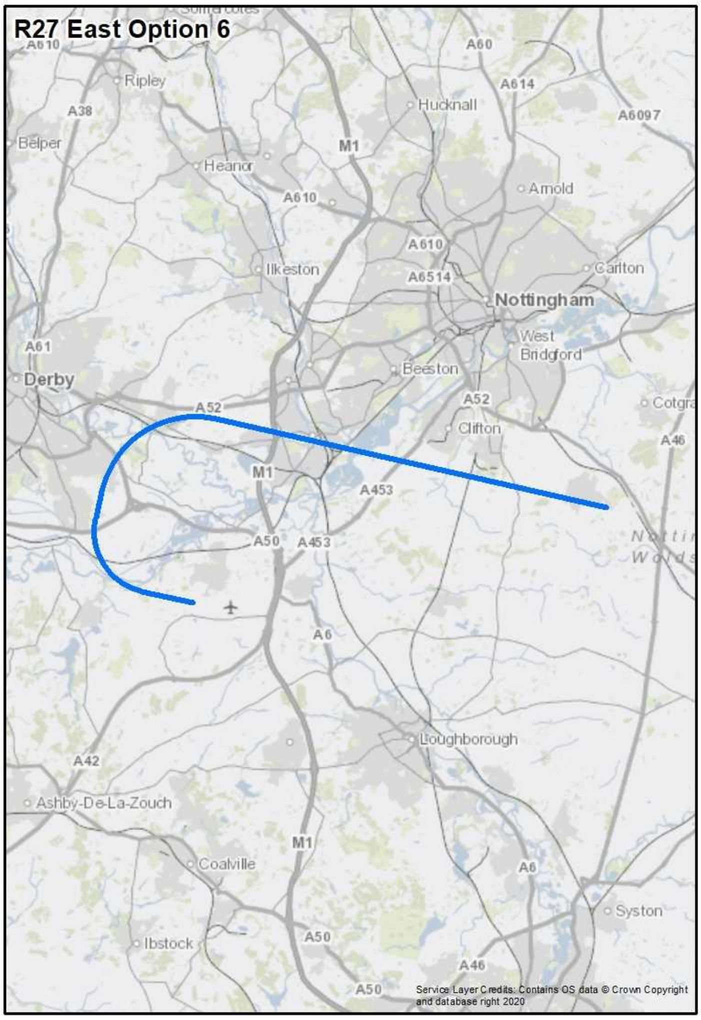
12.9. Runway 27 East Option 6

Description

Option 6 is responding to stakeholder feedback to use the maximum 15° northerly offset to reduce the impact of noise on Melbourne.

The initial 15° offset to the north results in the route passing north of Melbourne with the first 90° turn to the north at 1.3nm beyond the DER. The route makes a second 90° right turn shortly after to achieve an easterly heading. The route avoids all but the very eastern edges of Derby before overflying Long Eaton and terminating to the south east of Keyworth.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations.

Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving.

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

Noise N3: A 15° northerly offset to avoid overflight of communities close to the extended runway centreline, in particular Melbourne in response to stakeholder feedback.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

12.10. Runway 27 East Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A7	S	P	C

Description: This option departs runway 27 in a westerly direction for approximately 7nm in order to avoid Derby. It turns right before Burton upon Trent, proceeding in a northerly direction to the west of Derby, then turning right onto an easterly course to the north of Derby.

Programme: This option partially fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic a significant distance west turning it east leading to increased fuel burn and emissions. However, there may be some reduction in the number of people impacted by noise below 4,000ft.

Trade-offs: There may be a material benefit in the number of people impacted by noise which is a potential trade-off for the increased emissions. This option has therefore been rated as amber.

Continuity: This option fails to align with this design principle, because it would have a significant interaction with all options within the north west departure envelope which would increase delays for these flights and not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B8	S	P	C

Description: This option initiates an immediate right turn north and continues over Derby for approximately 8nm before turning right onto an easterly course near Ilkeston.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic north before turning it east leading to increased fuel burn and emissions. The track taken over Derby means that the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with all options within the north west departure envelope. In addition, it is likely to interact with arrivals to runway 27 from the north.

13. SID Runway 27 – North

13.1. Introduction to 27 North Design Envelope

This is a new envelope that has been created for traffic routing to the north from runway 27. At present, all north bound departures from EMA use the Trent (TNT) 2N towards the north west initially and are then vectored to the north by ATC once they are within the NATS upper airspace network. This envelope creates the option for a more direct and flight plannable route to the north.

Because this is a new envelope, there is no 'do minimum' option, but the current operational practice of using the TNT 2N SID followed by ATC vectoring is reflected in Option 1.

The remaining options have been designed to align with the current Pole Hill (POL 2P) departure that is currently available from runway 09 only. This is in line with the design principle for Sharing the Load (Noise N1).

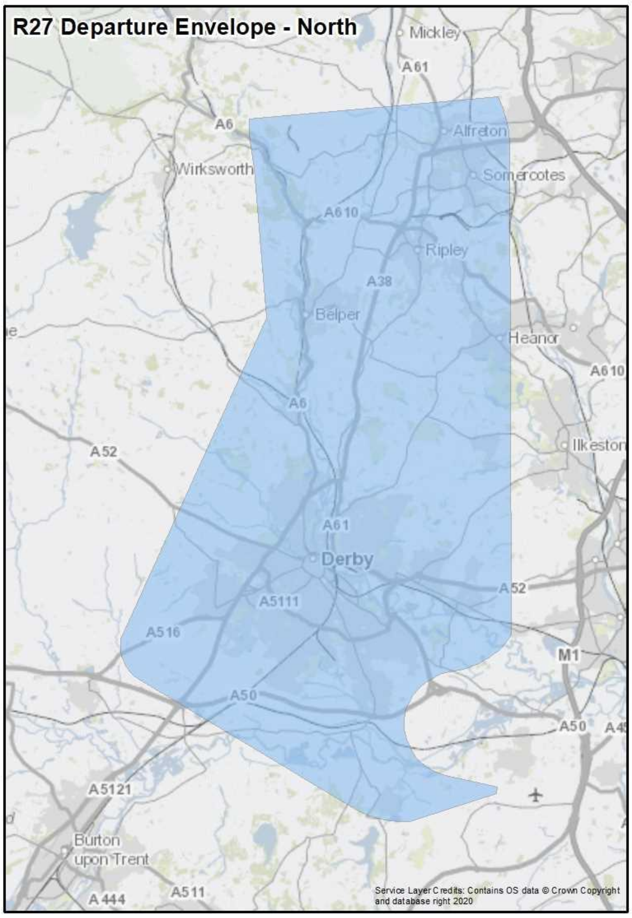
The creation of routes within this envelope also need to take into consideration the ability of routes in this north envelope to:

- Integrate with the NATS upper airspace network, in particular the placement of the airborne hold (above 7,000ft) to the north. This is currently at ROKUP to the north of Derby and west of Belper, but NATS design work and simulations are investigating the most safe and efficient position of this for the future, taking into account the network traffic flows for other airports in the MTMA and to the and from the south.
- Resolve interactions with inbounds to EMA from the north, whilst maintaining a continuous climb departure for fuel and noise purposes.

Discussions in relation to both these areas will form part of detailed design discussions in Stage 3.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft. They terminate at a letterbox that is centred on a track towards the POL DVOR and is 4.5nm wide (2.25nm either side of the nominal track). A minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

13.2. Design Envelope Location Map



13.3. 27 North Option Summary Table

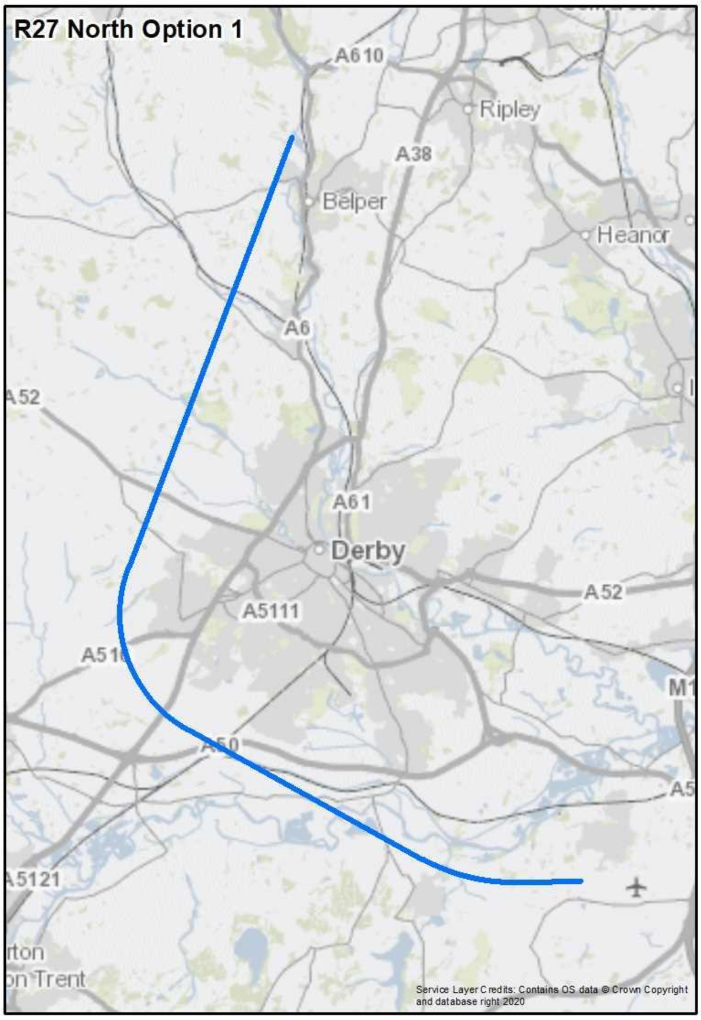
Viable and Good Fit		Viable but Poor Fit		Unviable	
1	This route reflects the current operational practice of using the TNT 2N SID followed by ATC vectoring. It passes to the west of Derby on a track that is initially similar to the current TNT departure and terminates north of Belper.	A9	An immediate left-hand wrap-around to the south of EMA before routing north between Derby and Nottingham. Option fails to align to: • Safety • Continuity Option partially aligns to • Programme.	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	Right turn to track north passing over eastern Derby, east of Belper and terminating north east of Crich.	B10	An extended north west departure before turning north east. Option fails to align to: • Programme • Continuity		

3	Right turn to track over central Derby, passing west of Belper and terminating west of Crich.	C11	An extended west departure, turning north just to the north east of Burton upon Trent. Turning north east between Derby and Ashbourne. Option fails to align to: • Programme • Continuity		
4	Right turn to pass over eastern Derby, terminating near Alfreton.	D12	Initially departing south west before turning north to pass over Burton upon Trent. Turning north east between Derby and Ashbourne. Option fails to align to: • Programme • Continuity		
5	Designed to avoid central Derby with a 15° northerly offset it takes a curved route east of Derby and Borrowash terminating north west-north of Belper.	E13	Two right-hand turns onto a north easterly heading. Turning north westerly once over north west Nottingham. Option fails to align to: • Programme • Continuity		
6	Designed to avoid central Derby with a 15° northerly offset it takes a curved route east of Derby and between Spondon and Borrowash, terminating north of Belper.				
7	A right turn route with a 15° northerly offset designed to pass between Derby and Nottingham. It passes west of Ilkeston and terminates south east of the M1 junction 28.				

8	Initial 15° northerly offset, followed by a right turn, passing east of Derby and between Spondon and Borrowash, terminating over Alfreton.				

13.4. Runway 27 North Option 1

Description	Reason for inclusion
Whilst this is not a replicated route, it reflects the current operational practice of initially using the TNT 2N SID to the north west followed by ATC vectoring to the north. This follows the runway heading for 1nm before commencing a right turn just to the north east of Melbourne, onto a north west heading to pass to the south west of Derby. A second right turn diverges it from the TNT departure and routes it on a north by north east heading to the terminating point north of Belper. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: Routes further to the west than other northerly options to reduce potential interaction with arrivals from the north. **Noise N3:** Aims to reduce the impact of noise by avoiding Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



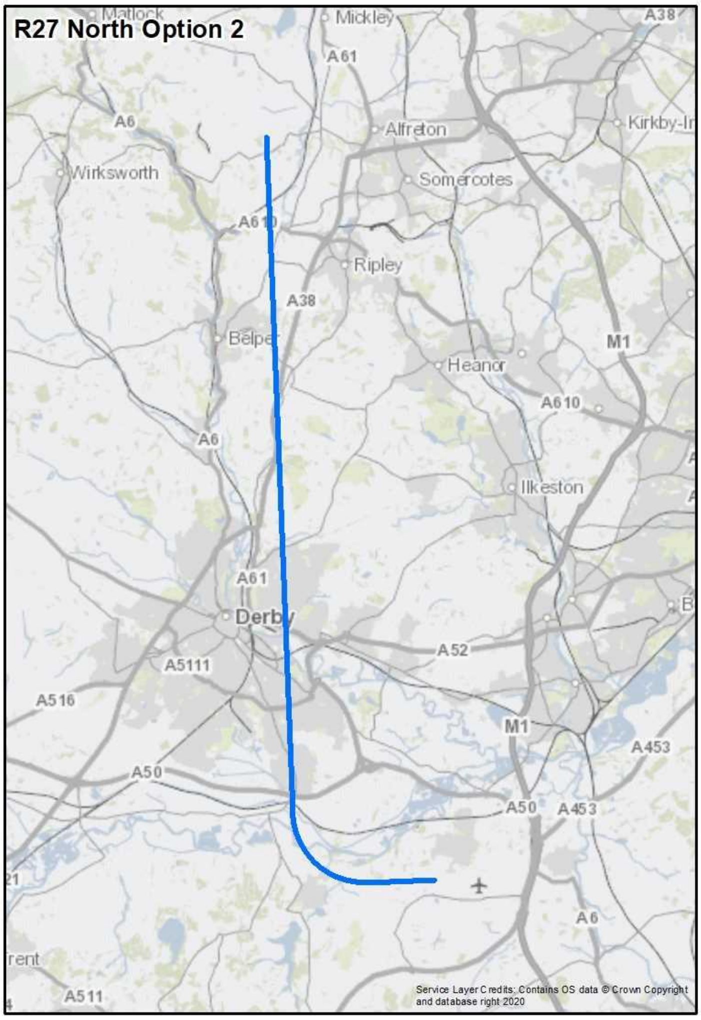
13.5. Runway 27 North Option 2

Description

Option 2 proceeds straight ahead after take-off with no offset before making a single right turn to head directly north.

After initial departure this option follows the runway heading for 1.4nm before commencing a 90° right turn to the north just to the north east of Melbourne. This north heading routes it over eastern Derby and the east edge of Belper and the route terminates to the north east of Crich.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Emissions: The shortest track length to join the network (compared to the current operational practice) is intended to minimise the fuel burn and emissions.

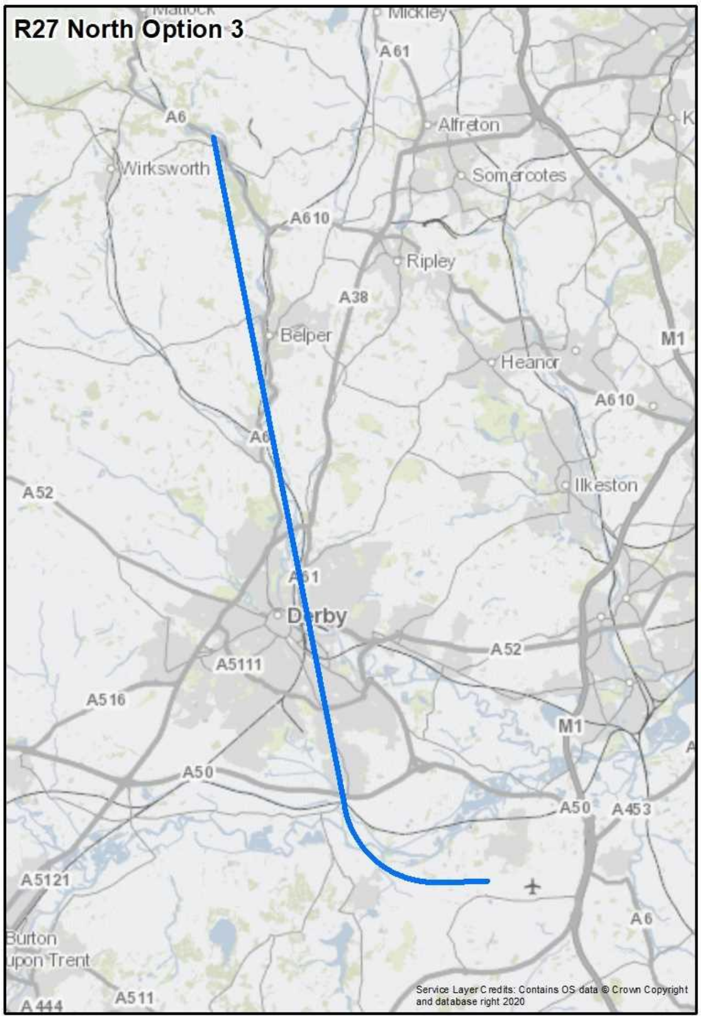
Continuity: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations.

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

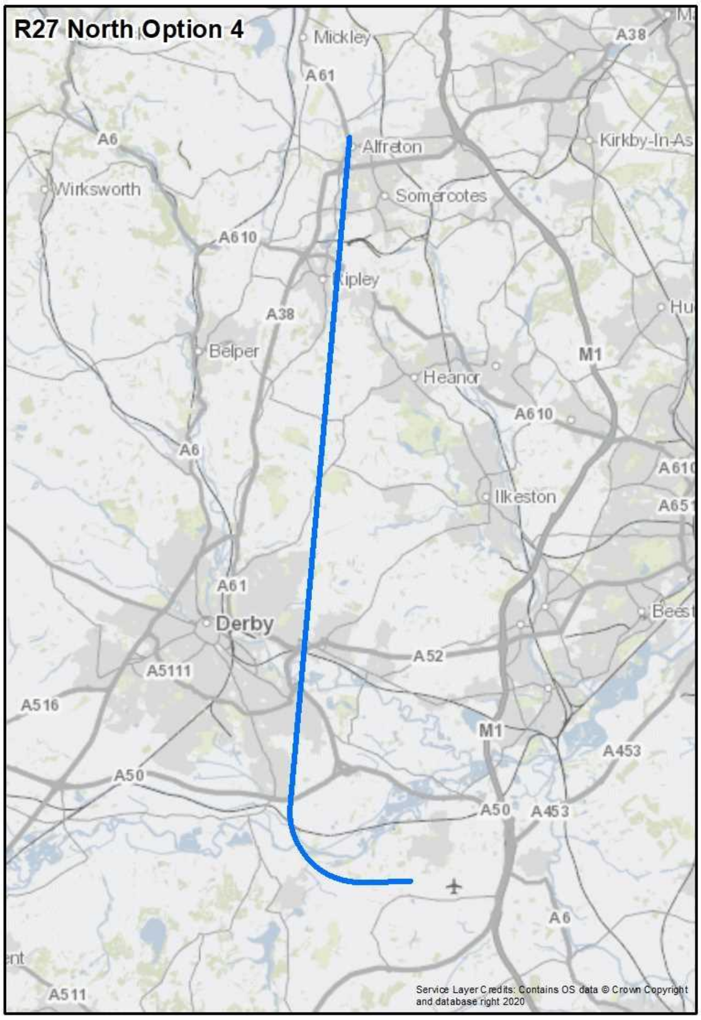
Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

13.6. Runway 27 North Option 3

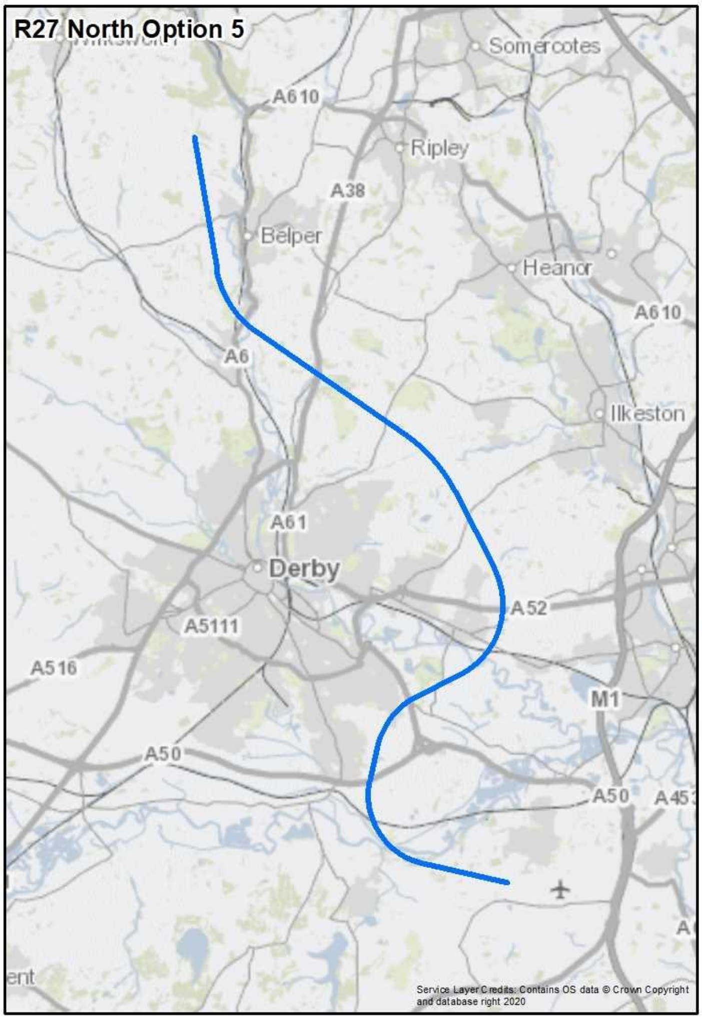
Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset before making a single right turn to head north, but on a track that is slightly to the west of Option 2. After initial departure this option follows the runway heading for 1nm before commencing a right turn north just to the north east of Melbourne. This north heading routes it over central Derby and the west edge of Belper and the route terminates to the north west of Crich. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Continuity**: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations. **Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



13.7. Runway 27 North Option 4

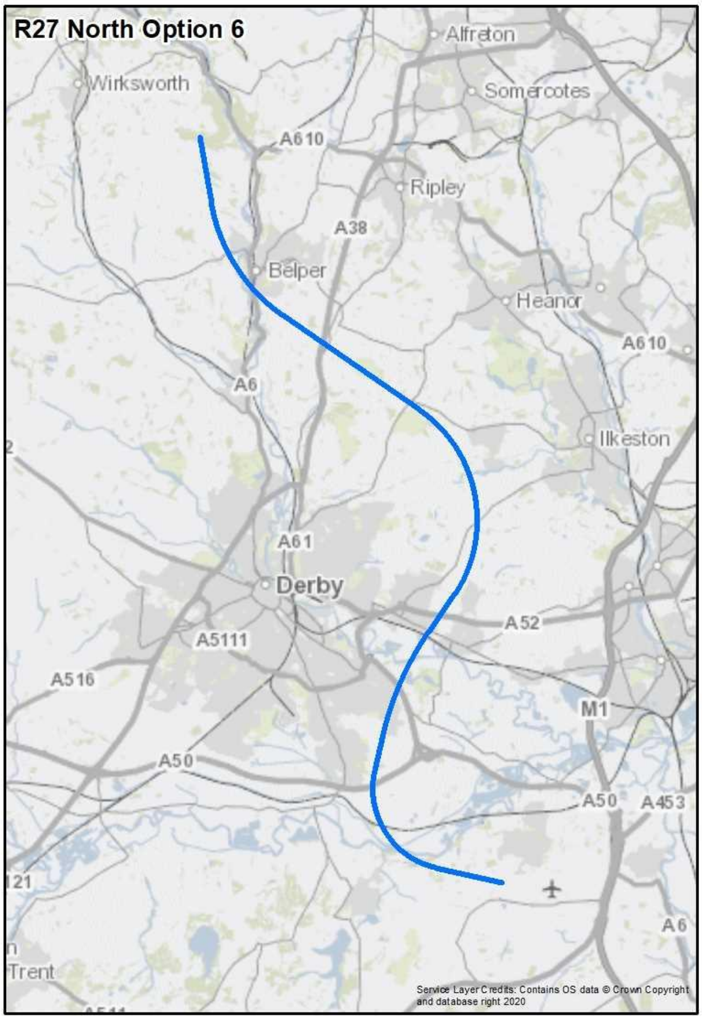
Description	Reason for inclusion
Option 4 proceeds straight ahead after take-off with no offset before making a single right turn to head north. It is similar to Options 2 and 3 but terminates further east. After initial departure this option follows the runway heading for 1nm before commencing a 90° right turn just to the north east of Melbourne. This takes it onto a north heading routing close to the eastern edge Derby and passing over eastern Ripley. The route terminates to the north east of Crich. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn. 	**Emissions:** When compared to the current route, the shorter track length is intended to minimise fuel burn and emissions. **Continuity**: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations. **Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3**: Aims to reduce the impact of noise by routing to the east of Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

13.8. Runway 27 North Option 5

Description	Reason for inclusion
Option 5 has a 15° northerly offset to avoid Melbourne and is a route that takes multiple turns to avoid overflight of Derby. The initial 15° offset to the north results in the route passing north of Melbourne with the first turn to the north at 1.54nm beyond the DER onto a northerly heading, before commencing a second right-hand turn onto a north easterly heading to pass just east of Borrowash. A third turn to the left routes it between Derby and Nottingham and the route then turns to a north west heading before finally turning north and terminating north west of Belper. This route endeavours to avoid overflight of built up and noise sensitive areas; however, all turns have been limited to 190KIAS to enable tight turns. Although PANS-OPS compliant it is a complex route that will require to be assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.  	Continuity: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations. Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Noise N3: Aims to reduce the impact of noise by routing between Derby and Nottingham A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

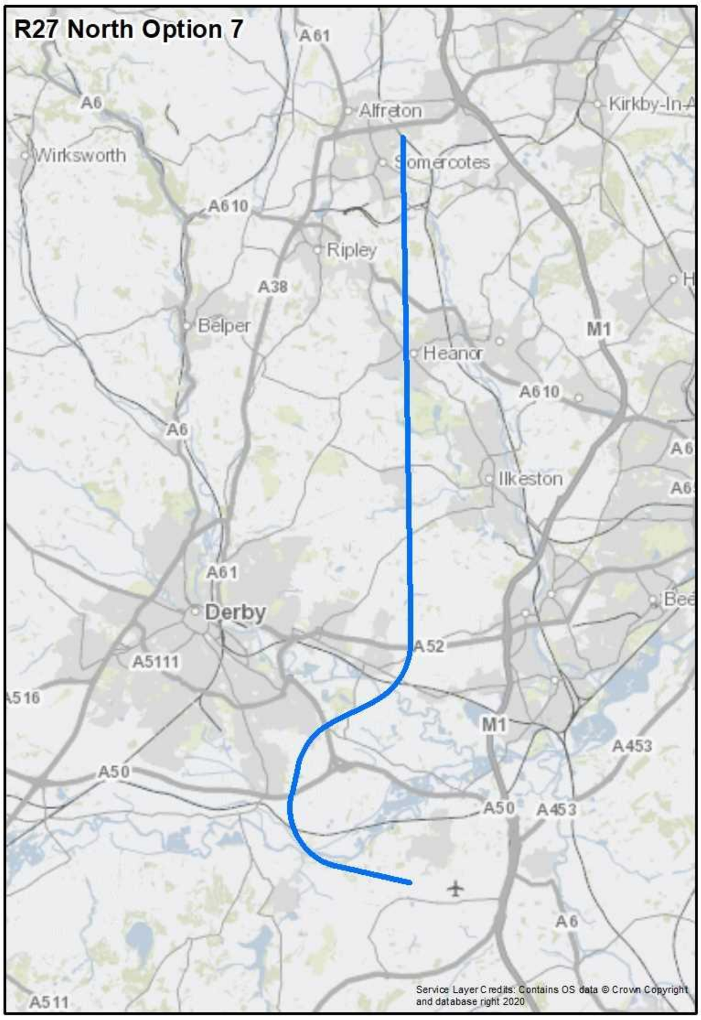
13.9. Runway 27 North Option 6

Description	Reason for inclusion
Option 6 has a 15° northerly offset to avoid Melbourne and is a route designed to avoid overflight of Derby. It is similar to Option 5 however the turns have been designed for 210KIAS to align with the speed recommendations within CAP 778 which results in a slightly different track. The initial 15° offset to the north results in the route passing north of Melbourne with the first turn to the north at 1.26nm beyond the DER onto a north east heading over the south east edge of Derby and passing between Spondon and Borrowash. A second left turn is made between Derby and Nottingham which leads to a north west heading passing over southern Belper before finally turning north and terminating north east of Belper. Although PANS-OPS and CAP778 compliant it is a complex route that may require to be assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	**Continuity**: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations. **Noise N1**: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3**: Aims to reduce the impact of noise by routing between Derby and Nottingham A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



13.10. Runway 27 North Option 7

Description	Reason for inclusion
Option 7 has a 15° northerly offset to avoid Melbourne and is a route that takes multiple turns to avoid overflight of Derby. It is similar to Option 5 but heads in a more northerly direction once past Derby. The initial 15° offset to the north results in the route passing north of Melbourne with the first turn to the north at 1.54nm beyond the DER onto a northerly heading, before commencing a second right-hand turn onto a north easterly heading to pass just east of Borrowash. A third turn to the left takes the route north between Derby and Nottingham and it passes west of Ilkeston and terminates south east of Alfreton. This route is intended to avoid overflight of built up and noise sensitive areas with all turns being limited to 190KIAS to enable tight turns. Although PANS-OPS compliant it may need to be assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	**Continuity**: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations. **Noise N1**: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3**: Aims to reduce the impact of noise by routing between Derby and Nottingham A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



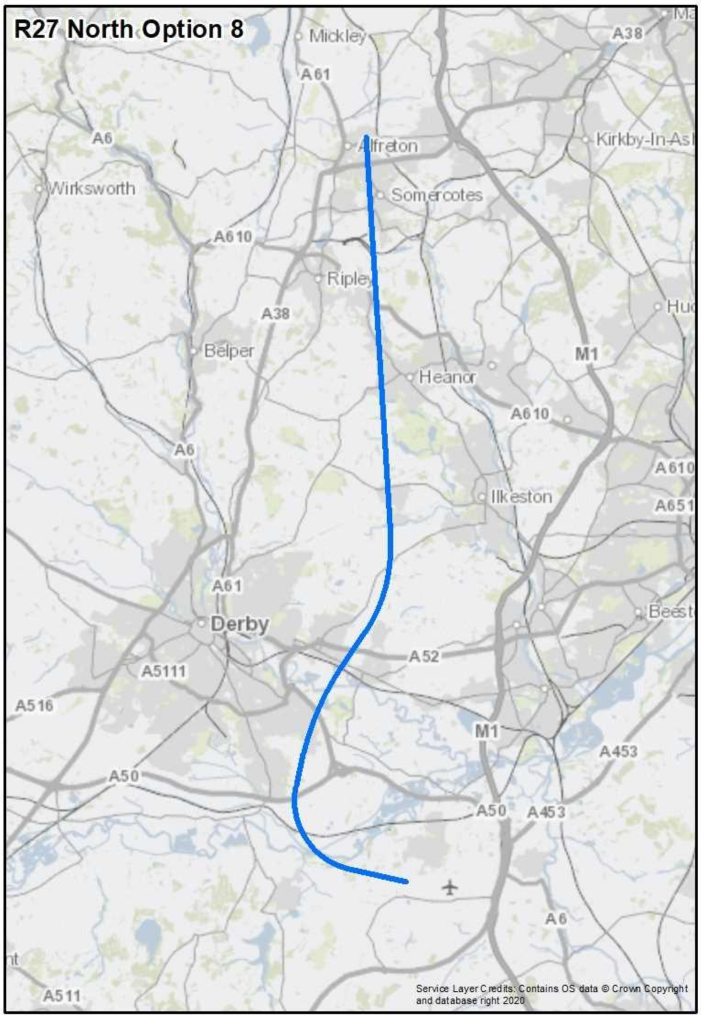
13.11. Runway 27 North Option 8

Description

Option 8 has a 15° northerly offset to avoid Melbourne and is a route that takes multiple turns to avoid overflight of Derby. It is similar to Option 7 however the turns have been designed for 210KIAS to align with the speed recommendations within CAP 778 which results in a slightly different track.

The initial 15° offset to the north results in the route passing north of Melbourne with the first turn to the north at 1.26nm beyond the DER onto a north east heading over the south east edge of Derby and passing between Spondon and Borrowash. A second left turn is made between Derby and Nottingham which leads to a northerly heading passing west of Ilkeston and Heanor, and the route terminates over Alfreton.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Continuity: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations.

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

Noise N3: Aims to reduce the impact of noise by routing away from central Derby.

A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

13.12. Runway 27 North Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A9	S	P	C

Description: On departure from runway 27 the aircraft will make a left-hand wrap-around turn to the south and east, before heading north to the SID aiming point.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option partially fails to align to the environmental end of the AMS and the altitude-based priorities of the ANG.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic a significant distance south and east before turning it north leading to increased fuel burn and emissions. However, there may be some reduction in the number of people impacted by noise below 4,000ft.

Trade-offs: There may be a material benefit in the number of people impacted by noise which is a potential trade-off for the increased emissions. This option has therefore been rated as amber.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes, south east, south, and south west. In addition, it may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B10	S	P	C

Description: This option departs runway 27 in a north westerly direction following the majority of the current TNT SID and turning right between Derby and Ashbourne on to a north easterly heading.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic a significant distance north west before turning it north leading to increased fuel burn and emissions. This option is already created in a more fuel efficient way by Option 1 and the number of people impacted by noise for this option in comparison to this and other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the west and north west departure envelope for an extended period of time. This would not enable best use of runway capacity.

C11	S	P	C

Description: This option departs runway 27 in a westerly direction for approximately 8nm before turning north at Burton upon Trent, then turning right between Derby and Ashbourne to a north easterly heading.

Programme: This option may align with the environmental end of the AMS and the altitude-based priorities of the ANG.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic a significant distance west before turning it north leading to increased fuel burn and emissions. A similar solution is already created in a more fuel efficient way by Option 1 and the number of people impacted by noise for this option in comparison to this and other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the west and north west departure envelope for an extended period of time. This would not enable best use of runway capacity.

D12	S	P	C

Description: This option departs runway 27 in a south west direction for approximately 8nm over Swadlincote before turning north at Burton upon Trent in a north westerly direction, then turning right between Derby and Ashbourne to a north easterly heading.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* This option would involve greater track mileage than is necessary by taking traffic a significant distance south west before turning it north leading to increased fuel burn and emissions. By overflying Swadlincote and Burton upon Trent the number of people impacted by noise for this option in comparison to this and other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the west and north west departure envelope for an extended period of time. This would not enable best use of runway capacity.

E13	S	P	C

Description: On departure from runway 27 the aircraft makes a right turn proceeding in a north easterly direction passing over central Nottingham before heading towards Alfreton.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The number of people impacted by noise for this option in comparison to other options does not show a material benefit. The emissions generated by this option have been assessed as being greater when compared with other options.

Continuity: This option fails to align with this design princple, because it would have an interaction with arrivals for runway 27 which would not enable best use of runway capacity.

14. SID Runway 27 – North West

14.1. Introduction to 27 North West Design Envelope

This envelope has been created for traffic routing to the north west from runway 27 and is based around the existing TNT 2N SID towards the Trent (TNT) DVOR. After departure the route options turn to the right to head north west.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft.

The north western options engaged upon in this envelope were designed around the replication of the current SID which enables connectivity to the NATS Upper Airspace Network in the vicinity of TNT. However, and as detailed in section 6.13, following bilateral engagement and feedback from NERL and the results of simulation exercises to progress their network designs, it was determined that the EMA runway 27 north west design envelope may not be fully aligned to the developing NERL network options. This was because of a potential interaction above 7,000ft between the original EMA departure options heading in a north west direction and inbounds to Manchester (MAN) descending on a similar heading between TNT and the DAYNE hold. This potential misalignment related to all options within the envelope but was most significant for those that terminated or headed to a point north and east of the TNT DVOR.

This resulted in a NERL concept to relocate the network joining point for the EMA 27 North West Envelope to a new position approximately 5nm to the west of TNT at the position 'W39B'. This change was intended to improve performance for EMA departures in relation to:

- Network connectivity: Consistent with the 'Simplification' end of the AMS and the need for EMA options to align to the traffic flows within the NATS network, this change will avoid these routes interacting with routes of other airports above 7,000ft.
- Environmental performance: In line with the design principles relating to Emissions and Noise N3, this revised position is more likely to guarantee continuous climb for EMA departures once entering the network.

This feedback and the development of the NERL concept resulted in the extension of the 27 North West Design Envelope to the south west by approximately 5nm of the original position and the creation six additional options aligned to the revised network join point at W39B which are Options 10-15 within this DOR.

Whilst discussions with NERL indicated this change would resolve the conflict and help ensure continuous climb for EMA departures to the north west, further analysis and tests were required by NERL to confirm which of the two joining points (TNT or W39B) would be preferred. Because this NERL analysis was ongoing in parallel with the creation of the additional design options, no options were discounted, and all options were retained for further analysis within the DPE and IOA.

In summary:

- Options 1- 9 are aligned to the current network join in the vicinity of TNT.
- Options 10-15 are aligned to the alternative network join in the vicinity of W39B.
- Option 4 is aligned to a network join in the vicinity of both TNT and W39B.

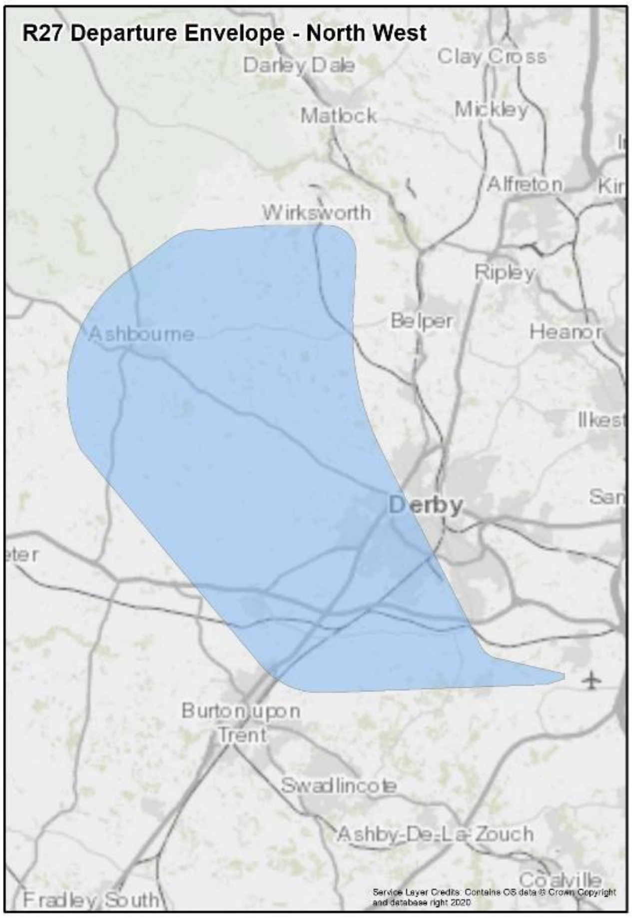
In relation to the requirement for a 'do minimum' option the design process has:

- Used the replication of the current TNT departure (Option 1A) to represent the 'do minimum' if the current join at TNT is retained.
- Created an alternative 'do minimum' option (Option 13) for use with the W39B joining point. This has been designed on the identical track to the replicated option until above 5,000ft at which point the final section of the route turns left to align it towards W39B.

Further detail on the 'do minimum' classification for departures is provided in section 4.4.3

Further detail on the background to the additional options can be found in section 6.14 of this DOR and in the Stakeholder Engagement Report.

14.2. Design Envelope Location Map



Runway 27 North West – Revised envelope.

14.3. 27 North West Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	This is a re-creation of the current TNT SID based on CAP778 recommended turn criteria and speeds.	A16	A left-hand wrap-around to the south of EMA, overflying north east Derby. Option fails to align to: • Safety • Programme • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.

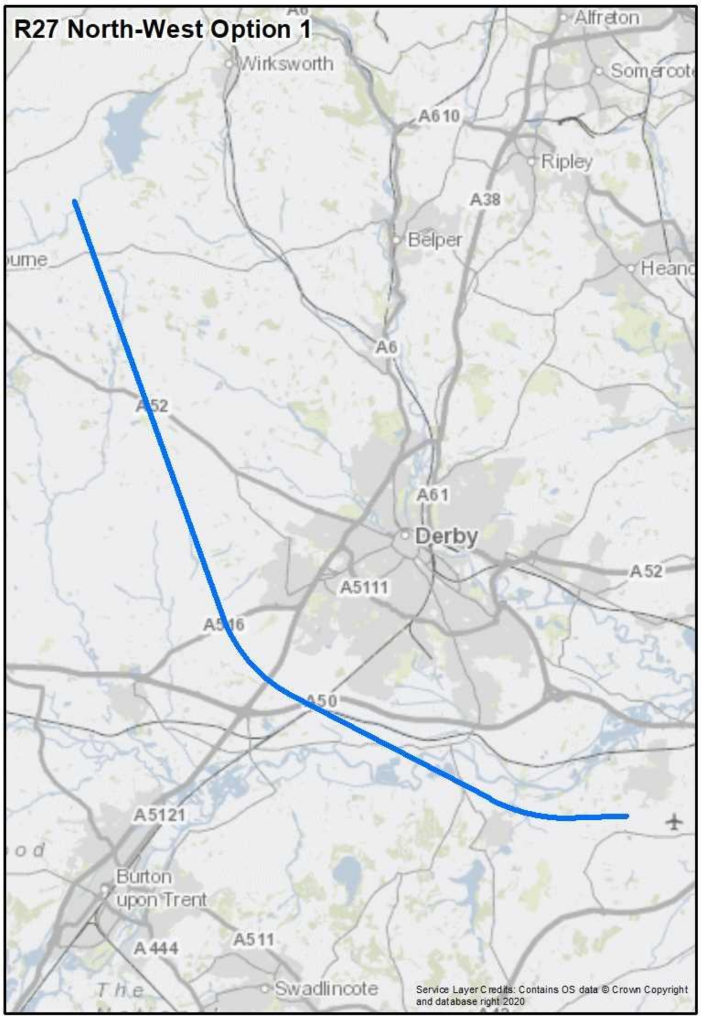
1A	This is a replication of the current Trent TNT2N SID included as a 'do minimum' option if the network joining point at TNT is retained. The first turn commences at 0.66nm beyond the DER which is exactly aligned to the first turn of the current procedure.	B17	Maintains a westerly heading until Burton upon Trent where it turns north east. Option fails to align to: • Programme • Continuity		
2	A right turn north west at 1.0nm beyond the DER. Overflies west Derby and terminates close to Kniveton, north east of Ashbourne.	C18	Departs south west routing to the south of Burton upon Trent where it turns north. Option fails to align to: • Programme • Continuity		
3	A right turn north west at 1.0nm beyond the DER. Similar to Option 2 but routes slightly further north west and overflies central Derby and terminates south west of Wirksworth.				
4	A right turn at 1.0nm with a direct route to the north west overhead south west Derby and terminating over Ashbourne.				
5	An extended track to the west prior to a 90 degree turn north towards TNT.				
6	A 15° northerly offset that tracks south of Derby before making a north-north west turn to TNT.				

7	A 15° northerly offset to the runway heading for approximately 6.5nm to a point south west of Derby. The route turns north west and terminates to the east of Ashbourne.				
8	A 15° northerly offset that tracks south of Derby before making a north-north west turn to a point east of TNT. It is similar to option 6 but terminates further east of TNT.				
9	A 15° northerly offset that tracks south of Derby before making a north-north west turn to a point east of TNT near Belper.				
10	Straight ahead for approximately 1 nm to route between Derby and Burton upon Trent, with a single right turn to the north west and terminating south of Ashbourne.				
11	A 15° northerly offset to the runway heading for approximately 6.5nm to a point south west of Derby. The route turns north west and terminates to the south of Ashbourne.				
12	A 15° northerly offset to the runway heading with a more direct track to the north west to reduce fuel burn and terminating south of Ashbourne				

13	Straight ahead for approximately 6nm, turning right to avoid overflying Derby. This initially follows the same track as the current TNT SID but turns north west in the final part of the route				
14	A 15° northerly offset to the runway heading to pass between Derby and Burton upon Trent and remaining south of Ashbourne.				
15	A 15° northerly offset to the runway heading to pass between Derby and Burton upon Trent and terminating south east of Ashbourne.				

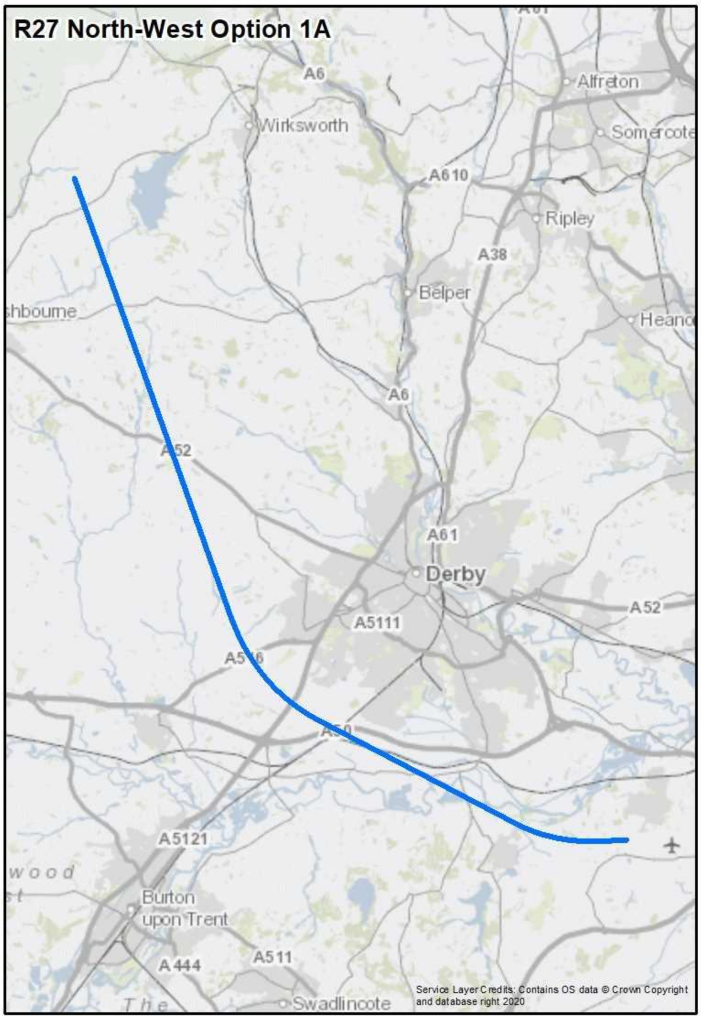
14.4. Runway 27 North West Option 1

Description	Reason for inclusion
This is a re-creation of the current TNT SID based on CAP778 recommended turn criteria and speeds. The first turn uses a speed of 210KIAS and commences at 1nm beyond the DER which is later than the current procedure but CAP778 recommended. As a replicated route it follows a similar track over the ground as the current route to connect to the NATS network at TNT. After departure this follows the runway heading for 1nm with no offset before commencing a right turn onto a north west heading just to the north east of Melbourne. It passes pass south west of Derby and a second right turn turns route it towards the TNT DVOR, which is located north east of Ashbourne, just west of Carsington Water. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



14.5. Runway 27 North West Option 1A

Description	Reason for inclusion
This is a replication of the current Trent TNT2N SID included as a ‘do minimum’ option, based on the current network joining point of TNT being retained for EMA departures to the north west. The first turn uses the CAP778 speed of 210KIAS but commences at 0.66nm beyond the DER which is aligned to the first turn of the current procedure but not CAP 778 recommended. This turn point results in a route that passes further north of Melbourne when compared to Option 1. As a replicated route it follows a similar track over the ground as the current route to connect to the NATS network at TNT. After departure this follows the runway heading for 0.66nm with no offset before commencing a right turn onto a north west heading just to the north east of Melbourne. It passes pass south west of Derby and a second right turn turns route it towards the TNT DVOR, which is north east of Ashbourne, just west of Carsington Water. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Aligns to a ‘do minimum’ option based on the current network joining point. **Noise N3**: Aims to reduce the impact of noise on Melbourne by making an earlier first turn when compared to Option 1. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



R27 North-West Option 1A

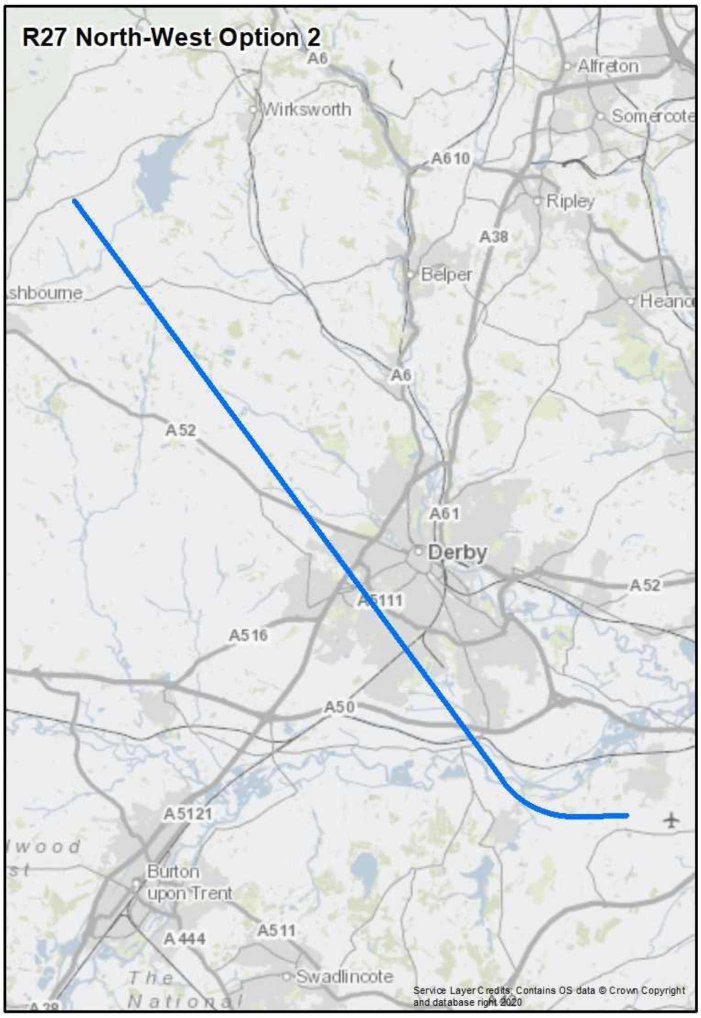
14.6. Runway 27 North West Option 2

Description

Option 2 proceeds straight ahead after take-off with no offset and has been created to provide a direct and fuel efficient route to join the NATS network close to TNT.

After departure this follows the runway heading for 1nm with no offset before commencing a right turn onto a north west heading to the north east of Melbourne. It overflies western Derby and terminates south of the TNT DVOR, close to Kniveton.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

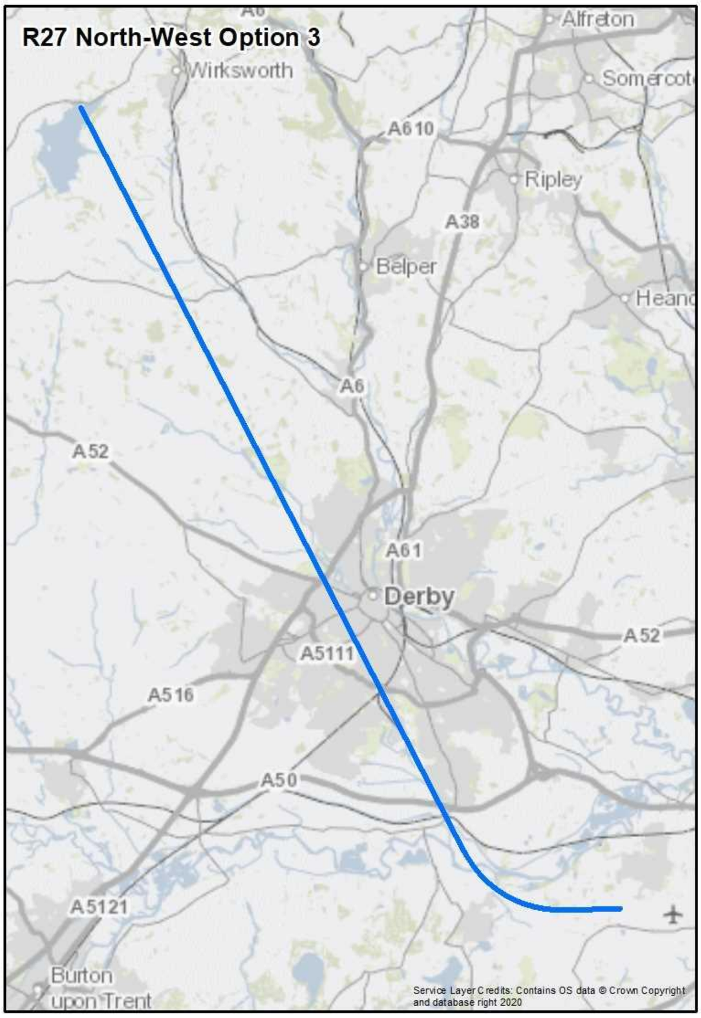
Emissions: When compared to the current route, the shorter track length for flights to the east is intended to minimise fuel burn and emissions.

Noise N2: Overflies the western side of Derby which is expected to have higher level of ambient noise than surrounding areas.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

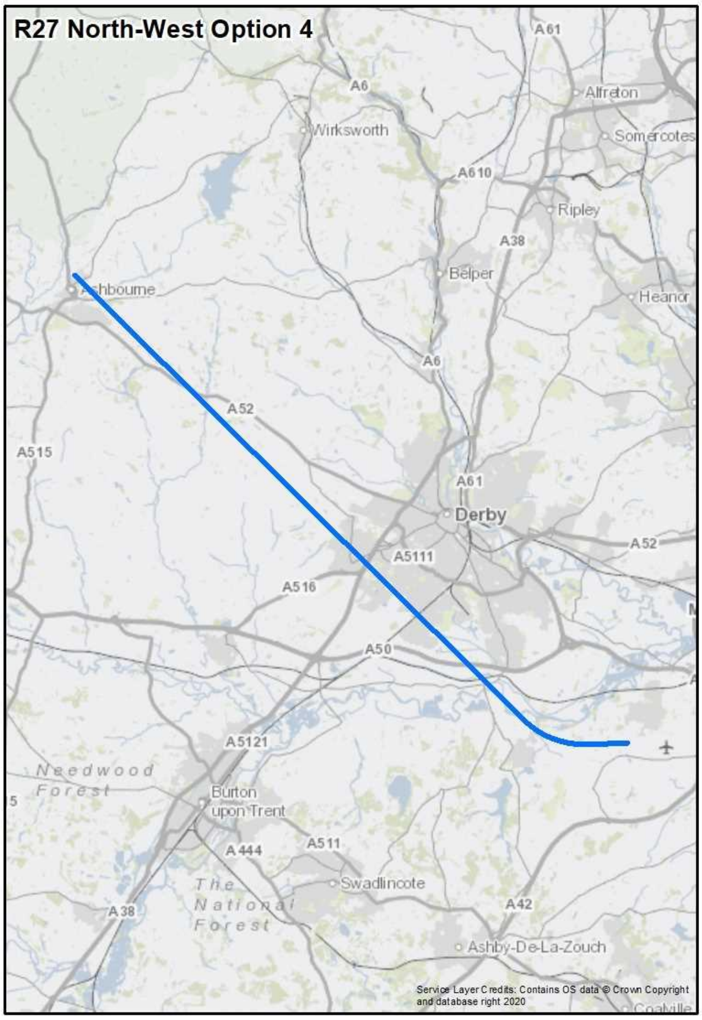
14.7. Runway 27 North West Option 3

Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset and has been created to provide a direct and fuel efficient route to join the NATS network slightly east of the current TNT SID. After departure this follows the runway heading for 1nm with no offset before commencing a right turn onto a north west heading to the north east of Melbourne. It overflies central Derby and terminates south west of Wirksworth near Carsington Water. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length for flights to the east is intended to minimise fuel burn and emissions. **Noise N2:** Overflies the centre of Derby which is expected to have higher level of ambient noise than surrounding areas. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



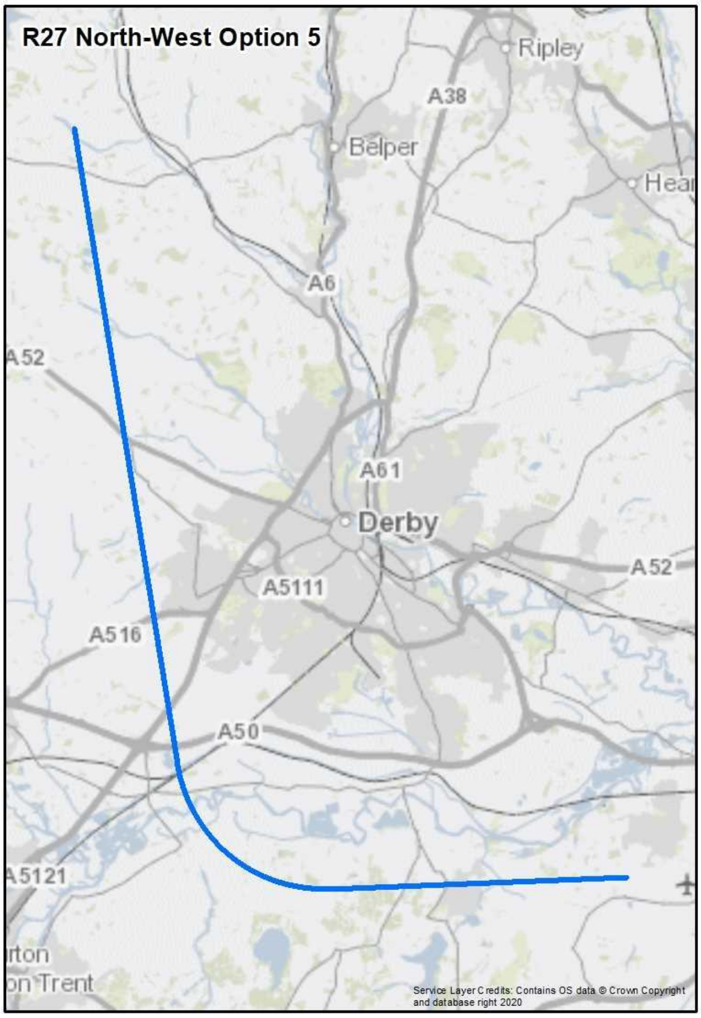
14.8. Runway 27 North West Option 4

Description	Reason for inclusion
Option 4 proceeds straight ahead after take-off with no offset and has been created to provide a direct and fuel efficient route to join the NATS network. After departure this follows the runway heading for 1nm with no offset before commencing a right turn onto a north west heading to the north east of Melbourne. It passes over the south west edge of Derby on a direct track to the termination point which is located over north Ashbourne. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length for flights to the east is intended to minimise fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



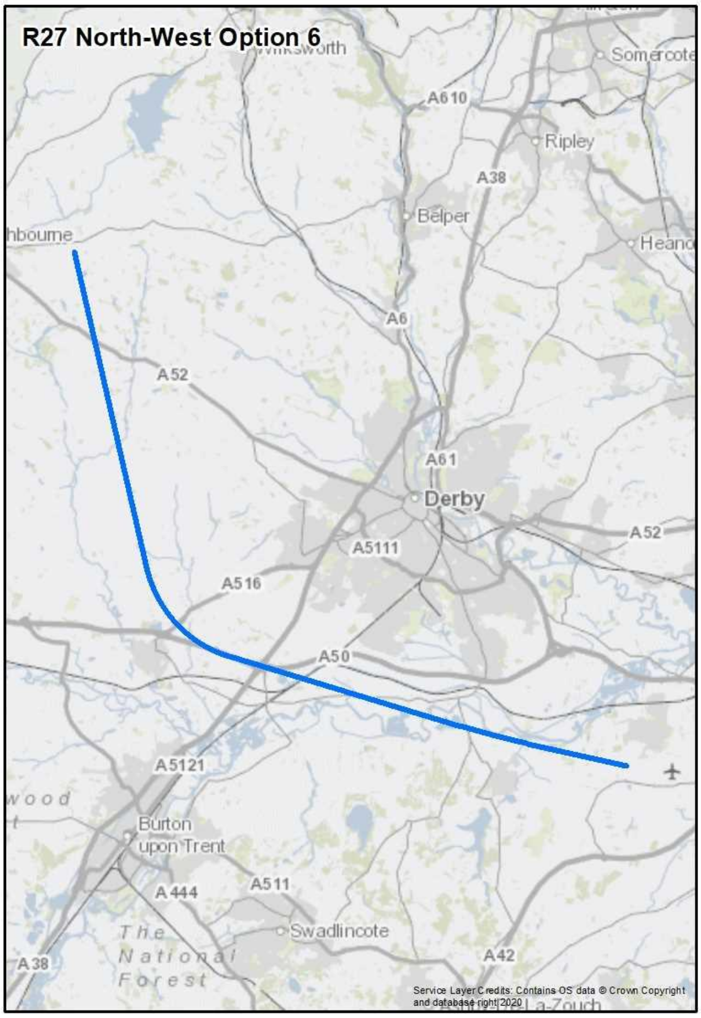
14.9. Runway 27 North West Option 5

Description	Reason for inclusion
Option 5 proceeds straight ahead after take-off before turning directly north to avoid Derby. After departure this follows the runway heading for approximately 6nm beyond the DER with no offset before commencing a right turn onto a northerly heading. This takes it west of Derby and it continues on this track until the termination point, south east of Carsington Water. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Emissions:** When compared to the current route, the shorter track length for flights to the east is intended to minimise fuel burn and emissions. **Noise N3:** Aims to reduce the impact of noise by routing south and west of Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



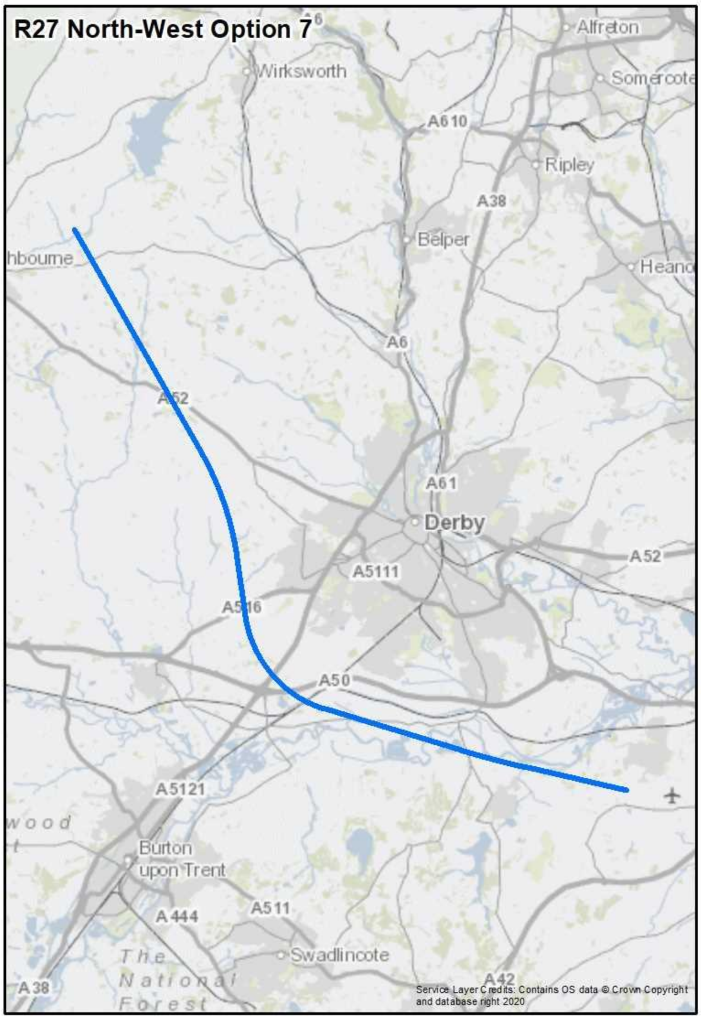
14.10. Runway 27 North West Option 6

Description	Reason for inclusion
Option 6 has a 15° northerly offset to the runway and has been created to reduce the impact of noise immediately after departure and later in the route by avoiding Derby. The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and this route heading is maintained for just over 6.5nm. A right turn is made to the south west of Derby, close to Derby airfield which takes it onto a north westerly heading which it continues on until the termination point to the east of Ashbourne. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3**: Aims to reduce the impact of noise by routing away from Derby. A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



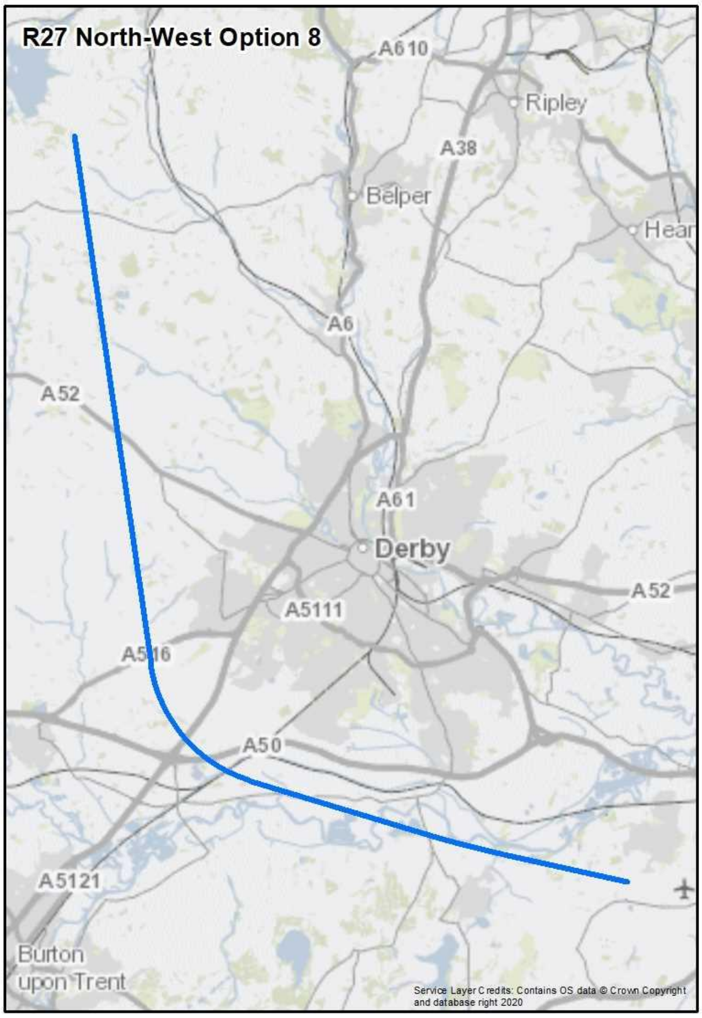
14.11. Runway 27 North West Option 7

Description	Reason for inclusion
Option 7 has a 15° northerly offset to the runway and has been created to reduce the impact of noise immediately after departure and later in the route by avoiding Derby. The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and this route heading is maintained for just over 6.5nm. The first turn is made to the south west of Derby, close to the junction of the A38 and A50 which takes it onto a northerly heading before a left turn onto a north westerly heading. The route terminates to the east of Ashbourne. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise by routing away from Derby. A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



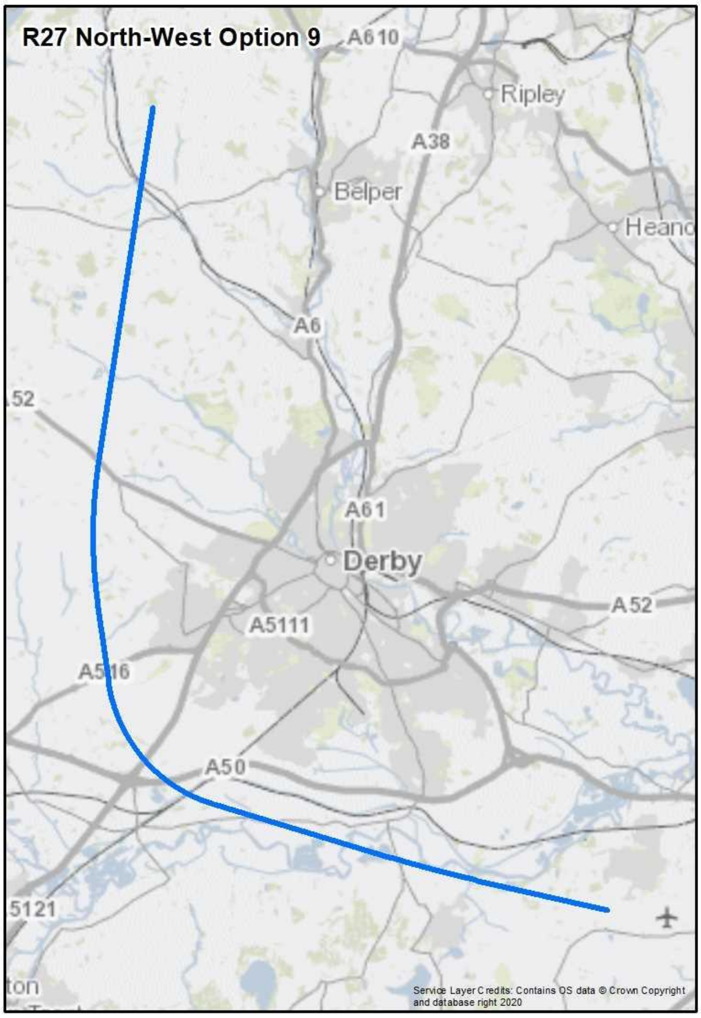
14.12. Runway 27 North West Option 8

Description	Reason for inclusion
Option 8 has a 15° northerly offset to the runway and has been created to reduce the impact of noise immediately after departure and later in the route by avoiding Derby. It is similar to option 6 but terminates further east of TNT. The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and this route heading is maintained for just over 6.5nm. A right turn is made to the south west of Derby, close to the junction of the A38 and A50 which takes it onto a northerly heading which it continues on until the termination point to the south east of Carsington Water. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise by routing away from Derby. A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



14.13. Runway 27 North West Option 9

Description	Reason for inclusion
Option 9 has a 15° northerly offset to the runway and has been created to reduce the impact of noise immediately after departure and later in the route by avoiding Derby. It is similar to option 6 but terminates further east of TNT. The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and this route heading is maintained for just over 6.5nm. A right turn is made to the south west of Derby, close to the junction of the A38 and A50 which takes it onto a north easterly heading which it continues on until the termination point to the south east of Wirksworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise by routing away from Derby. A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



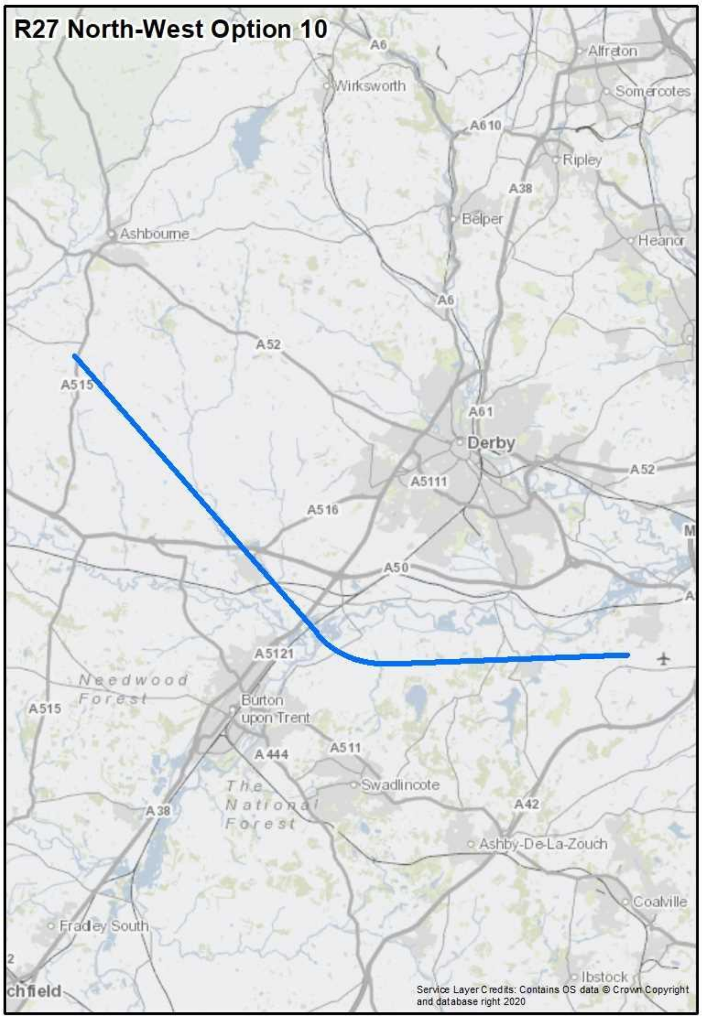
14.14. Runway 27 North West Option 10

Description

Option 10 proceeds straight ahead after take-off with no offset and has been created to provide a route that has the maximum avoidance of Derby and Burton upon Trent.

After departure this follows the runway heading with no offset to a point approximately 6.5nm from the DER, where the route passes south of Repton and turns onto to a north west heading. It passes between Derby and Burton upon Trent and overhead Hilton prior to terminating to the south of Ashbourne.

Because there is no immediate turn a higher design speed of 250 KIAS can be used which is the CAP778 recommended speed when turning above 3000ft.



Reason for inclusion

Programme: In line with the ends of the AMS, the route was created following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network.

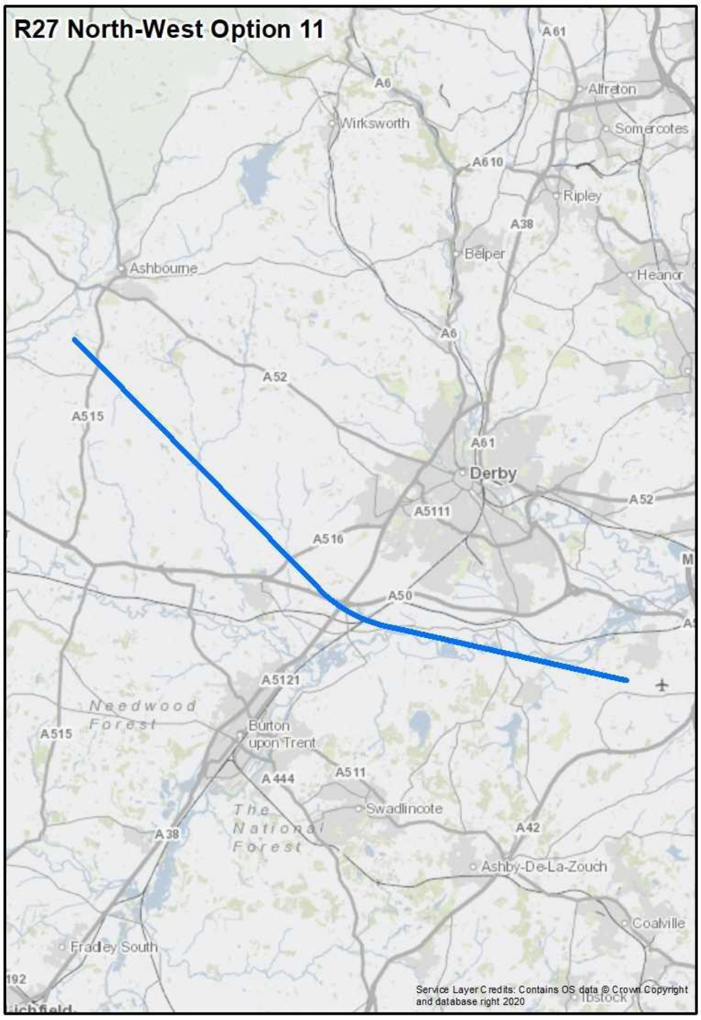
Noise N3: Aims to reduce the impact of noise by routing between the large population centres of Derby and Burton upon Trent.

In addition, the design speed of 250kts will allow aircraft to climb higher more quickly, with the potential to reduce the impact of noise to communities on the ground.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

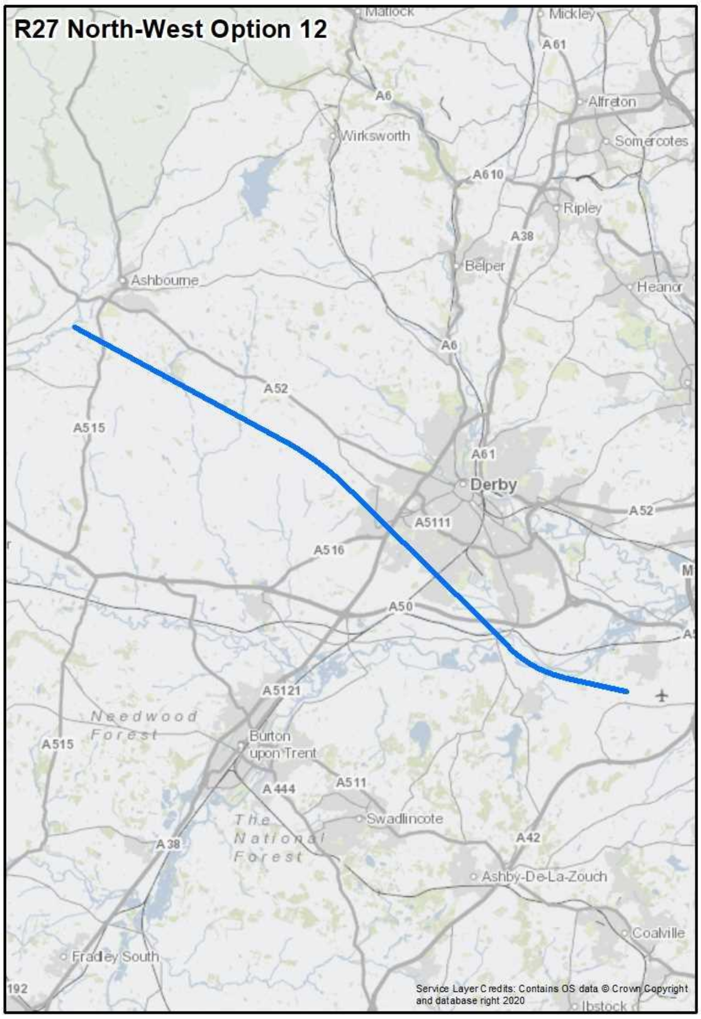
14.15. Runway 27 North West Option 11

Description	Reason for inclusion
Option 11 has a 15° northerly offset to the runway and has been created to reduce the impact of noise immediately after departure and later in the route by avoiding Derby. The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and this route heading is maintained for just over 6.5nm. The first turn is made to the south west of Derby, over the junction of the A38 and A50 which takes it onto a north westerly heading and the route terminates on the southern side of envelope, south of Ashbourne. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Programme**: In line with the ends of the AMS, the route was created following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network. **Noise N3:** Aims to reduce the impact of noise by routing between the large population centres of Derby and Burton upon Trent. A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



14.16. Runway 27 North West Option 12

Description	Reason for inclusion
Option 12 has a 15° northerly offset to the runway and has been created with a more direct track to reduce fuel burn, and increased divergence from departures on the west envelope to ensure capacity is not impacted. The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton where the route turns to a north westerly heading and routes over the south west corner of Derby. When north of Radbourne, the route turns slightly west to track south of the A52 and terminates to the south west of Ashbourne. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Programme**: In line with the ends of the AMS, the route was created following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network. **Noise N3:** The 15° northerly offset aims to reduce the impact of noise on communities close to the extended runway centreline. **Continuity**: The first turn and route slightly further north has been included to aid runway capacity and optimise departure spacing for following aircraft. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



14.17. Runway 27 North West Option 13

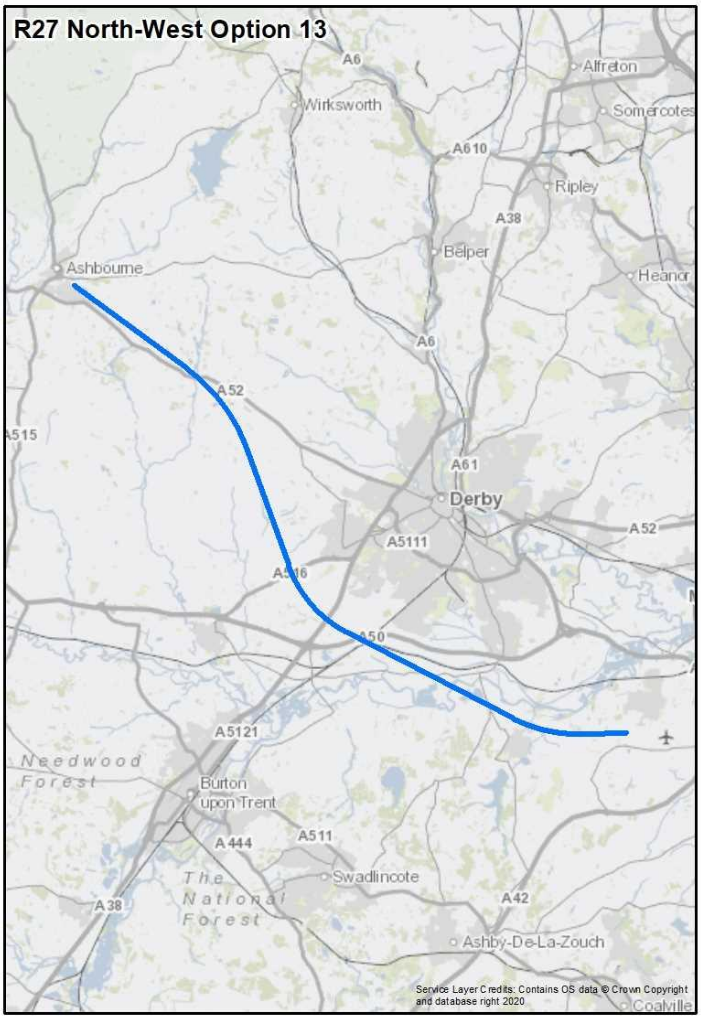
Description

Option 13 proceeds straight ahead after take-off with no offset and has been created to avoid overflying Derby. It follows the same initial track as the current TNT SID but turns north west in the final part of the route to align to the revised network joining point at W89A.

On this basis it has been created as the 'do minimum' option to the alternative network joining point if the current TNT replication is discontinued within the DPE or IOA.

After departure this follows the runway heading with no offset along the extended runway centreline with a right turn to the north of Melbourne in a north westerly direction routing to the south west of Derby. Between the A38 and A516 the route turns to a north by north west heading to pass west of Derby. At Brailsford, the route turns west and terminates over south east Ashbourne.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Programme: In line with the ends of the AMS, the route was created following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network.

Noise N3: Aims to reduce the impact of noise by routing between the large population centres of Derby and Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

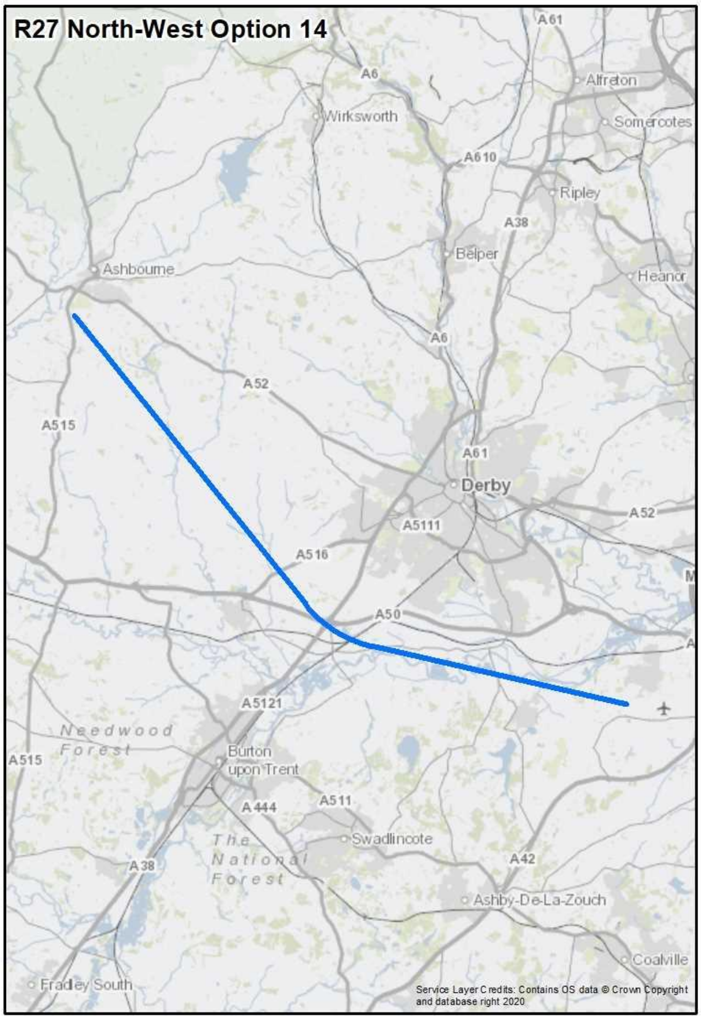
14.18. Runway 27 North West Option 14

Description

Option 14 has a 15° northerly offset to the runway and has been created as a route that seeks to reduce the impact of noise by avoiding Derby, Burton upon Trent and remaining south of Ashbourne.

The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and the route continues on this heading to pass between Derby and Burton upon Trent. Around the junction of the A50 and A516 the route turns to a north west heading prior to terminating south west of Ashbourne.

The route has a constant climb gradient of 6% terminating at 7,000ft and a speed restriction of 250 KIAS is applied to the first turn which is the CAP 778 recommended speed when turning above 3000ft on a 10% climb.



Reason for inclusion

Programme: In line with the ends of the AMS, the route was modified was modified following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network.

Noise N3: Aims to reduce the impact of noise by routing between the large population centres of Derby and Burton upon Trent and remaining south of Ashbourne.

A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne.

In addition, the design speed of 250kts will allow aircraft to climb higher more quickly, with the potential to reduce the impact of noise to communities on the ground.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

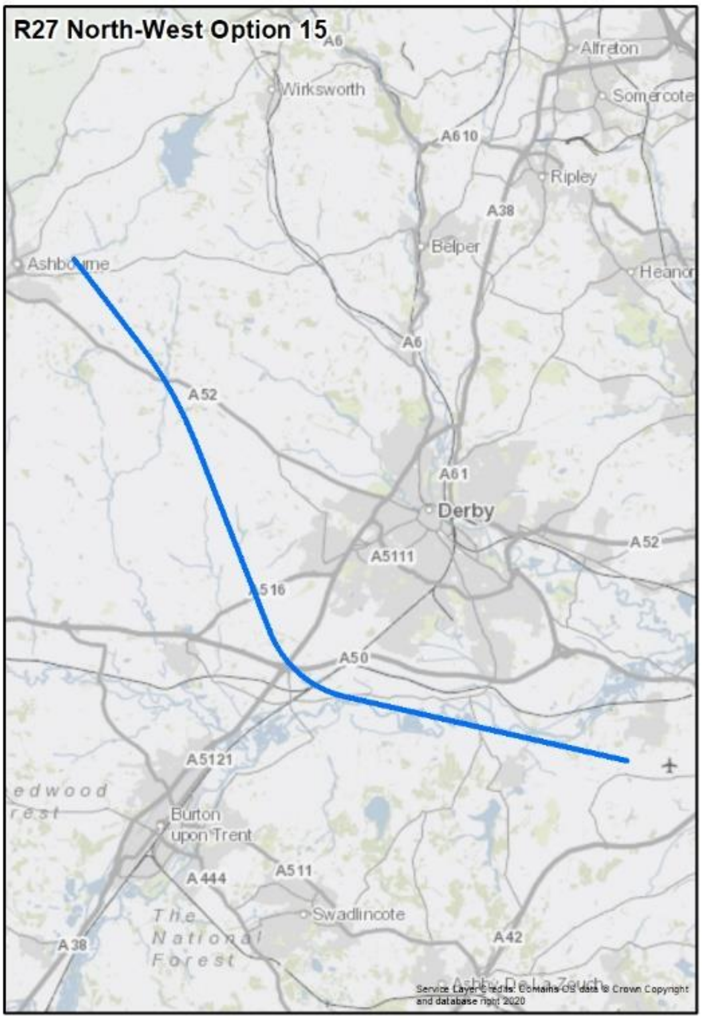
14.19. Runway 27 North West Option 15

Description

Option 15 has a 15° northerly offset to the runway and has been created as a route that seeks to reduce the impact of noise by avoiding Derby and Burton upon Trent. It takes the same initial track as Option 14 but routes further north after the first turn.

The initial 15° offset to the north results in the route passing north of Melbourne and Kings Newton and the route continues on this heading to pass between Derby and Burton upon Trent. Around the junction of the A50 and A516 the route turns to a north west passing west of Derby and terminating south east of Ashbourne.

The route has a constant climb gradient of 6% terminating at 7,000ft and a speed restriction of 250 KIAS is applied to the first turn which is the CAP 778 recommended speed when turning above 3000ft on a 10% climb.



Reason for inclusion

Programme: In line with the ends of the AMS, the route was modified was modified following Stage 2 engagement to align to the traffic flows within the NATS upper airspace network.

Noise N3: Aims to reduce the impact of noise by routing between the large population centres of Derby and Burton upon Trent.

A 15° northerly offset to avoids overflight of communities close to the extended runway centreline, in particular Melbourne.

In addition, the design speed of 250kts will allow aircraft to climb higher more quickly, with the potential to reduce the impact of noise to communities on the ground.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

14.20. Runway 27 North West Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A16	S	P	C

Description: On departure from runway 27 aircraft will initiate an immediate left-hand wrap-around turn to the south, east and north before proceeding north west.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option fails to align with the simplification and environmental ends of the AMS.

> *Simplification*: Following the decision by NERL to relocate the network joining point to avoid conflicts between EMA north west departures and MAN arrivals the termination point of this option in a northerly direction is misaligned with the NATS network traffic flow.
>
> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the revised network joining point. By overflying north east Derby, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the misalignment to the network or increased emissions, and insufficient justification for an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes, south east, south, and north. In addition, it may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B17	S	P	C

Description: On departure from runway 27 this continues in a westerly direction, turning right north of Burton upon Trent in a north-north easterly direction towards Belper.

Programme: This option fails to align with the simplification and environmental ends of the AMS.

> *Simplification*: Following the proposal by NERL to relocate the network joining point to avoid conflicts between EMA north west departures and MAN arrivals the termination point of this option in a north east direction is misaligned with the NATS network traffic flow.
>
> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the revised network joining point. By overflying Burton upon Trent, the number of people impacted by noise for this option in comparison to this and other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the misalignment to the network or increased emissions, and insufficient justification for an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the west departure envelopes which would not enable best use of runway capacity.

C18	S	P	C

Description: This option departs runway 27 on a 15 degree offset in a south westerly direction until just south of Burton upon Trent where it turns right in a northerly direction to the east of Ashbourne.

Programme: This option fails to align with the simplification and environmental ends of the AMS.

> *Simplification*: Following the decision by NERL to relocate the network joining point to avoid conflicts between EMA north west departures and MAN arrivals the termination point of this option in a northerly direction is misaligned with the NATS network traffic flow.
>
> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the revised network joining point. By overflying Burton upon Trent, the number of people impacted by noise for this option in comparison to this and other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the misalignment to the network or increased emissions, and insufficient justification for an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the west and south west departure envelopes which would not enable best use of runway capacity.

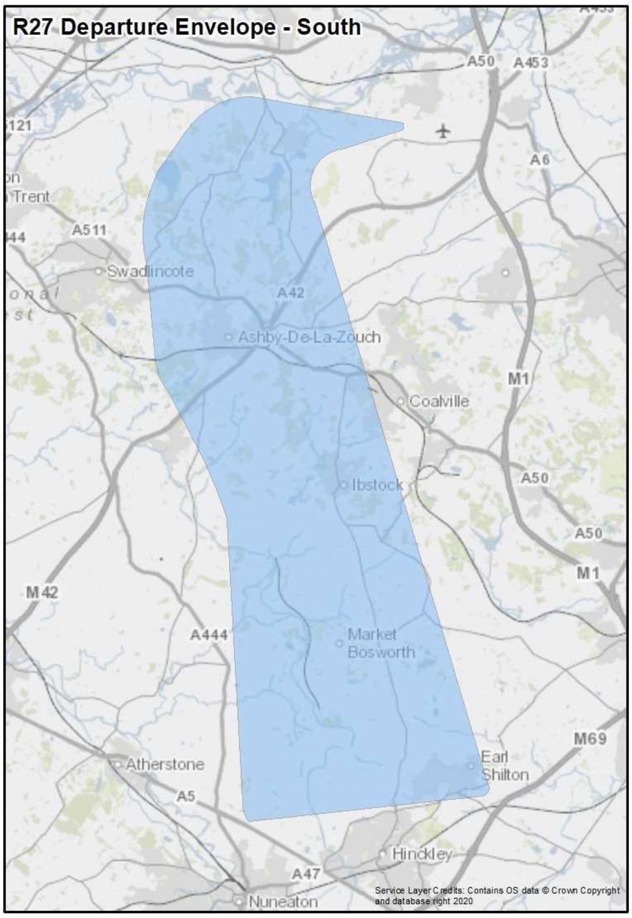
15. SID Runway 27 – South

15.1. Introduction to 27 South Design Envelope

This envelope has been created for traffic routing to the south from runway 27. It is based around the existing DTY 3N SID which routes towards the Daventry DVOR with new options being created towards potential upper airspace joining points with the NATS Upper Airspace Network to the south.

All options have been designed as RNAV1 routes and terminate at 7,000ft at a letterbox that is centred on where the current DTY 3N SID exits EMA airspace. This letterbox is 4.5nm wide (2.25nm either side of the nominal track). A minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

15.2. Design Envelope Location Map



15.3. 27 South Option Summary Table

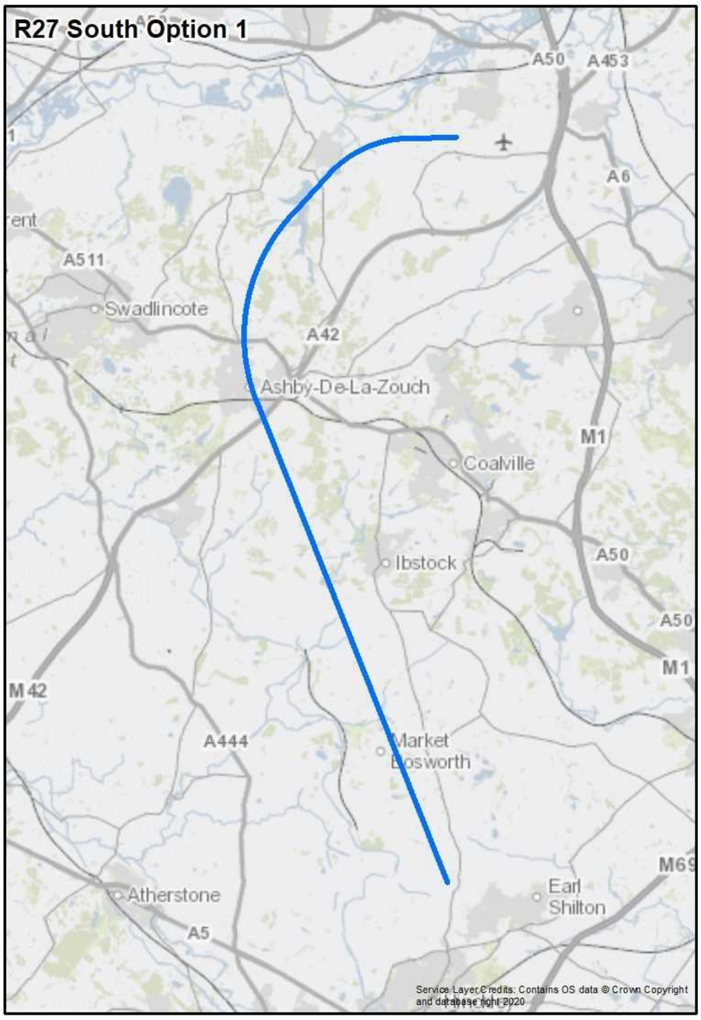
Viable and Good Fit		Viable but Poor Fit		Unviable	
1	A re-creation of the current DTY 3N SID using the CAP 778 recommended design criteria.	A12	A westerly departure for approximately 6nm turning south over Swadlincote to terminate north of Nuneaton. Option fails to align to: • Programme • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
1A	This is a replication of the current Daventry DTY 3N SID included as a 'do minimum' option. However, the first turn commences at 0.66nm beyond the DER which is exactly aligned to the first turn of the current procedure.	B13	An extended westerly departure for approximately 9nm turning south east over Burton upon Trent. Option fails to align to: • Programme • Continuity		

2	Straight ahead with a single turn left at 1.4nm beyond the DER, and a direct route to the south, terminating north of Hinkley.	C14	A right-hand wrap-around to the north of EMA routing over south Nottingham, and finishing on a south westerly heading. Option fails to align to: • Safety • Programme • Continuity		
3	Straight ahead with a single turn left at 1nm beyond the DER, and a direct route to the south, terminating on the southern edge of Earl Shilton.	D15	A north westerly heading initially then making a turn between Derby and Burton upon Trent and routing over Swadlincote. Option fails to align to: • Programme • Continuity		
4	Straight ahead with a single turn left at 1.4nm beyond the DER, and a direct route to the south, terminating north of Nuneaton.				
5	A 12° southerly offset to the runway heading for approximately 1.6nm followed by a left turn to route between Ashby-de-la-Zouch and Coalville to terminate north of Nuneaton.				
6	A 10° northerly offset for approximately 3nm followed by a left turn to route between Swadlincote and Ashby-de-la-Zouch and terminating north of Nuneaton.				

7	A 12° southerly offset to the runway heading for approximately 4.5nm followed by a left turn south to join up with Option 6 and routing between Swadlincote and Ashby-de-la-Zouch and terminating north of Nuneaton.				
8	An initial 15° southerly offset to the runway heading for approximately 4.5nm followed by a left turn south to join up with Options 6 and 7. It routes between Swadlincote and Ashby-de-la-Zouch and terminates south east of Market Bosworth.				
9	An initial 15° southerly offset to the runway heading followed by a left turn south to pass between Coalville and Ashby-de-la-Zouch and terminating over Earl Shilton.				
10	Follows the same route as Option 7 but with an increased 15° southerly offset. It routes between Swadlincote and Ashby-de-la-Zouch and terminates north of Nuneaton.				
11	Follows the same route as Option 6 but with an increased 15° northerly offset. It routes between Swadlincote and Ashby-de-la-Zouch and terminates north of Nuneaton.				

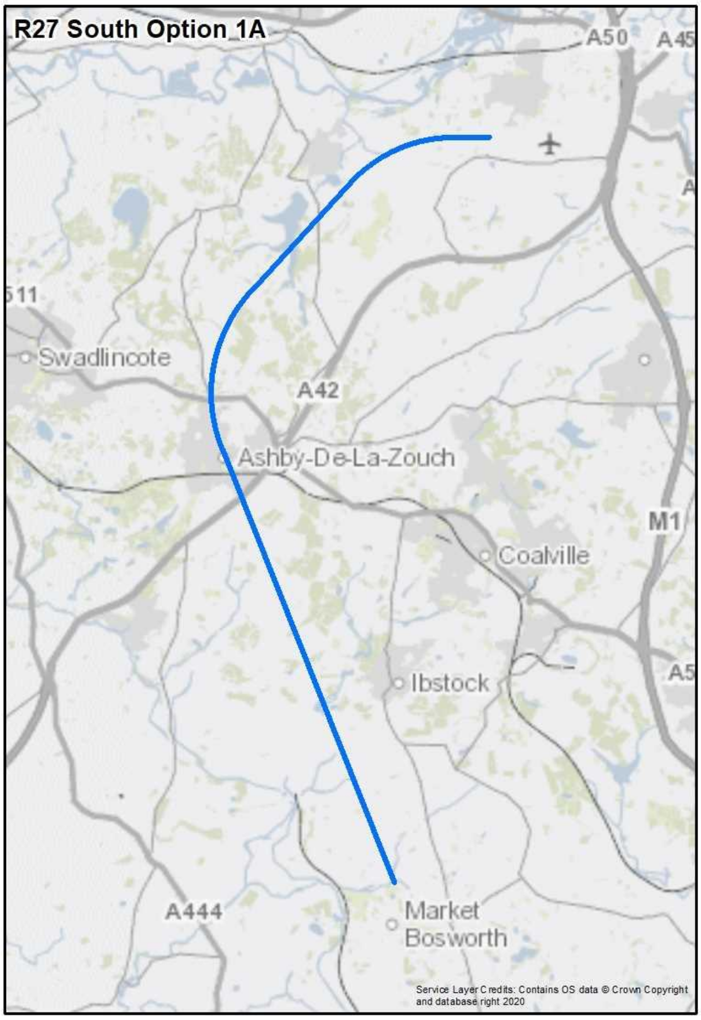
15.4. Runway 27 South Option 1

Description	Reason for inclusion
A re-creation of the current DTY 3N SID using the CAP 778 recommended design criteria. The first turn uses a speed of 210KIAS and commences at 1nm beyond the DER which is later than the current procedure but CAP778 recommended. As a replicated route it follows a similar track over the ground as the current route to connect to the NATS network. After departure this follows the runway heading for 1nm with no offset before commencing a left turn onto a south west heading just to the south east of Melbourne. It then makes a second left turn which overflies Ashby-de-la-Zouch and it then continues south to terminate north of Boswell and Earl Shilton. The SID is designed to terminate at 7,000ft and the climb gradient has been set at 6%. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



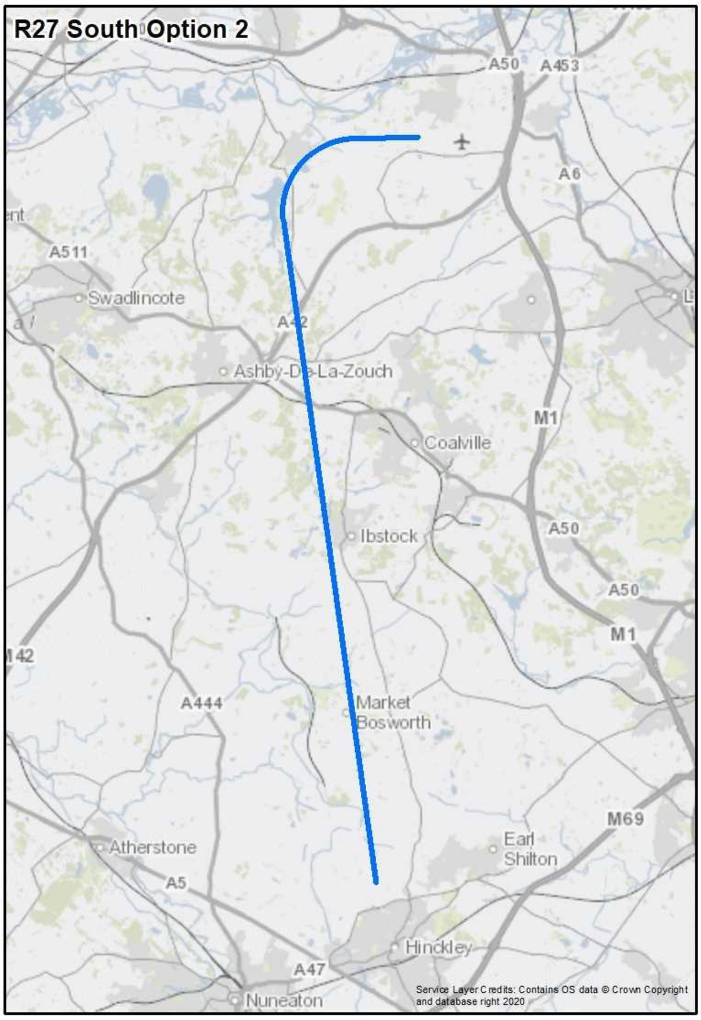
15.5. Runway 27 South Option 1A

Description	Reason for inclusion
This is a replication of the current Daventry DTY 3N SID included as a 'do minimum' option. However, the first turn commences at 0.66nm beyond the DER which is exactly aligned to the first turn of the current procedure. After departure this follows the runway heading for 0.66nm with no offset before commencing a left turn onto a south west heading which takes it further to the south east of Melbourne than Option 1. It then makes a second left turn which overflies Ashby-de-la-Zouch and it then continues south to terminate north of Boswell and Earl Shilton. The SID is designed to terminate at 7,000ft and the climb gradient has been set at 6%. The CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Aligns to a 'do minimum' option. **Noise N3**: Aims to reduce the impact of noise on Melbourne by making an earlier first turn when compared to Option 1. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



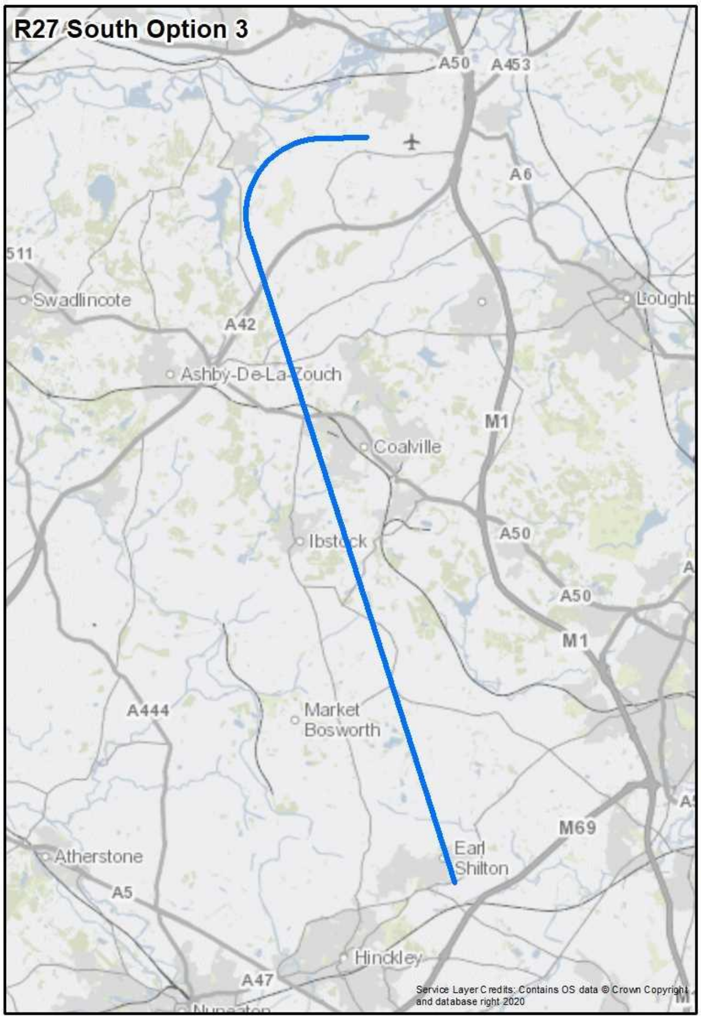
15.6. Runway 27 South Option 2

Description	Reason for inclusion
Option 2 proceeds straight ahead after take-off with no offset and has been created to provide a shorter and more fuel efficient route to the south. After departure this follows the runway heading for 1.4nm with no offset before commencing a single left turn onto a southerly heading just to the south of Melbourne. It passes between Ashby-de-la-Zouch and Coalville, and just west of Ibstock and terminates north of Hinckley. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3**: Aims to reduce the impact of noise when compared to the current route by avoiding overflight of Ashby-de-la-Zouch. **Emissions:** The shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



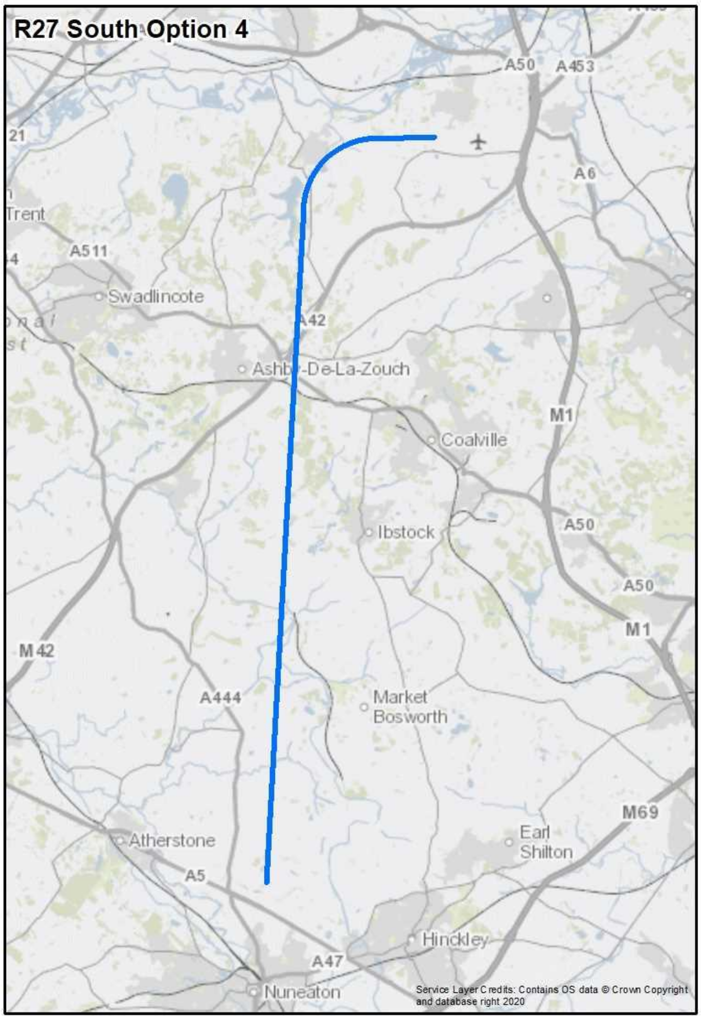
15.7. Runway 27 South Option 3

Description	Reason for inclusion
Option 3 proceeds straight ahead after take-off with no offset and has been created to provide an alternative shorter and more fuel efficient route to the south. After departure this follows the runway heading for 1nm with no offset passing close to the south east corner of Melbourne. A single left turn is made onto a south easterly heading and it passes east of Ashby-de-la-Zouch and overflies the western edge of Coalville, terminating on the southern edge of Earl Shilton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3**: Aims to reduce the impact of noise when compared to the current route by avoiding overflight of Ashby-de-la-Zouch. **Emissions:** The shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



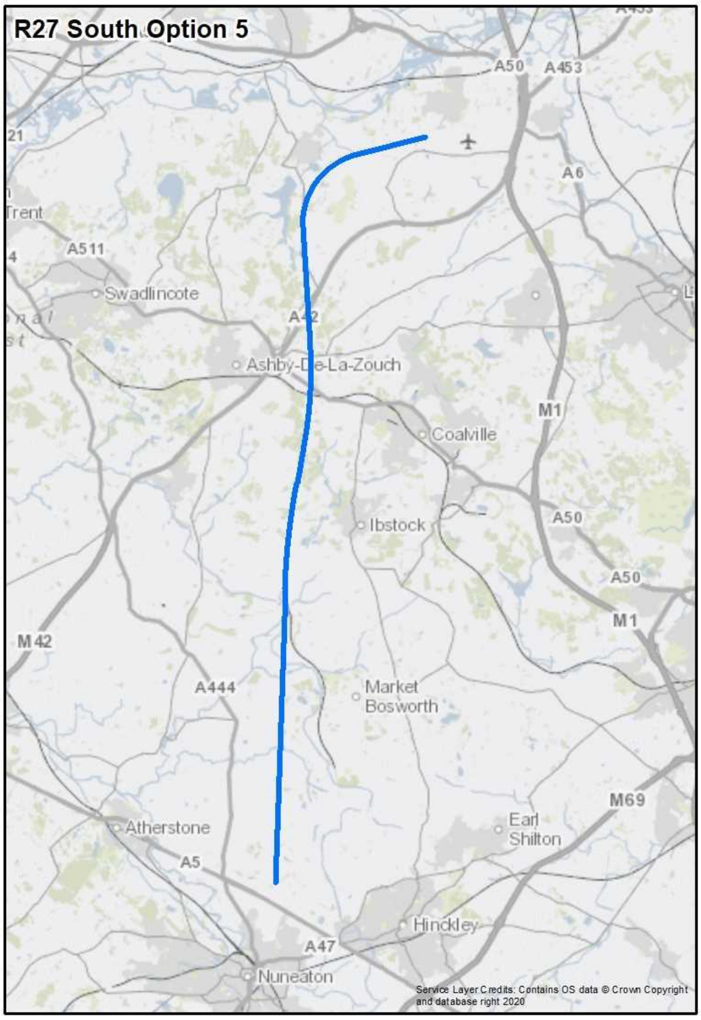
15.8. Runway 27 South Option 4

Description	Reason for inclusion
Option 4 proceeds straight ahead after take-off with no offset and has been created to provide the most direct and fuel efficient route to the expected network join to the south. After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A single left turn is then made onto a southerly heading and it passes between Ashby-de-la-Zouch and Coalville. This option is slightly further west than Option 2, resulting in the route passing to the west of Ibstock and terminating north of Nuneaton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3**: Aims to reduce the impact of noise when compared to the current route by avoiding overflight of Ashby-de-la-Zouch. Also avoids overflight of Coalville. **Emissions:** The shortest track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



15.9. Runway 27 South Option 5

Description	Reason for inclusion
Option 5 has a 12° southerly offset and has been created as a route that specifically seeks to reduce the impact of noise on built up areas, whilst also retaining the fuel benefits of Option 4. The initial 15° offset to the south results in the route passing south of Melbourne. A left turn is made at approximately 1.6nm beyond the DER onto a southerly heading to pass between Ashby-de-la-Zouch and Coalville, but with slightly greater distance from Ashby-de-la-Zouch than Option 4. It then seeks to avoid Ibstock to the west and terminates to the north of Nuneaton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch, Coalville and Ibstock. The 12° southerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



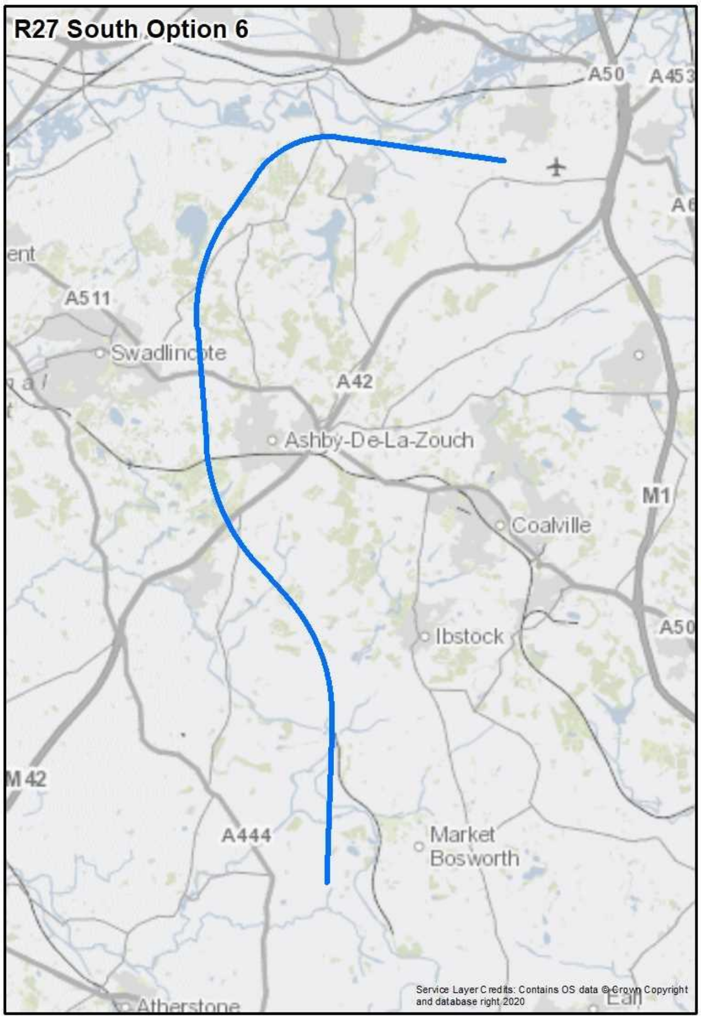
15.10. Runway 27 South Option 6

Description

Option 6 has a 10° northerly offset, as an alternative to avoid Melbourne to the north. It also seeks to reduce the impact of noise on built up areas to the south west.

The initial 10° offset to the north results in the route passing north of Melbourne and this heading is continued for approximately 3nm. At this point a turn onto a south westerly heading is made, followed by a second left turn to the west of Hicknall to achieve a more southerly heading passing between Swadlincote and Ashby-de-la-Zouch. A third turn onto a southerly direction is made near Ibstock, and it terminates to the west of Market Bosworth.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

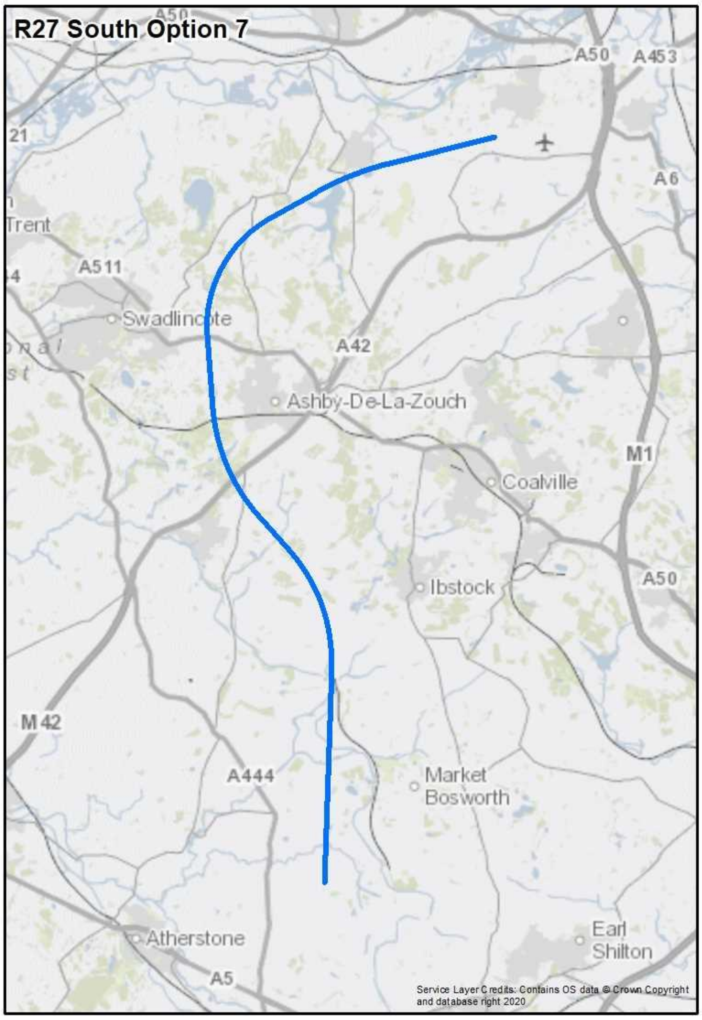
Noise N3: Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch and Swadlincote.

The 10° northerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne.

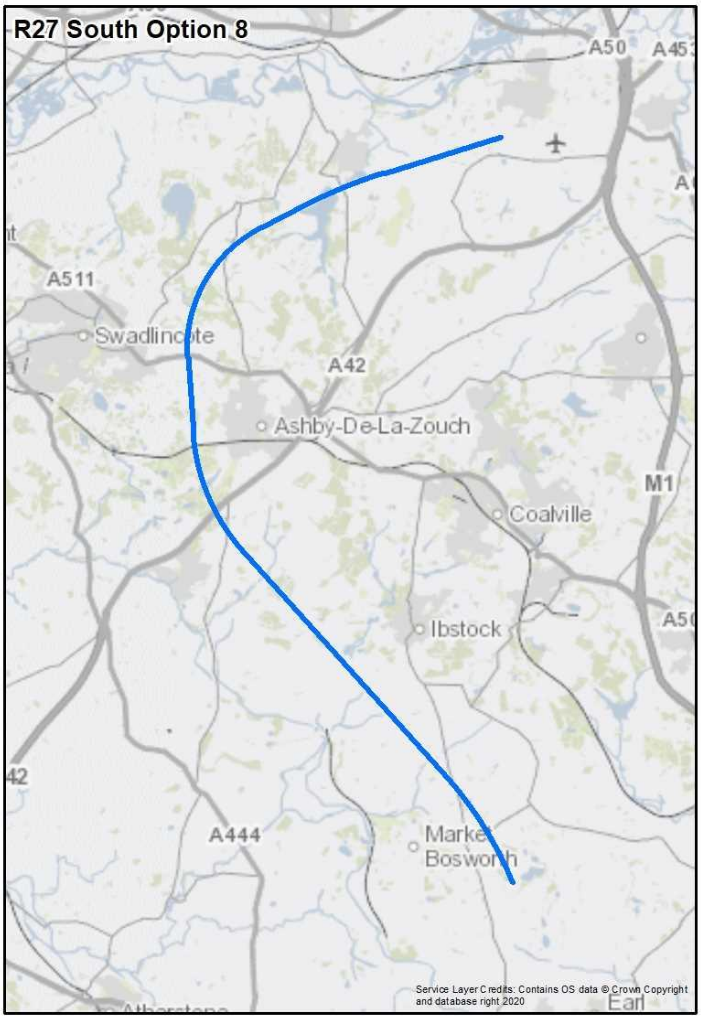
Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

15.11. Runway 27 South Option 7

Description	Reason for inclusion
Option 7 has a 12° southerly offset to avoid Melbourne whilst seeking to reduce the impact of noise on built up areas. It is similar to Option 6 once the route options combine to the north of Ashby-de-la-Zouch. The initial 12° southerly offset results in the route passing south of Melbourne and this heading is continued for approximately 4.5nm until a point close to Ticknall. At this point a turn onto a southerly heading is made where it joins with the track for Option 6 to pass between Swadlincote and Ashby-de-la-Zouch. A third turn onto a southerly direction is made near Ibstock, and it terminates to the south west of Market Bosworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch and Swadlincote. The 12° southerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

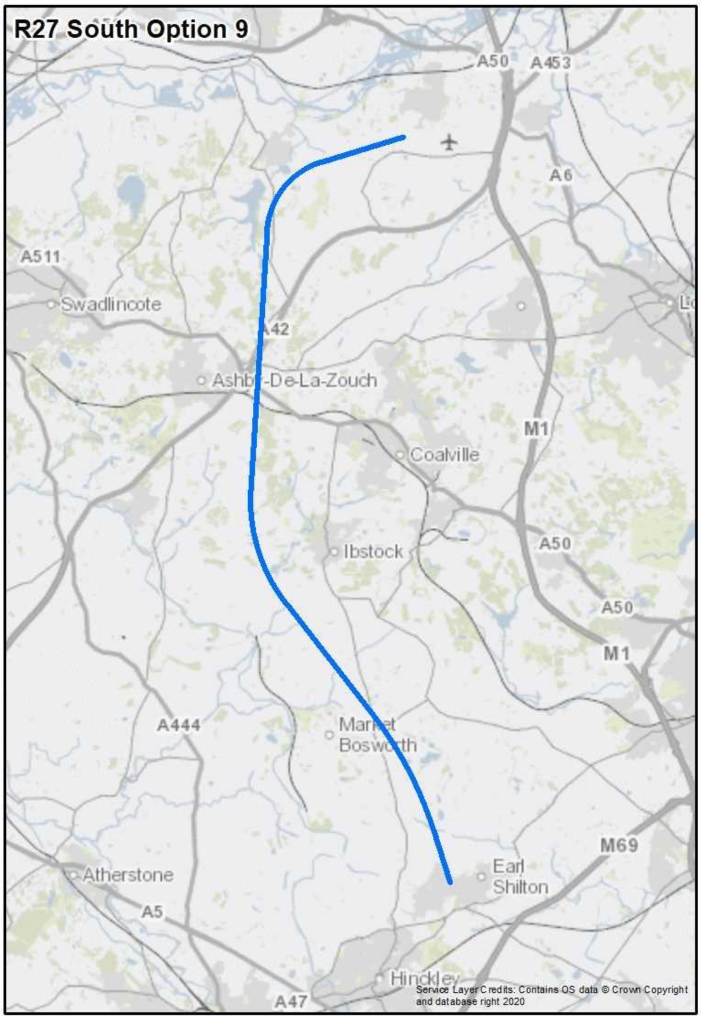


15.12. Runway 27 South Option 8

Description	Reason for inclusion
Option 8 has a 15° southerly offset to avoid Melbourne whilst seeking to reduce the impact of noise on built up areas. It is similar to Option 6 and 7 but terminates further east, close to Mallory Park circuit. This higher initial offset achieves a slightly greater divergence from Melbourne. The initial 15° southerly offset results in the route passing south of Melbourne and this heading is continued for approximately 4.5nm until a point close to Ticknall. At this point a turn onto a southerly heading is made where it joins with the track for Option 6 to pass between Swadlincote and Ashby-de-la-Zouch. A third turn onto a south easterly direction is made close to Measham, and it maintains this heading terminating to the south east of Market Bosworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	**Noise N3:** Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch and Swadlincote. The increased 15° southerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne in response to stakeholder feedback. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

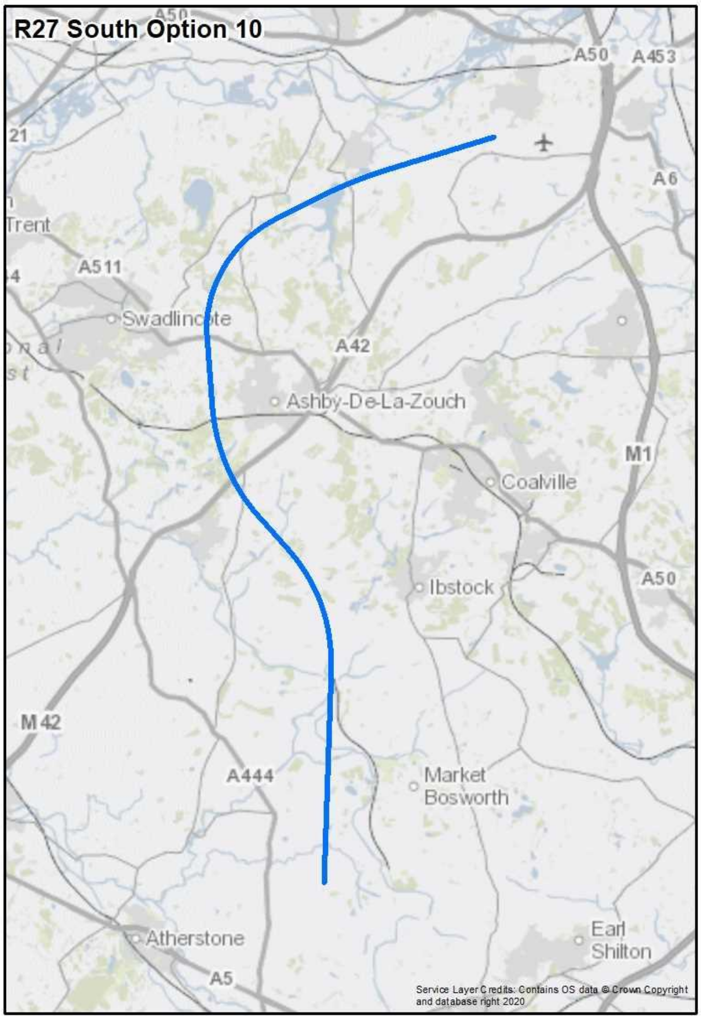
15.13. Runway 27 South Option 9

Description	Reason for inclusion
Option 9 has a 15° southerly offset to avoid Melbourne but has a more direct and fuel efficient route that still avoids the impact of noise on built up areas. It is similar to Option 8 but routes to the east of Ashby-de-la-Zouch. The initial 15° southerly offset results in the route passing south of Melbourne where a turn to the south is made. The track passes to the east of Ashby-de-la-Zouch and once west of Ibstock, it makes a second left turn to achieve a south east heading terminating over Earl Shilton. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N3: Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch. The increased 15° southerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne in response to stakeholder feedback. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



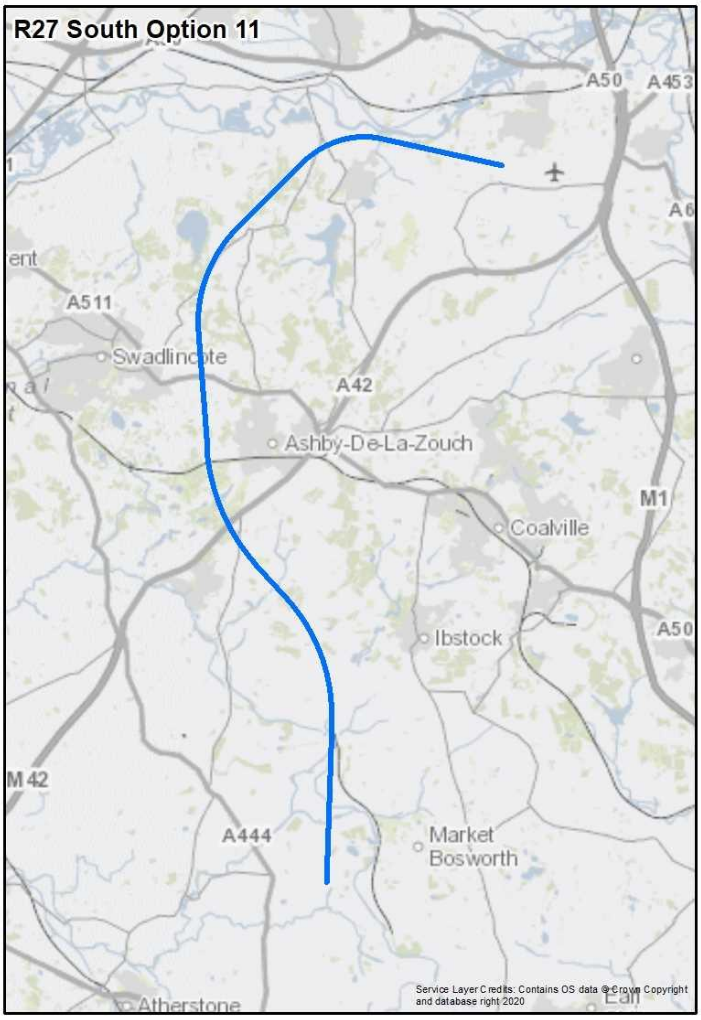
15.14. Runway 27 South Option 10

Description	Reason for inclusion
Option 10 has a 12° southerly offset to avoid Melbourne whilst seeking to reduce the impact of noise on built up areas. It is similar to Option 7 but the higher initial offset achieves a slightly greater divergence from Melbourne. The initial 15° southerly offset results in the route passing south of Melbourne and this heading is continued for approximately 4.5nm until a point close to Ticknall. At this point a turn onto a southerly heading is made where it joins with the track for Option 6 to pass between Swadlincote and Ashby-de-la-Zouch. A third turn onto a southerly direction is made near Ibstock, and it terminates to the south west of Market Bosworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch and Swadlincote. The increased 15° southerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



15.15. Runway 27 South Option 11

Description	Reason for inclusion
Option 11 has a 15° northerly offset to avoid Melbourne to the north and also seeks to reduce the impact of noise on built up areas to the south west. It is similar to Option 6 but the higher initial offset achieves a slightly greater divergence from Melbourne. The initial 15° offset to the north results in the route passing north of Melbourne and this heading is continued for approximately 2.2nm beyond the DER, where a turn to south westerly heading is made. To the west of Hicknall a second turn is made to achieve a more southerly heading passing between Swadlincote and Ashby-de-la-Zouch. A third turn is made near Ibstock, and it terminates to the west of Market Bosworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3:** Aims to reduce the impact of noise on built up areas by avoiding overflight of Ashby-de-la-Zouch and Swadlincote. The increased 15° northerly offset aims to reduce the impact of noise on communities close to the runway in particular Melbourne in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



15.16. Runway 27 South Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A12	S	P	C

Description: This option departs runway 27 in a westerly direction for approximately 6nm before turning left overflying Swadlincote in a south easterly direction towards Nuneaton.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying Swadlincote, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes west, north west and south west. This would not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B13	S	P	C

Description: This option heads west until Burton upon Trent where it turns left onto a south easterly heading towards Nuneaton.

Programme: This option fails to align with the simplification and environmental ends of the AMS.

> *Simplification*: By routing so far west, this option has potential to interact with arrivals and departures to and from Birmingham airport.
>
> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying Burton upon Trent, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions and interaction with traffic to and from Birmingham airport. There is therefore no benefit that could be traded to justify an amber rating.

Meeting demand: This option fails to align with this design principle, because it would have an interaction with the west departure envelope. This would not enable best use of runway capacity.

C14	S	P	C

Description: This option makes an immediate right-hand wrap-around turn after departure from runway 27, overflying southern Nottingham and proceeding in a south-south westerly direction towards Hinckley.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the revised network joining point. By overflying south Nottingham, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes south east and north. In addition, it may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

D15	S	P	C

Description: This option departs runway 27 in a north westerly direction before making a left-hand turn to the south west of Derby onto a south-south east heading overflying Swadlincote and proceeding towards Nuneaton.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying south Derby and Swadlincote, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions, and insufficient justification for an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes north west, west and south west. This would not enable best use of runway capacity.

16. SID Runway 27 – South East

16.1. Introduction to 27 South East Design Envelope

This is a new envelope that has been created for traffic routing to the to the south east and east from runway 27. At present, all south east departures from this runway use the DTY SID initially and are then vectored by ATC once within the NATS upper airspace network. This envelope creates the option for more direct and flight plannable routes, to both the south east and the east.

Because this is a new envelope, there is no 'do minimum' option for any of the design options.

Following the second phase of engagement, feedback was received from NERL on the viability of this envelope and the associated design options once above 7,000ft. This is outlined in full in section 6.15 but the feedback was that this envelope may present traffic in the opposite direction to the network flow, and this may limit the ability of EMA departing aircraft to receive a continuous climb. However, because the network design to the south of EMA has not been developed, this envelope and all options have been retained for analysis in the DPE and IOA. Further work will be carried out at Step 3A to analyse the viability of these options in light of the feedback received from NERL.

In addition to the above, and as detailed in section 6.15, preliminary qualitative analysis of the options within the 27 east right envelope suggested that those options may adversely increase the number of people affected by noise. In seeking to provide an alternative, the original 27 South East Design Envelope has been extended to the north and seven additional design options added which provide alternative options for flights to the east. These seven options duplicate the first part of the route used for Options 1-7 in the original 27 South East Design Envelope by routing to the south of Loughborough. However, at a point above 4,000ft these additional options make a left turn to head east. These additional options are described as options 8-12 in the description below.

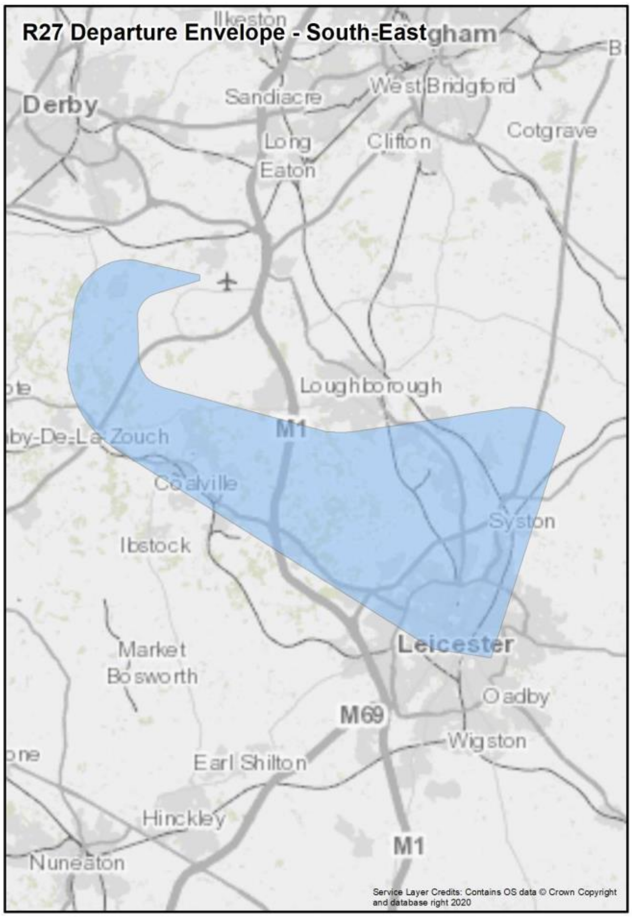
These departure options to the east have the potential to create significant fuel savings but will require additional CAS. As a result of this potential benefit, and their responsibility for creating this airspace, NERL have led engagement conversations with impacted stakeholders including the military and the GA community on the concepts being proposed for this additional. These include discussions on the operating hours and the horizontal and vertical dimensions of this airspace to ensure safety for both commercial and non-commercial aviation is assured.

Any proposed changes to either the use or hours of this airspace will be included in coordinated consultation activities between EMA and NERL in Stage 3. Suitable design options that are developed through this process will then be consulted upon more widely in Stage 3 if pursued by EMA. Whilst NERL will be responsible for formal consultation with impacted stakeholders above 7,000ft, the responsibility will remain with EMA where any proposed departure or arrivals routes pass through any volume of new airspace below 7,000ft.

However, at this early stage of the process there is uncertainty as to the exact position of this airspace and any joining points, therefore there is a requirement to maintain flexibility in the proposed options. These options are therefore retained in this comprehensive list of options to be carried forward for analysis in the DPE and IOA.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient and terminate at 7,000ft. The original options 1-7 terminate in the area where this current BPK departure exits EMA airspace whilst the revised options terminate in the area between Syston and Barrow-upon-Soar. The resulting combined envelope is approximately 5.5nm wide.

16.2. Design Envelope Location Map



16.3. 27 South East Option Summary Table

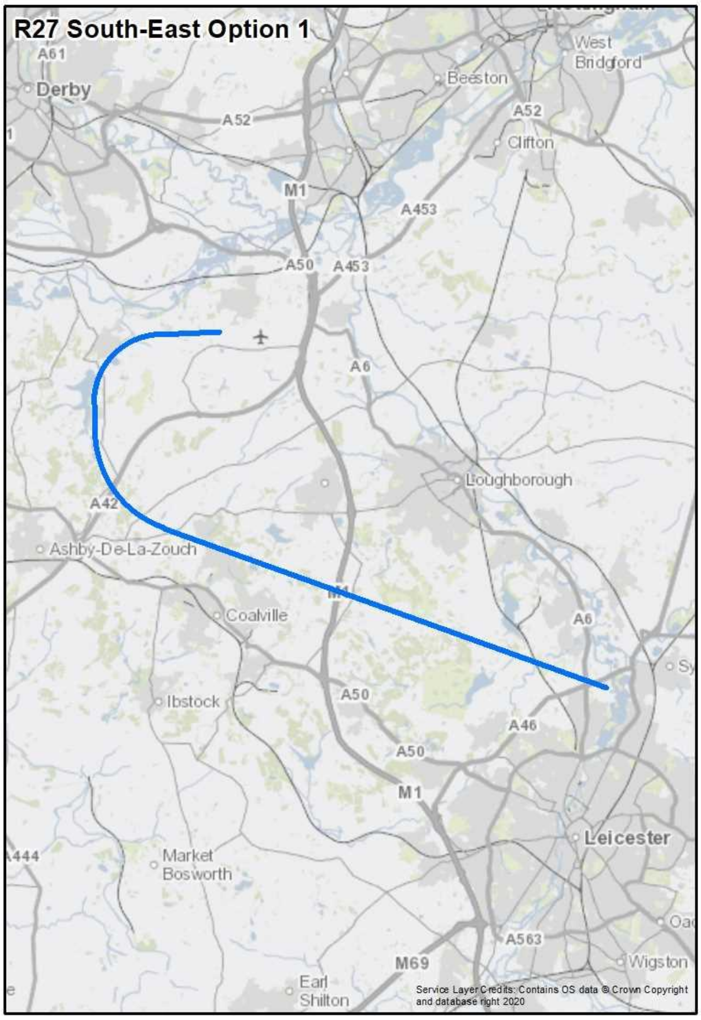
Viable and Good Fit		Viable but Poor Fit		Unviable	
1	Straight ahead with no offset before making a left turn followed soon after by a second turn to achieve a south east heading terminating just north of Leicester.	A8	A right-hand wrap-around to the north of EMA, routing to the east of Loughborough. Option fails to align to: • Safety • Programme • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	Straight ahead with no offset and following the same initial track as Option 1 with two left turns to head south east. It takes a more northerly south east track after the second turn, terminating close to Syston.	B9	Initially straight ahead before turning south to pass between Swadlincote and Ashby-de-la-Zouch. Turning to a south east heading. Option fails to align to: • Programme • Continuity		

3	Straight ahead with no offset and following the same initial track as Option 1 with two left turns to head south east. It takes a more southerly south east track after the second turn, terminating over northern Leicester.	C10	An early turn south passing to the east of Ashby-de-la-Zouch making a second turn towards Leicester. Option fails to align to: • Programme • Continuity		
4	A 10° northerly offset before turning south and then south east, overflying Coalville and terminating just north east of Leicester.	D11	Departing to the north west before turning to a south east heading to pass north of Ashby-de-la-Zouch. Option fails to align to: • Programme • Continuity		
5	A 10° southerly offset before a tight south then south east turn passing between Coalville and Shepshed and terminating north east of Leicester.				
6	A 10° southerly offset before turning south then south east passing over Coalville and terminating over west Leicester.				
7	A 10° northerly offset before turning south then east south east and terminating close to Mountsorrel north of Leicester.				
12	Straight ahead with no offset before turning south and then south east. Turns left when south of Loughborough to head east.				

13	Straight ahead with no offset before turning south and then south east passing north of Ashby-de-la-Zouch. Turns left when south of Loughborough to head east.				
14	Straight ahead with no offset before turning south and then south east passing over Coalville. Turns left when west of Woodhouse Eaves to head east.				
15	A 10° northerly offset before turning south and then south east, overflying Coalville before turning left to head east.				
16	A 10° southerly offset before turning south and then south east, avoiding Coalville and Loughborough before turning left to head east.				
17	A 10° southerly offset before turning south and then south east, routing west of Coalville before turning left to head east.				
18	A 10° northerly offset before turning south and then south east passing north of Ashby-de-la-Zouch and Coalville and south of Loughborough. Makes a small left turn to head east.				

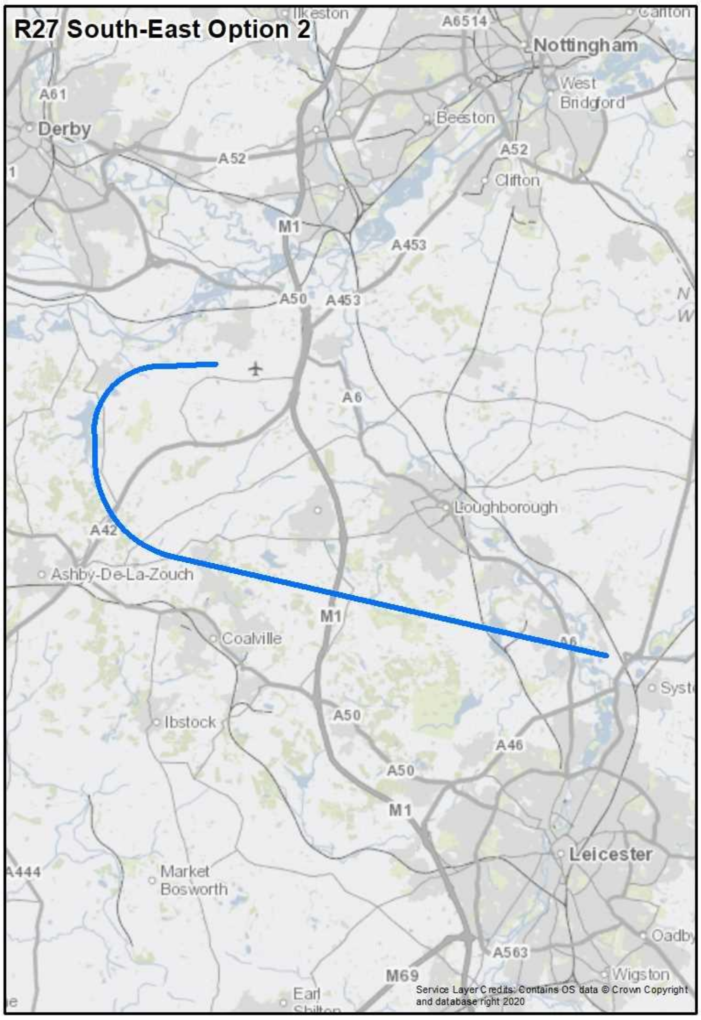
16.4. Runway 27 South East Option 1

Description	Reason for inclusion
Option 1 proceeds straight ahead after take-off with no offset and uses CAP778 speeds and turn criteria to route to the south east. After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A left turn is then made onto a southerly heading for a short distance before making a second left turn to route north of Coalville and head in a south easterly direction, terminating to the east of the A6 and A46 junction just north of Leicester. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



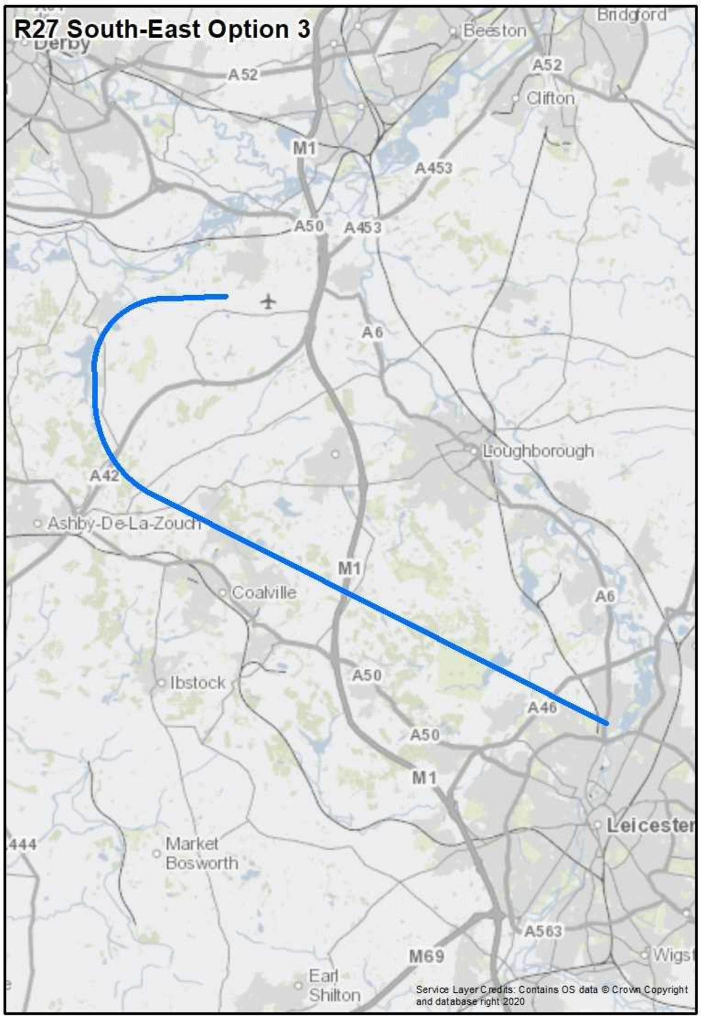
16.5. Runway 27 South East Option 2

Description	Reason for inclusion
Option 2 is similar to Option 1 but takes a more northerly track after the second turn. After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A left turn is then made onto a southerly heading for a short distance before making a second left turn to route north of Coalville. It heads in a south easterly direction overflying Mountsorrel and terminates close to Syston. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3**: Aims to reduce the impact of noise by routing north of Leicester. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



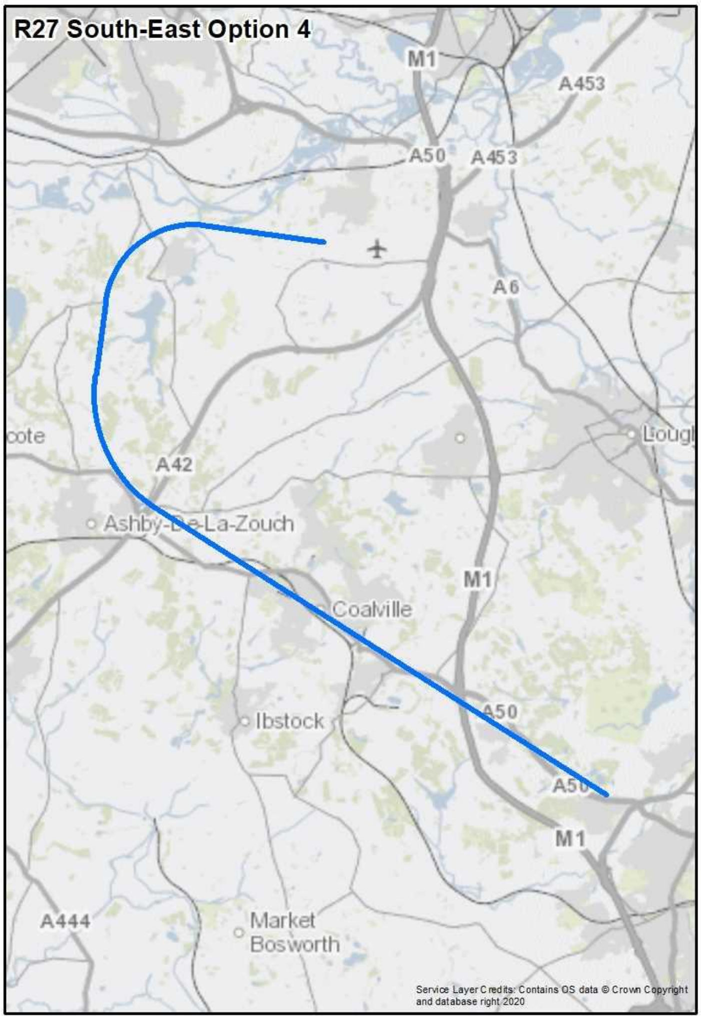
16.6. Runway 27 South East Option 3

Description	Reason for inclusion
Option 3 is similar to Option 1 but takes a more southerly track after the second turn to terminate closer to Leicester. After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A left turn is then made onto a southerly heading for a short distance before making a second left turn to route over Coalville. It heads in a south easterly direction overflying Whitwick and terminates over northern Leicester, close to Birstall. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Noise N2: Terminates over Leicester which has a higher level of ambient noise than surrounding rural areas. Emissions: A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



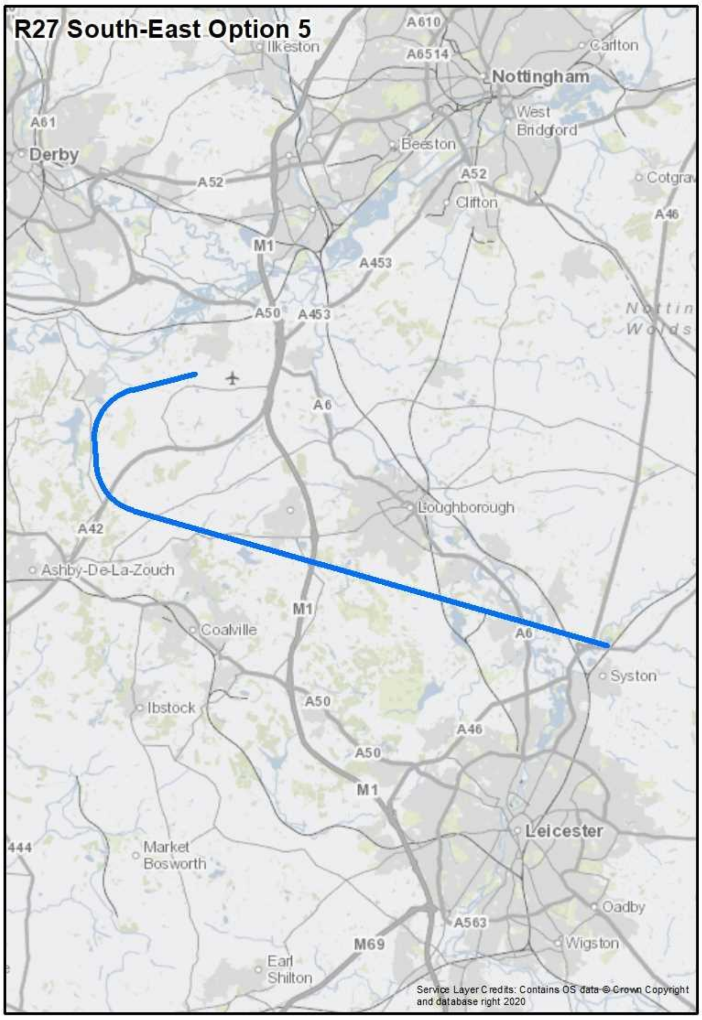
16.7. Runway 27 South East Option 4

Description	Reason for inclusion
Option 4 has a 10° northerly offset, as an alternative to avoid Melbourne to the north. The 10° offset to the north results in the route passing north of Melbourne and then turning left to head south. A second turn is made to the north east of Ashby-de-la-Zouch to route in a south east direction, passing west of Coalville. The option terminates to the north west of Leicester close to Groby. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N2**: Aims to follow the line of the A511 and A50 where possible, which have a higher level of ambient noise than surrounding rural areas. **Noise 3**: The 10° northerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

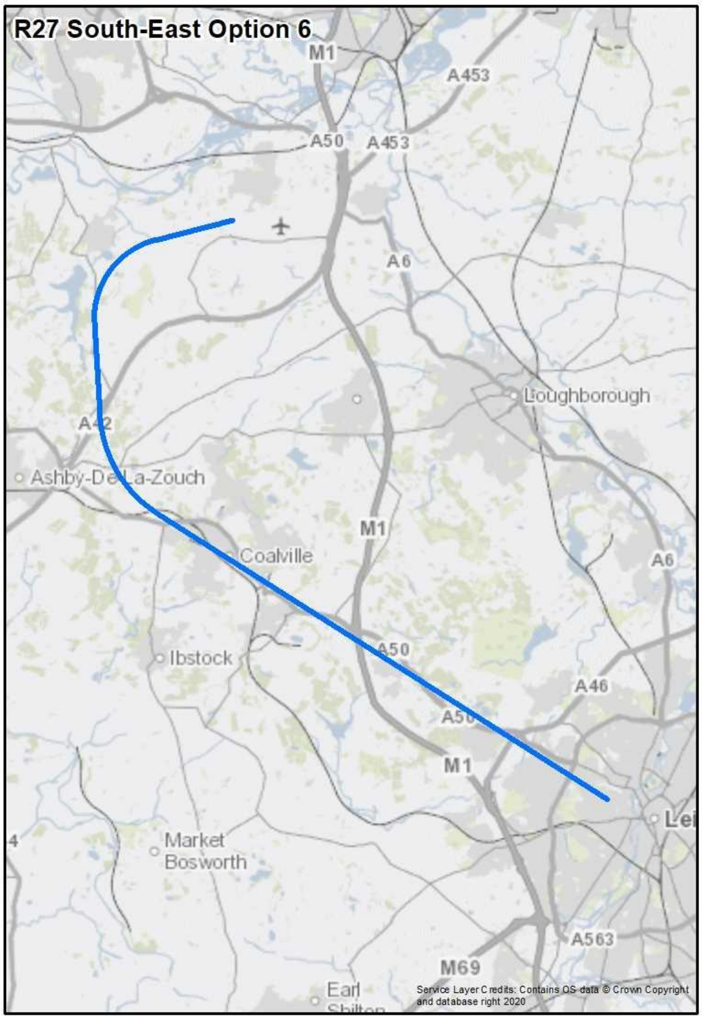


16.8. Runway 27 South East Option 5

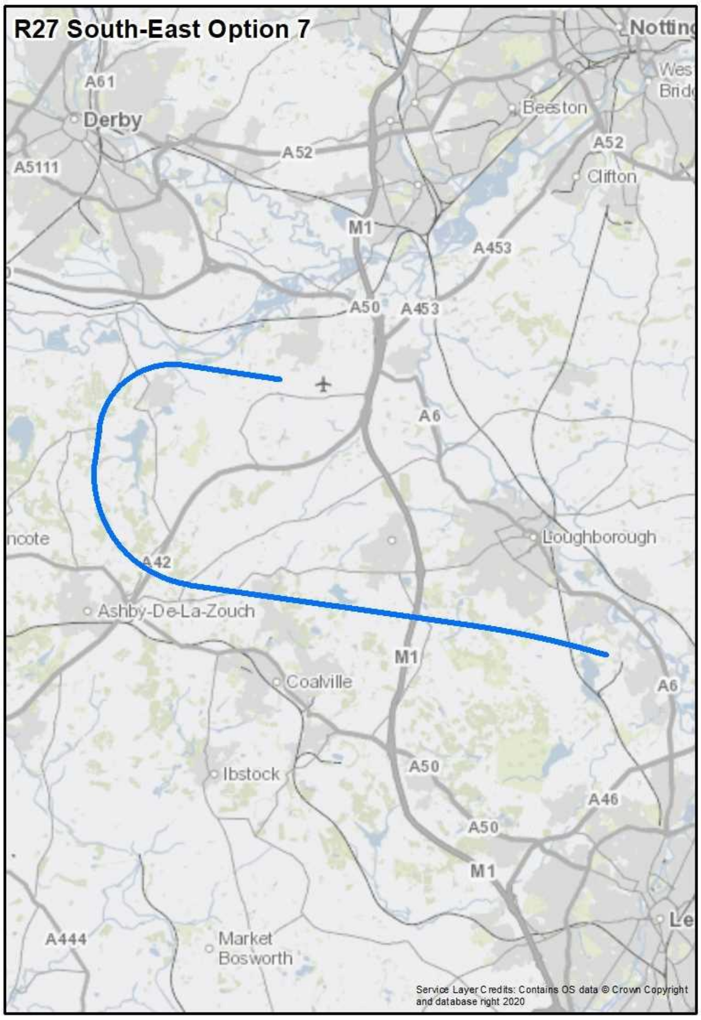
Description	Reason for inclusion
Option 5 has a 10° southerly offset followed by a series of tight turns to avoid Coalville and Leicester. The 10° offset to the south results in the route passing south of Melbourne and then making two turns in quick succession to head to the south east. This results in a track that passes north of Coalville and south of Shepshed and Loughborough before terminating north of Syston just to the north east of Leicester. The route has a constant climb gradient of 6%, terminating at 7,000ft. The two initial turns have been limited to 190KIAS to enable the tightest turn possible to achieve a more northerly route to avoid Coalville. The route is PANS-OPS compliant but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.	Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Noise N3: The tight first turns have been created to reduce the impact of noise by avoiding Coalville, Shepshed, Loughborough and Leicester. The 10° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne. Emissions: A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



16.9. Runway 27 South East Option 6

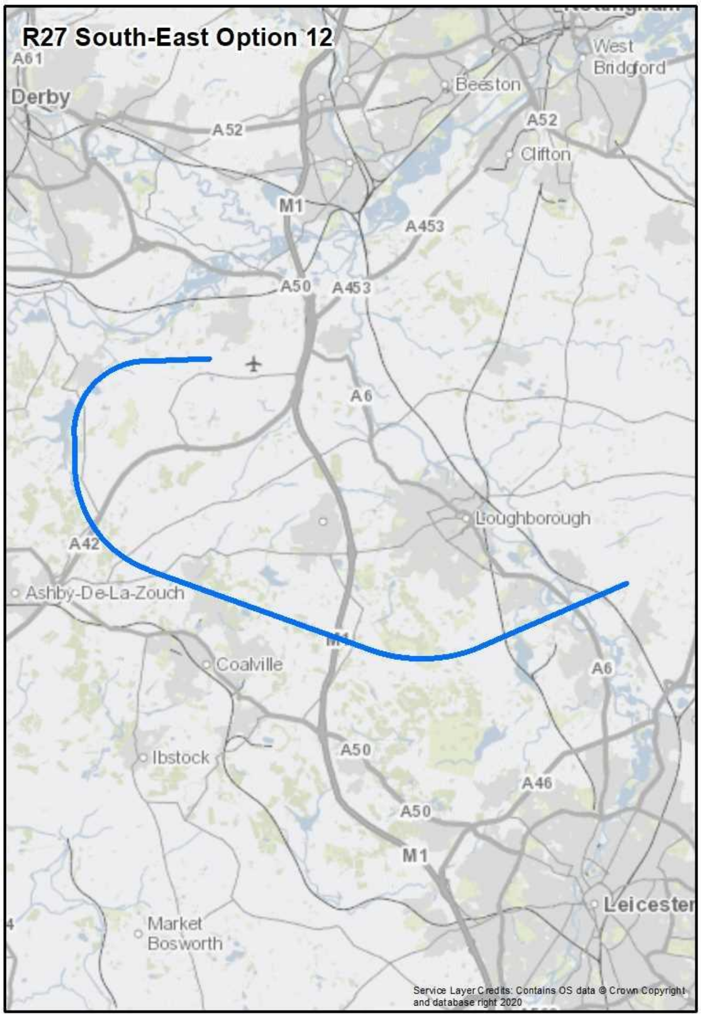
Description	Reason for inclusion
Option 6 has a 10° southerly offset to provide a noise benefit and then heads south to follow the similar route as Option 4. This results in a slightly shorter route for fuel burn and emissions benefits. The 10° offset results in the route passing south of Melbourne and then turning left to head south and route between Ashby-de-la-Zouch and Coalville. A second turn is made at the A42 which delivers a south east heading where it joins the track for Option 5 passing west of Coalville. The option terminates over west Leicester. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	**Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N2:** Aims to follow the line of the A511 and A50 where possible and terminates over Leicester, both of which have a higher level of ambient noise than surrounding rural areas. **Noise N3:** A 10° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne in response to stakeholder feedback. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

16.10. Runway 27 South East Option 7

Description	Reason for inclusion
Option 7 has a 10° northerly offset and then heads south east to follow a similar route to Option 5 to avoid Coalville and Loughborough. The 10° offset results in the route passing north of Melbourne and then making two turns to head south then south east, remaining north of both Ashby-de-la-Zouch and Coalville. This track continues to pass south of Shepshed and Loughborough before terminating north of Syston. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn. 	**Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise 3**: Routes to reduce the impact of noise by avoiding Coalville, Shepshed, Loughborough and Leicester. The 10° offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne in response to stakeholder feedback. **Emissions:** A shorter track length compared to the current route to join the network is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

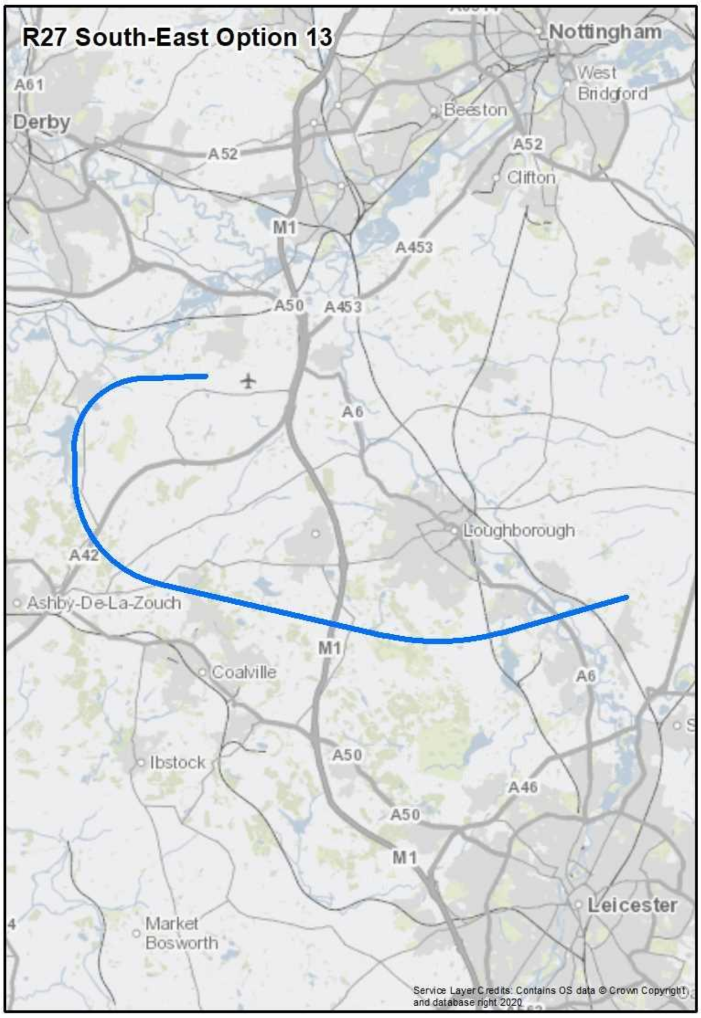
16.11. Runway 27 South East Option 12

Description	Reason for inclusion
Option 12 is initially similar to Option 1 but turns left when south of Loughborough to provide an alternative option for flights to the east. After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A left turn is then made onto a southerly heading for a short distance before making a second left turn to route north of Coalville and head in a south easterly direction. At a point close to Woodhouse Eaves it makes a left turn to route between Quorn and Mountsorrel before terminating before terminating east of Barrow upon Soar. The route has a constant climb gradient of 6% terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Noise N3: Aims to reduce the impact of noise by routing south of Loughborough and north of Leicester. Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



16.12. Runway 27 South East Option 13

Description	Reason for inclusion
Option 13 is initially similar to Option 2 but turns left when south of Loughborough to provide an alternative option for flights to the east. After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A left turn is then made onto a southerly heading for a short distance before making a second left turn to route north of Coalville. It heads in a south easterly direction flying north of Woodhouse Eaves to route between Quorn and Mountsorrel between Barrow upon Soar and Sileby. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Noise N3: Aims to reduce the impact of noise by routing south of Loughborough and north of Leicester. Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



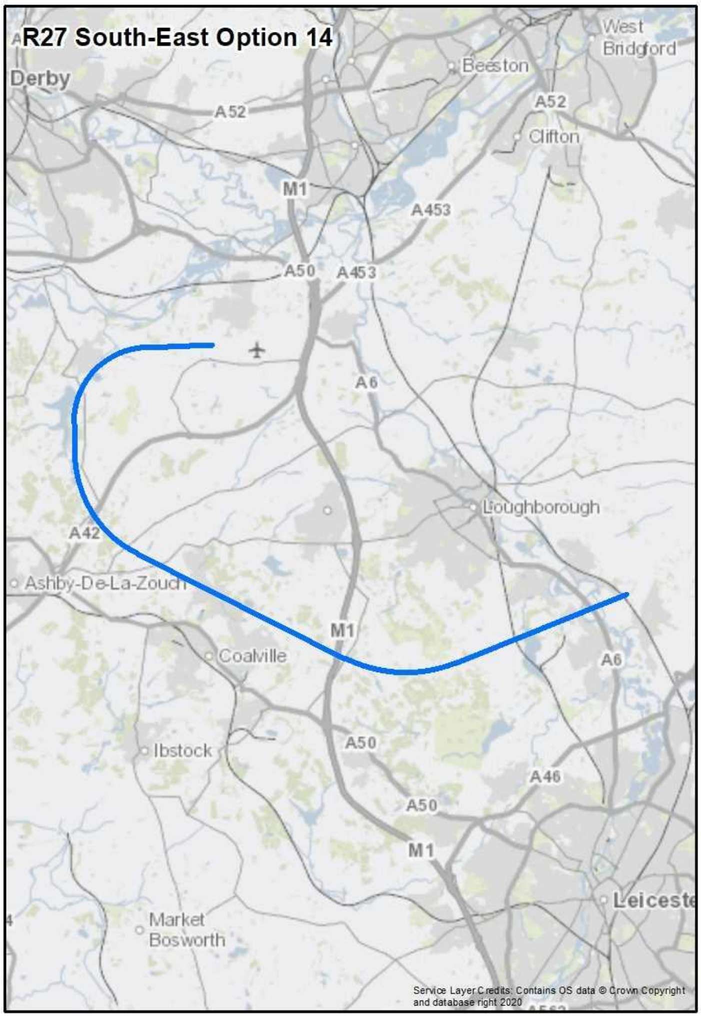
16.13. Runway 27 South East Option 14

Description

Option 14 is initially similar to Option 3 but turns left when mid-way between Loughborough and Leicester to provide an alternative option for flights to the east.

After departure this follows the runway heading for 1.4nm with no offset passing close to the south east corner of Melbourne. A left turn is then made onto a southerly heading for a short distance before making a second left turn to route over Coalville. It heads in a south easterly direction until passing the M1 where it turns left to route south of Woodhouse Eaves and passing north of Mountsorrel before terminating close to Sileby.

The route has a constant climb gradient of 6% terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

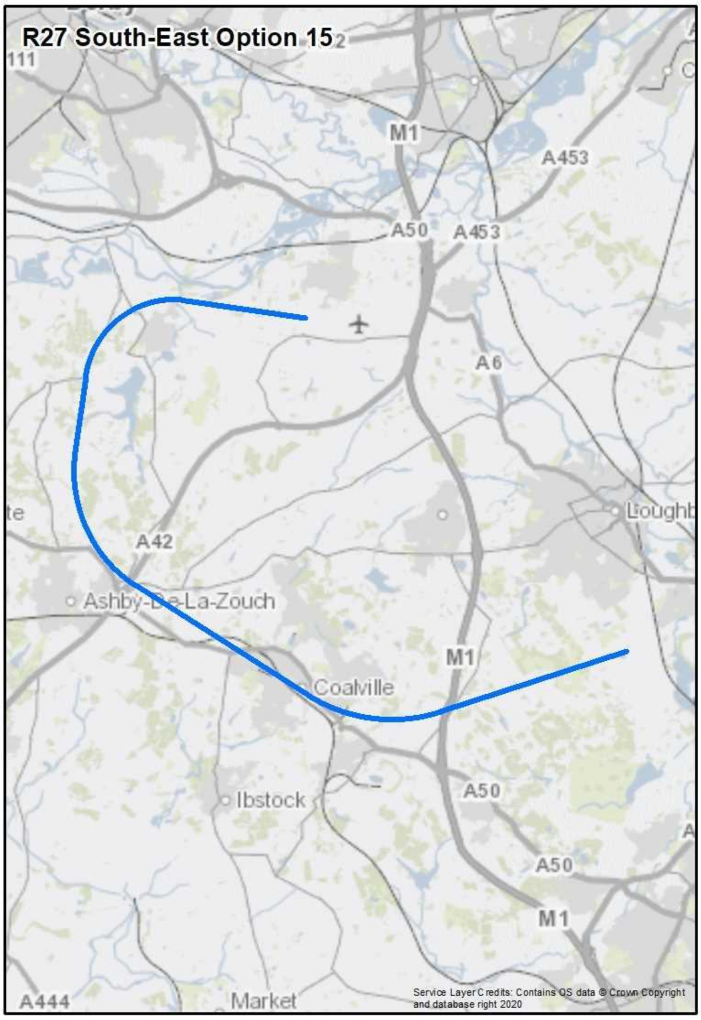
Noise N3: Aims to reduce the impact of noise by routing south of Loughborough and north of Leicester.

Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

16.14. Runway 27 South East Option 15

Description	Reason for inclusion
Option 15 is initially similar to Option 4 and has a 10° northerly offset but turns left south of Coalville to provide an alternative option for flights to the east. The 10° offset to the north results in the route passing north of Melbourne and then turning left to head south. A second turn is made to the north east of Ashby-de-la-Zouch to route in a south east direction, passing west of Coalville. It continues in this south easterly direction until passing Bardon Hill where it turns left to route towards Woodhouse Eaves and terminates just west of Quorn. The route has a constant climb gradient of 6% terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N1**: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3**: The 10° northerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne. In addition, the route aims to reduce the impact of noise by avoiding Coalville and routing south of Loughborough. **Emissions**: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Technology**: RNAV is the lowest PBN specification and therefore usable by all aircraft.



16.15. Runway 27 South East Option 16

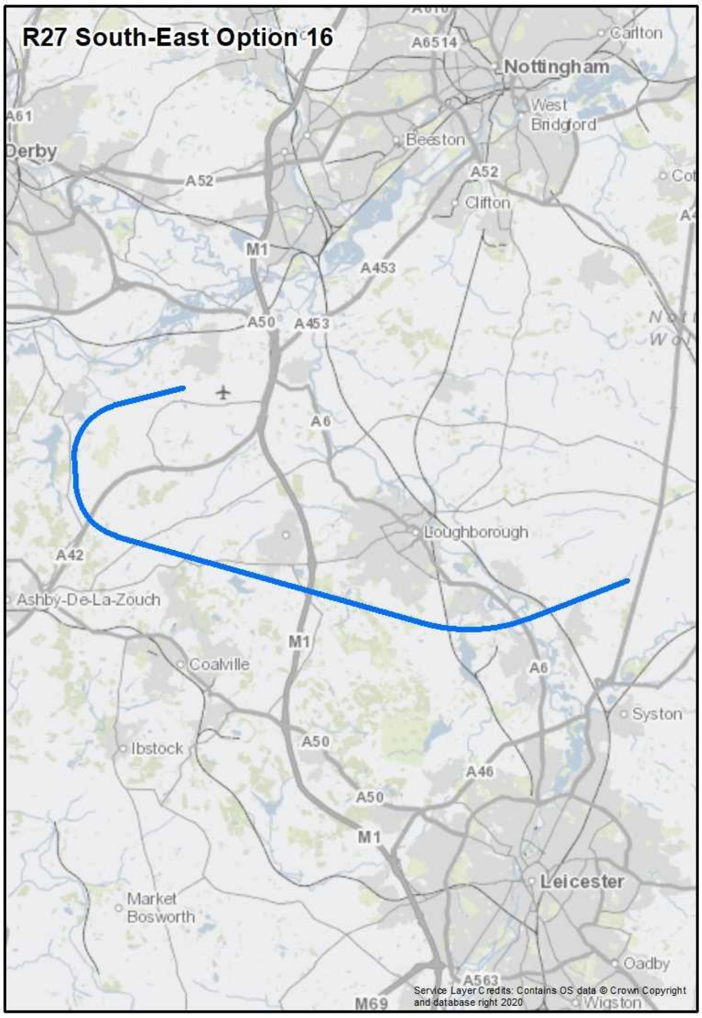
Description

Option 16 is initially similar to Option 5 and has a 10° southerly offset but turns left south of Quorn to provide an alternative option for flights to the east.

The 10° offset to the south results in the route passing south of Melbourne and then making two turns in quick succession to head to the south east. This results in a track that passes north of Coalville and south of Shepshed and Loughborough. It continues in this south easterly direction until south of Quorn where it turns left to head in a north easterly direction, passing between Barrow upon Soar and Sileby and terminating west of Seagrave.

The route has a constant climb gradient of 6%, terminating at 7,000ft.

The two initial turns have been limited to 190KIAS. This slower speed enables a tighter turn that helps avoid built up areas. The route is PANS-OPS compliant but should it become a preferred option then it is recommended that it is assessed for flyability as part of the procedure validation process within Stage 4 of CAP1616.



Reason for inclusion

Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes.

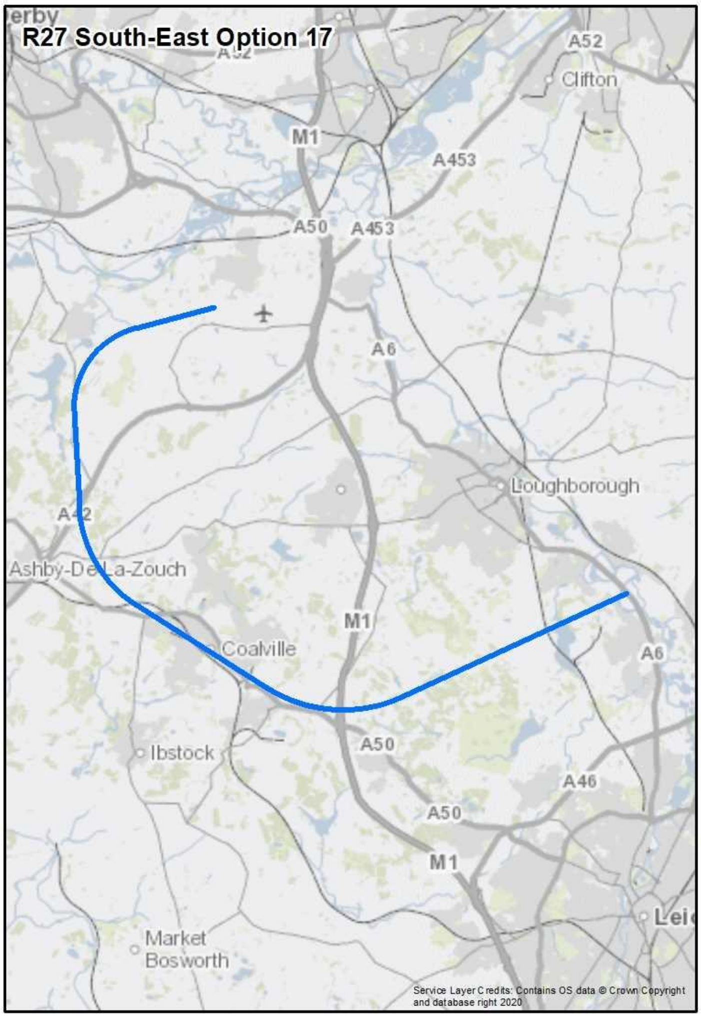
Noise N3: The 10° southerly offset and speed restriction aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne.

In addition, the route aims to reduce the impact of noise by routing south of Shepshed and Loughborough.

Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving.

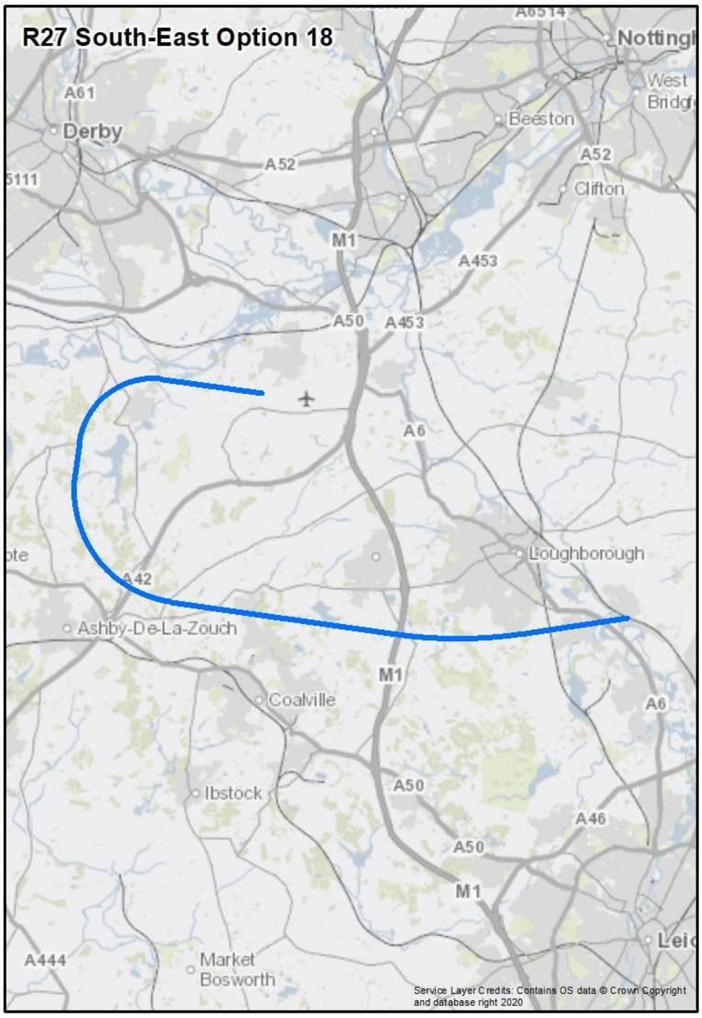
Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

16.16. Runway 27 South East Option 17

Description	Reason for inclusion
Option 17 is initially similar to Option 6 and has a 10° southerly offset but turns left south east of Coalville to provide an alternative option for flights to the east. The 10° offset results in the route passing south of Melbourne and then turning left to head south and route between Ashby-de-la-Zouch and Coalville. A second turn is made at the A42 onto a south east heading until reaching the M1 just west of Markfield where it turns left to head north east. It continues on this heading to pass between Quorn and Mountsorrel and terminates south of Barrow upon Soar. The route has a constant climb gradient of 6% terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.  	**Noise N1:** Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. **Noise N3**: The 10° southerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne. In addition, the route aims to reduce the impact of noise by routing between Ashby-de-la-Zouch and Coalville and south of Loughborough. **Emissions**: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. **Technology**: RNAV is the lowest PBN specification and therefore usable by all aircraft.

16.17. Runway 27 South East Option 18

Description	Reason for inclusion
Option 18 is similar to option 7 and has a 10° northerly offset but turns left south of Loughborough to provide an alternative option for flights to the east. The 10° offset results in the route passing north of Melbourne and then making two turns to head south then south east, remaining north of both Ashby-de-la-Zouch and Coalville. This track continues to pass south of Shepshed and Loughborough where it makes a left turn to head east and passes overhead Quorn and terminating over Barrow-upon-Soar. The route has a constant climb gradient of 6% terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N1: Spreads the impact of noise by creating an additional SID, which reducing the concentration on the current routes. Noise N3: The 10° northerly offset aims to reduce the impact of noise on communities close to the extended runway centreline including Melbourne. In addition, the route aims to reduce the impact of noise by routing south of Shepshed and Loughborough. Emissions: A flight plannable and significantly shorter track length than existing options for east bound departures. When combined, this will provide a fuel and emissions saving. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



16.18. Runway 27 South East Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A8	S	P	C

Description: This option makes an immediate right-hand wrap-around turn after departure from runway 27, overflying southern Nottingham and proceeding in a south easterly direction over Loughborough and north Leicester.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the revised network joining point. By overflying south Nottingham and Loughborough, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes to the north and may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B9	S	P	C

Description: This option departs runway 27 in a westerly direction for approximately 6nm before turning left overflying Swadlincote and then turning left in a south easterly direction towards Leicester.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying Swadlincote, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes west, north west and south west. This would not enable best use of runway capacity.

C10	S	P	C

Description: This makes a left turn in a southerly direction to overfly Ashby-de-la-Zouch and continuing south for around 8nm before turning south east towards Leicester.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying Ashby-de-la-Zouch, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelope to the south. This would not enable best use of runway capacity.

D11	S	P	C

Description: This option departs runway 27 in a north westerly direction before making a left-hand turn to the south west of Derby onto a south-south east heading passing overflying Swadlincote, Ashby de la Zouch and Coalville.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying south Derby, Swadlincote, Ashby de la Zouch and Coalville, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions, and insufficient justification for an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes north west, west and south west. This would not enable best use of runway capacity.

17. SID Runway 27 – South West

17.1. Introduction to 27 South West Design Envelope

This is a new envelope that has been created for traffic routing to the south west from runway 27. At present, all south west departures use the DTY SID initially and are then vectored once within the NATS upper airspace network. This envelope has been created to offer potential for a more direct and flight plannable route to the south west and to provide a greater spread of routes in line with Design Principle Noise N1.

Because this is a new envelope, there is no 'do minimum' option.

Whilst there is a benefit to EMA departures, bilateral meetings with BHX identified potential interactions for traffic routing in this direction. This interaction was identified to the east of the Birmingham CTA in the vicinity of Nuneaton and highlighted interactions between EMA 27 south west departures and:

- BHX LUVEM 1Y departures from runway 15.
- BHX UNGAP 1M departures from runway 33.

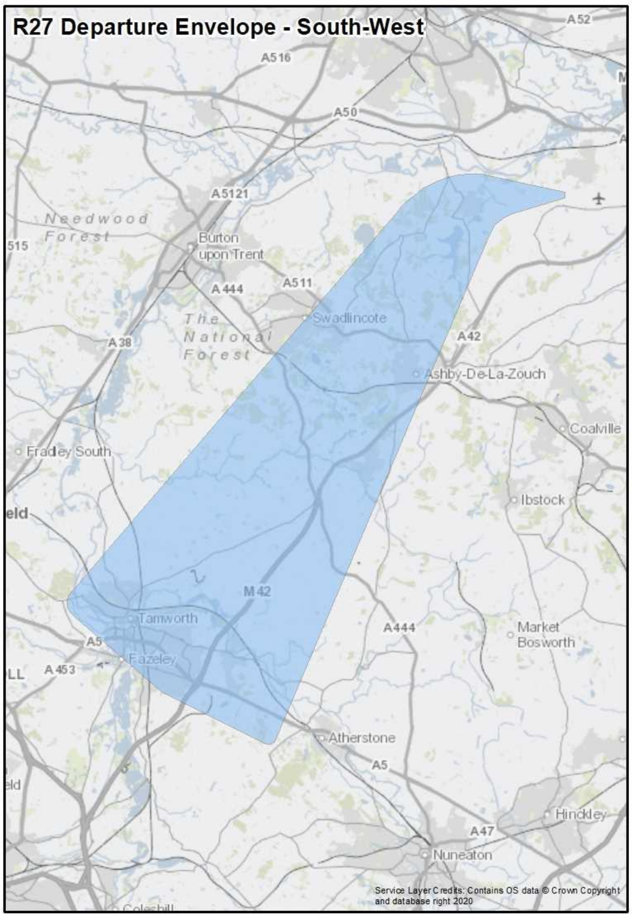
Further detailed design work is required with BHX to understand if safe separation exists or can be achieved through the modification of these options. This interaction has also been highlighted in the EMA ACP HAZID as an interaction with potential safety implications which requires further analysis. However, this envelope and the design options have been retained within the DOR as part of the comprehensive list of options. Analysis on interactions is outlined within the DPE and IOA, and further work to understand and resolve these issues will form part of detailed design discussions in Stage 3A.

All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient.

The letterbox is 4.5nm wide (2.25nm either side of the nominal track) and a minimum climb gradient of 6% is used to determine the point at which 7,000 ft is achieved.

A 6% climb gradient was chosen in this case due to the proximity of Birmingham airspace and the higher climb gradient allows aircraft to climb above the Birmingham Control Area (CTA).

17.2. Design Envelope Location Map



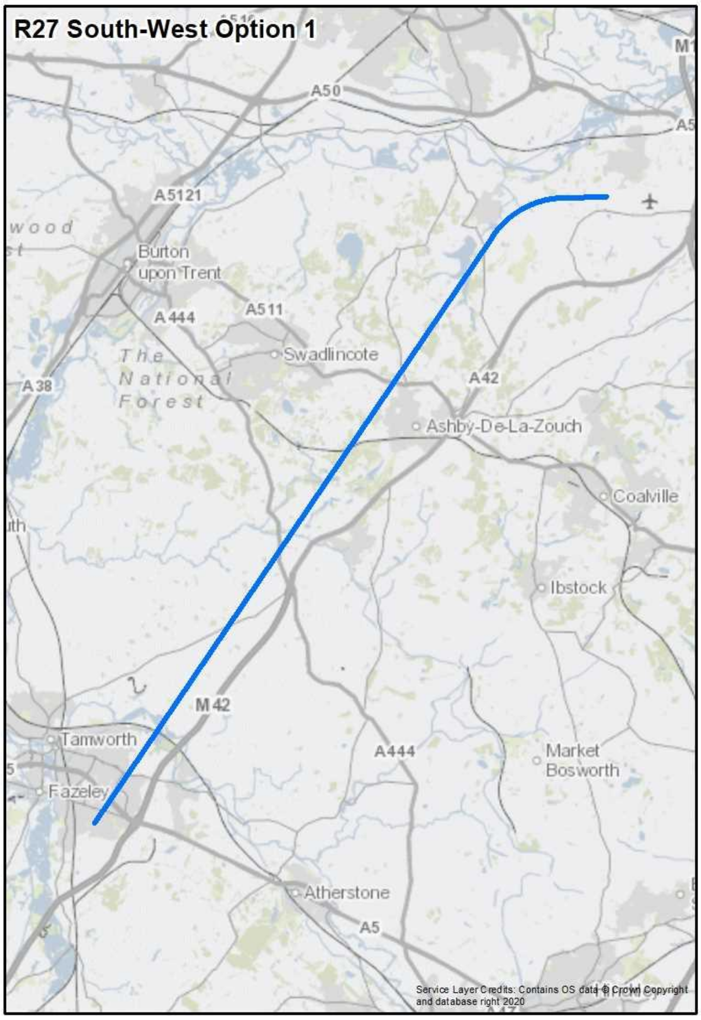
17.3. 27 South West Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	Straight ahead for 1nm with a left turn to the south west between Ashby-de-la-Zouch and Swadlincote, terminating over southern Tamworth.	A8	Initial westerly departure turning south west and overflying Burton upon Trent. Option fails to align to: • Programme • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	Straight ahead for 1nm with a left turn to the south west routing over Ashby-de-la-Zouch and Swadlincote, terminating south east of Tamworth.	B10	Left turn south with a second turn at Market Bosworth to a south west heading. Option fails to align to: • Programme • Continuity		

3	Straight ahead for 1nm with a left turn to the south west passing just south of Swadlincote, terminating north of Tamworth.	C11	Right-hand wrap-around to the north of EMA passing close to Loughborough on a south west heading. Option fails to align to: • Safety • Programme • Continuity		
4	A 10° southerly offset followed by a turn south west routing between Ashby-de-la-Zouch and Swadlincote, terminating south east of Tamworth.				
5	A 10° northerly offset followed by a turn south west passing just south of Swadlincote and paralleling the M42, terminating south east of Tamworth.				
6	A 10° northerly offset followed by a left turn south west passing over Swadlincote and terminating over north west Tamworth.				
7	A 15° southerly offset followed by a left turn southwest passing over Ashby-de-la-Zouch and terminating south of Tamworth.				
9	A 15° southerly followed by a turn south west routing between Ashby-de-la-Zouch and Swadlincote, terminating south of Tamworth.				

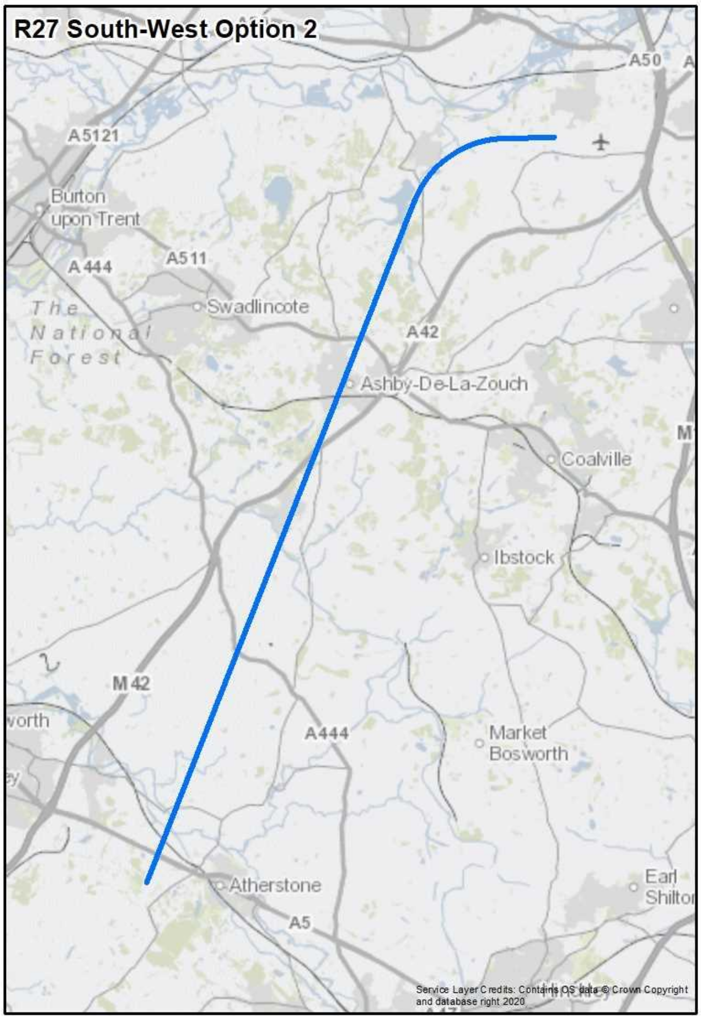
17.4. Runway 27 South West Option 1

Description	Reason for inclusion
Option 1 proceeds straight ahead after take-off and has been created to provide a direct route to the south west. After departure this follows the runway heading for 1nm with no offset before commencing a left turn onto a south west heading to pass just south east of Melbourne. The route passes between Ashby-de-la-Zouch and Swadlincote and follows a line parallel to the M42 and terminates over southern Tamworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N2:** Tracks parallel and close to the M42 which has a level of ambient noise. **Noise N3**: Aims to reduce the impact of noise by routing between Ashby-de-la-Zouch and Swadlincote. **Emissions:** The shortest track length to the south west is intended to minimise the fuel burn and emissions. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



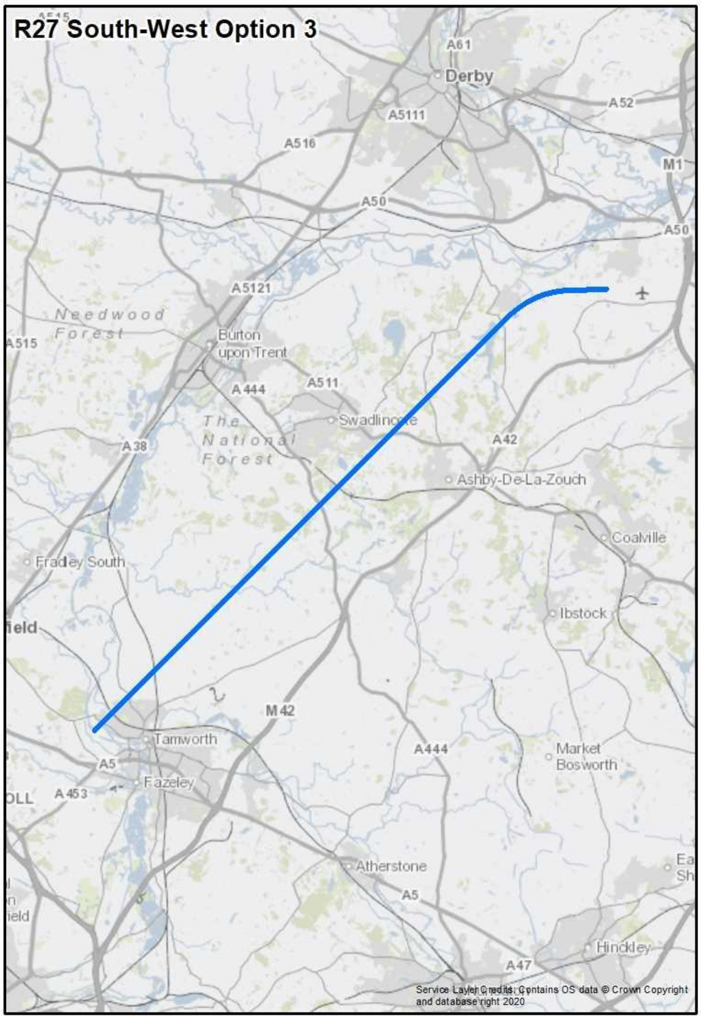
17.5. Runway 27 South West Option 2

Description	Reason for inclusion
Option 2 is similar to Option 1 but takes a more southerly track after the first turn. After departure this follows the runway heading for 1nm with no offset before commencing a left turn onto a south west heading to pass just south east of Melbourne. The route passes overhead Ashby-de-la-Zouch and follows a line south of the M42 to terminate south east of Tamworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N2:** Tracks parallel and close to the M42 which has a level of ambient noise. **Noise N3**: Aims to reduce the impact of noise by avoiding Tamworth. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



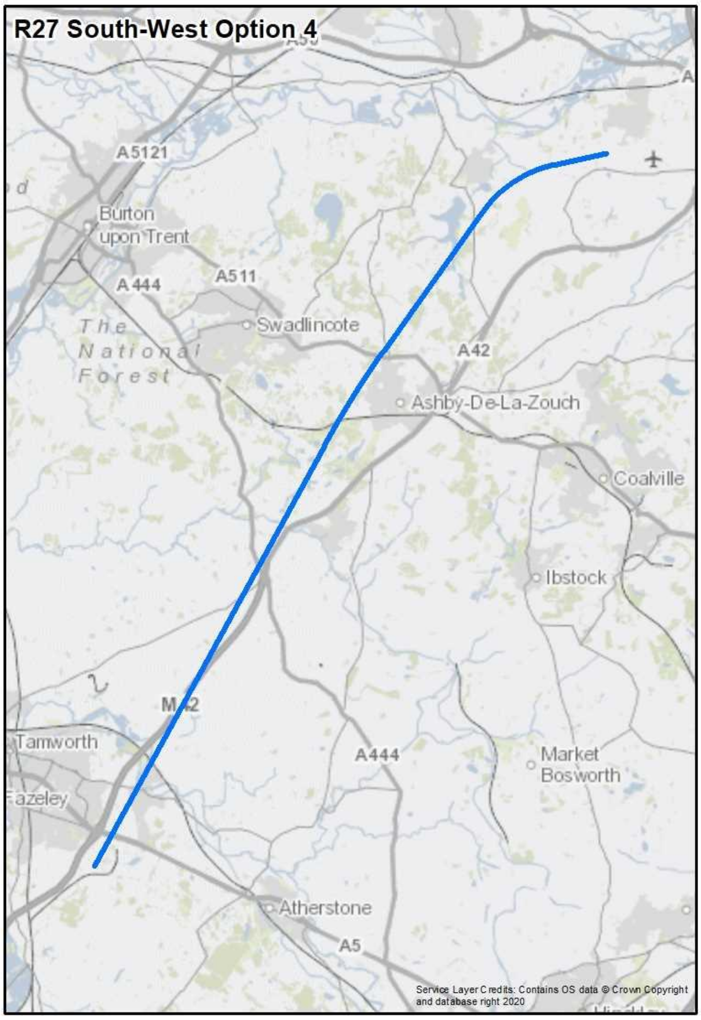
17.6. Runway 27 South West Option 3

Description	Reason for inclusion
Option 3 is similar to Option 1 but takes a more northerly track after the first turn. After departure this follows the runway heading for 1nm with no offset before commencing a left turn onto a south west heading to pass just south east of Melbourne. The route passes between Ashby-de-la-Zouch and Swadlincote and terminates north of Tamworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3**: Aims to reduce the impact of noise by routing between Ashby-de-la-Zouch and Swadlincote. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



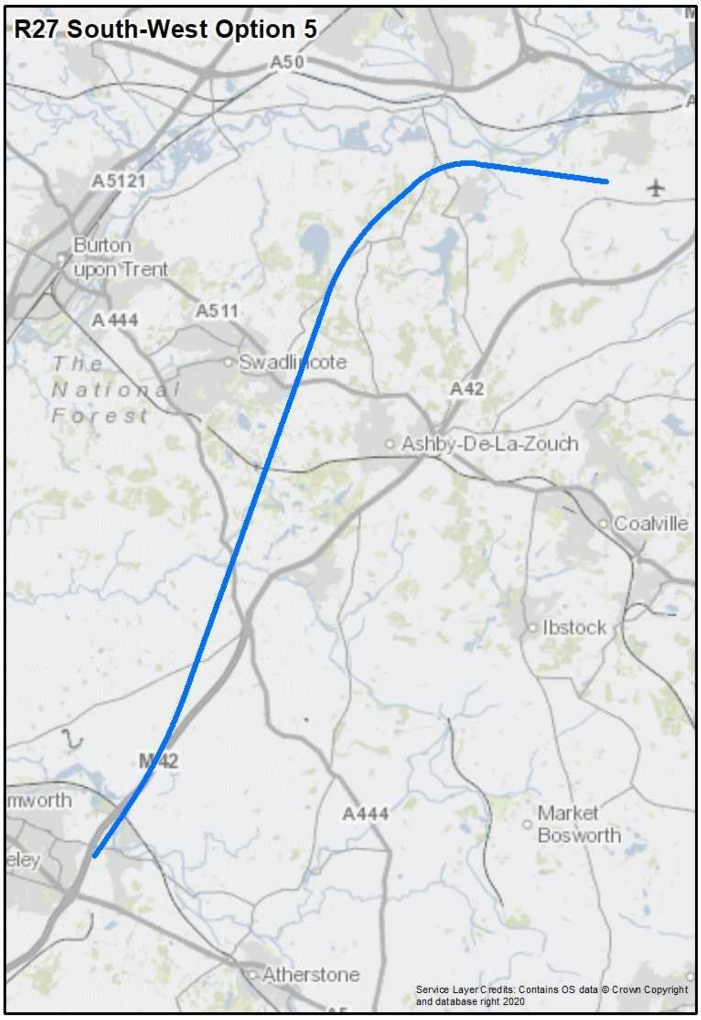
17.7. Runway 27 South West Option 4

Description	Reason for inclusion
Option 4 has a 10° southerly offset to avoid Melbourne and has been created to avoid Ashby-de-la-Zouch and Tamworth. The 10° offset results in the route passing south east of Melbourne and it then makes a left turn to pass north of Ashby-de-la-Zouch prior to turning slightly more to the south to follow the line of the M42 and terminates south east of Tamworth and the A5 and M42 junction. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N2: Tracks overhead the M42 which has a level of ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Swadlincote, Ashby-de-la-Zouch and Tamworth. The 10° southerly offset aims to avoid overflight of communities closer to the extended runway centreline including Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



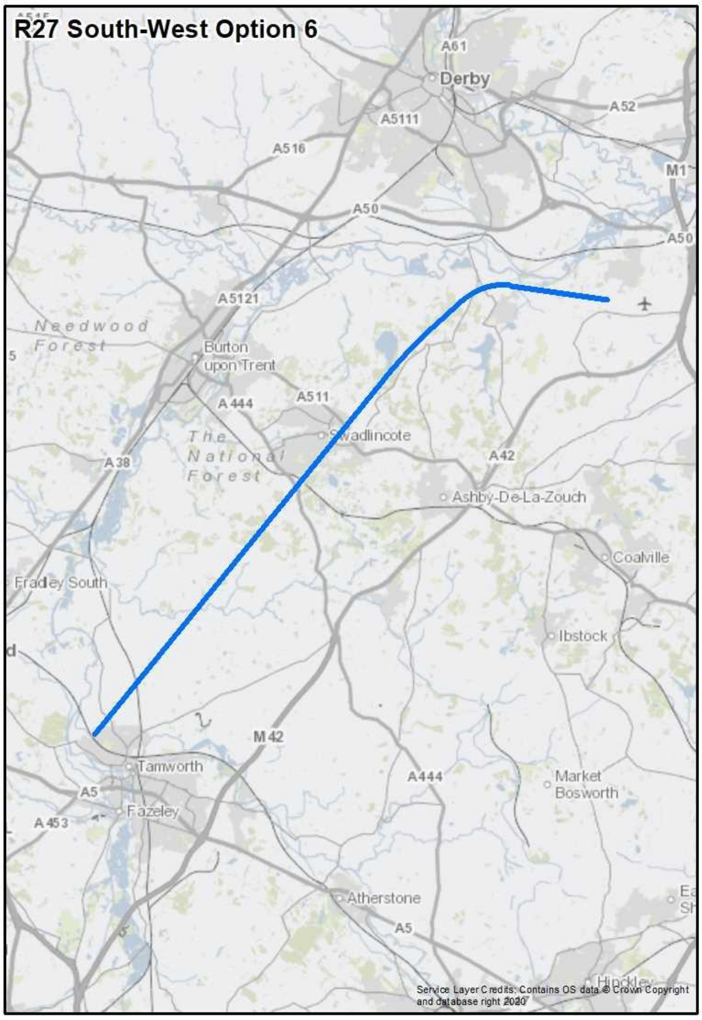
17.8. Runway 27 South West Option 5

Description	Reason for inclusion
Option 5 is similar to Option 4 but instead uses a 10° northerly offset to avoid Melbourne and has been created to avoid Swadlincote, Ashby-de-la-Zouch and Tamworth. The 10° offset results in the route passing north of Melbourne and it then makes a left turn to pass between Ashby-de-la-Zouch and Swadlincote. It continues on this heading but turns very slightly to the north as it crosses the M42, terminating south east of Tamworth and north east of the A5 and M42 junction. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N2: Tracks close to the M42 which has a level of ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Swadlincote, Ashby-de-la-Zouch and Tamworth. The 10° northerly offset aims to avoid overflight of communities closer to the extended runway centreline including Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



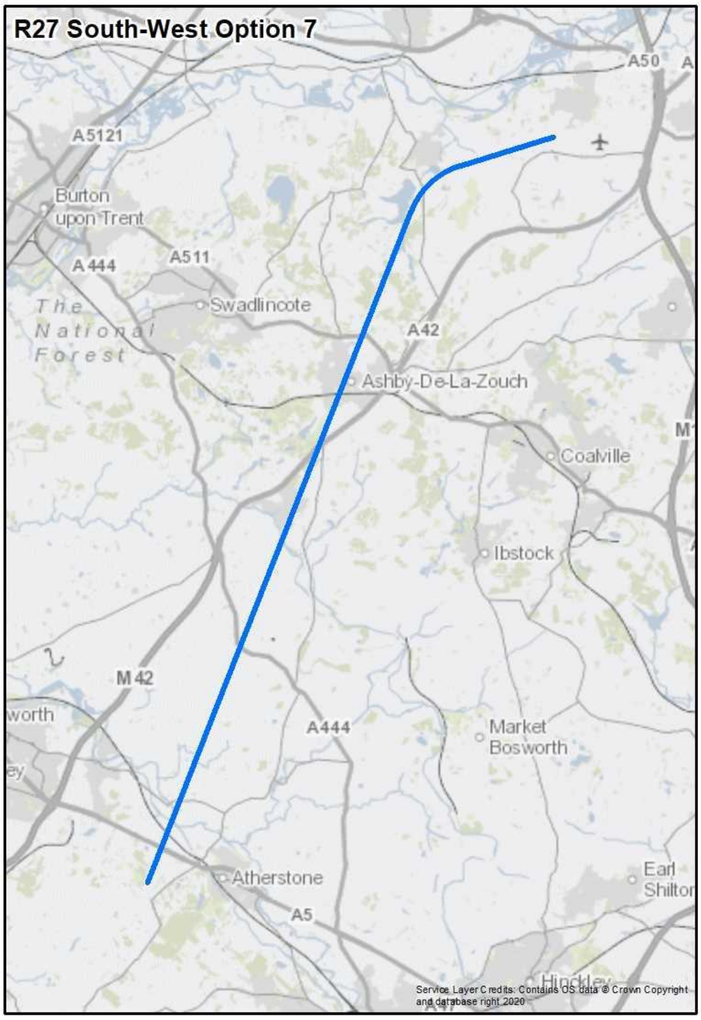
17.9. Runway 27 South West Option 6

Description	Reason for inclusion
Option 6 has the same 10° northerly offset as Option 5 but tracks further north. The 10° offset results in the route passing north of Melbourne and it then makes a left turn passing overhead Swadlincote. It continues on this heading terminating over north west Tamworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Noise N3**: A 10° northerly offset aims to avoids overflight of communities close to the extended runway centreline in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



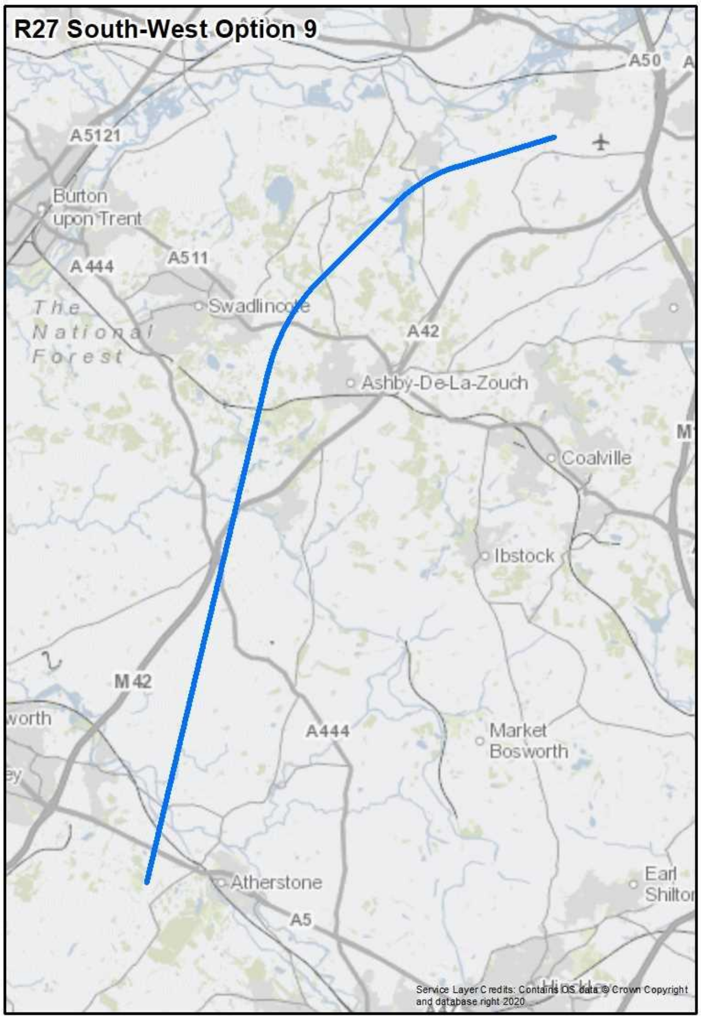
17.10. Runway 27 South West Option 7

Description	Reason for inclusion
Option 7 has the maximum 15° southerly offset to avoid Melbourne and then takes the same track as Option 2 to avoid Tamworth. The 15° offset results in the route passing south east of Melbourne and it then makes a left turn to pass overhead Ashby-de-la-Zouch. It continues on this heading and follows a line south of the M42 to terminate south east of Tamworth. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N2: Tracks close to the M42 which has a level of ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Tamworth. In addition, the 15° southerly offset aims to avoid the overflight of communities close to the extended runway centreline in response to stakeholder feedback. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



17.11. Runway 27 South West Option 9

Description	Reason for inclusion
Option 9 also has a 15° southerly offset to avoid Melbourne but then routes to avoid both Swadlincote and Ashby-de-la-Zouch. The 15° offset results in the route passing south east of Melbourne. At 2nm beyond the DER the route turns left to a south westerly heading, making a second left turn to pass between Swadlincote and Ashby-de-la-Zouch. It cuts across the M42 and terminates south east of Tamworth in the same position as Option 7. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Noise N2: Tracks parallel and close to the M42 which has a level of ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Ashby-de-la-Zouch, Swadlincote and Tamworth. In addition, the 15° southerly offset avoids overflight of communities close to the extended runway centreline in response to stakeholder feedback. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



17.12. Runway 27 South West Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A8	S	P	C

Description: This option departs runway 27 in a westerly direction for approximately 8nm before turning left overflying Burton upon Trent and heading in a south west direction.

Programme: This option fails to align with the simplification and environmental ends of the AMS.

> *Simplification*: The extended westbound track taken by this option has potential to interact with the routes to and from Birmingham airport.
>
> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network joining point. By overflying Burton upon Trent, the number of people impacted by noise this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions or interaction with Birmingham airport routes to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes west and north west. This would not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B10	S	P	C

Description: On departure from runway 27, this option initiates an immediate left turn, proceeding in a southerly direction over Coalville before turning right prior to Market Bosworth to a south westerly direction.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network. By overflying Coalville, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelope to the south. This would not enable best use of runway capacity.

C11	S	P	C

Description: This option makes an immediate right-hand wrap-around turn after departure from runway 27, overflying southern Nottingham and then proceeding in a south westerly direction over Loughborough and Coalville.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network. By overflying south Nottingham Loughborough and Coalville, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes to the north and south east and may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

18. SID Runway 27 – West

18.1. Introduction to 27 West Design Envelope

This is a new envelope created to provide traffic with the potential to route directly to the west, thereby avoiding additional track miles by routing north west on the current TNT SID, or south on the current DTY SID, before turning west. This envelope is aimed at decreasing the track mileage and fuel burnt in reaching the network.

Because this is a new envelope, there is no 'do minimum' option.

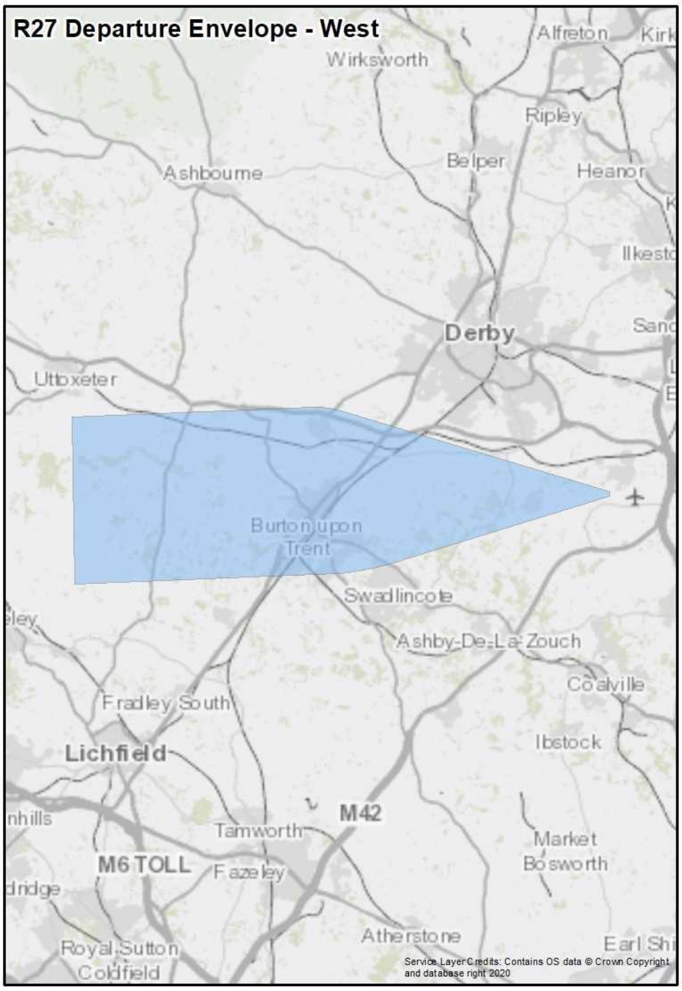
Whilst there is a benefit to EMA departures, bilateral meetings with both NERL and BHX following Stage 2 stakeholder engagement identified potential interactions and misalignments to the NERL network for traffic routing in this direction.

- BHX: Departures to the west create a potential interaction with flights to and from BHX to the west of Burton upon Trent. In particular these options may interact with arrivals from the CHASE hold, and arrivals that are being vectored in a left-hand pattern for runway 15 at BHX. Whilst BHX operations were identified as a constraint to EMA operations, this is not a published procedure but is used to create a more fuel efficient operation for their arrivals. Detailed design work is required with NERL and BHX to understand if safe separation exists or can be achieved through the modification of the EMA options.
- NERL: The concept of FUA remains a strategic priority for NERL and is being pursued as part of initiatives that align to the AMS. However, as described in section 6.13e) the military primacy in danger areas/restricted areas will remain unchanged. In relation to these design envelopes, once above 7,000ft all departure options would be seeking a route through the network that is directly west. There is currently no network joining point in this area, and this would ultimately result in aircraft transiting the North Wales Military Training Area (NWMTA) and thereafter a number of Danger Areas in the vicinity of Cardigan Bay. Whilst neither are notified as H24, conversations will be required with NERL and the military to understand the viability of any routes in this area.

These interactions have also been highlighted in the EMA ACP HAZID as having potential safety implications which requires further analysis. However, this envelope and the design options have been retained within the DOR as part of the comprehensive list of options. Analysis on both aspects is outlined within the DPE and IOA, and further work to understand and resolve these issues will form part of detailed design discussions in Stage 3A. All options in this envelope have been designed as RNAV1 routes with a 6% climb gradient.

This letterbox is 4.5nm wide (2.25nm) and a minimum climb gradient of 6% is used to determine the point at which 7,000ft is achieved.

18.2. Design Envelope Location Map



18.3. 27 West Option Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	This option follows the extended runway centreline heading directly west with no turn, overflying Burton upon Trent and terminating close to Blithfield reservoir.	A7	A 90 degree turn north, turning south west over north west Derby. Option fails to align to: • Programme • Continuity	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for noncompliance. This safety justification includes options where the first turn is less than PANS-OPS recommended distance in relation to the DER, but which is operated safely under current operations. Unviable options are those that are non-compliant with PANS-OPS in relation to: • MSD. • Position of the first turn in relation to DER if it is less than the current position within conventional procedures. • Turn radius based on speed, altitude and climb gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	A 15° southerly offset turning west just north of Swadlincote and terminating south east of Abbots Bromley.	B8	A right-hand wrap-around passing to the north, then east, then south of EMA to achieve a westerly heading. Option fails to align to: • Safety • Programme • Continuity		

3	A 15° northerly offset which routes between Derby and Burton upon Trent, terminating north east of Abbots Bromley and south of Uttoxeter.	C9	A left-hand wrap-around passing to the south, then east, then north of EMA to achieve a westerly heading. Option fails to align to: • Safety • Programme • Continuity		
4	A hybrid of Options 1 and 3 which has a 10° northerly offset, routing just north of Burton upon Trent a terminating north east of Abbots Bromley.	D10	Straight ahead followed by an early turn south, turning north west towards the letterbox. Option fails to align to: • Programme • Continuity		
5	A 15° northerly offset which turns west north of Derby and following the path of the A50, terminating south east of Uttoxeter.				
6	This option is the same as Option 4 until north west of Burton upon Trent where it turns south by south west, terminating south east of Abbots Bromley.				

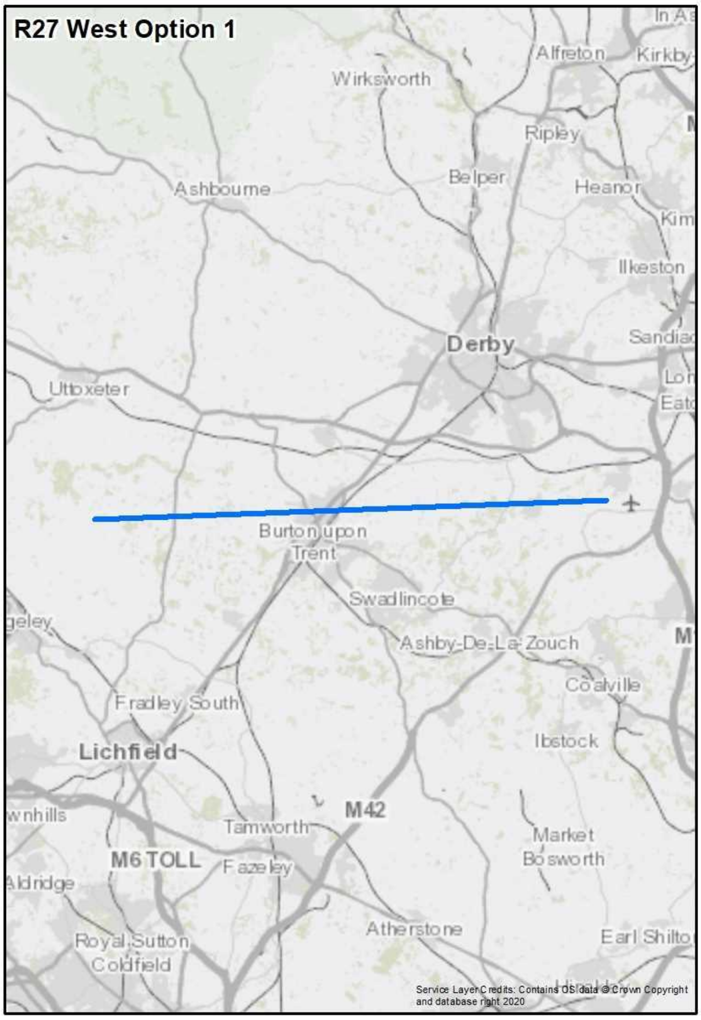
18.4. Runway 27 West Option 1

Description

This option provides a direct route to the west and proceeds straight ahead without making any turns. It has the least track mileage within this envelope as the route flies directly on runway heading.

After departure this follows the runway heading with no offset and overflies Melbourne and northern portion of Burton upon Trent before terminating close to Blithfield reservoir and Abbots Bromley.

There would be no speed restrictions applied to the procedure; therefore, the maximum speed of 250kts would apply. This will permit many aircraft to fly this route in a clean configuration (without the use of flaps) which has potential benefits in terms of noise.



Reason for inclusion

Continuity: Has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on westerly operations.

Emissions: When compared to the current route, the shorter track length for flights to the west is intended to minimise fuel burn and emissions.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

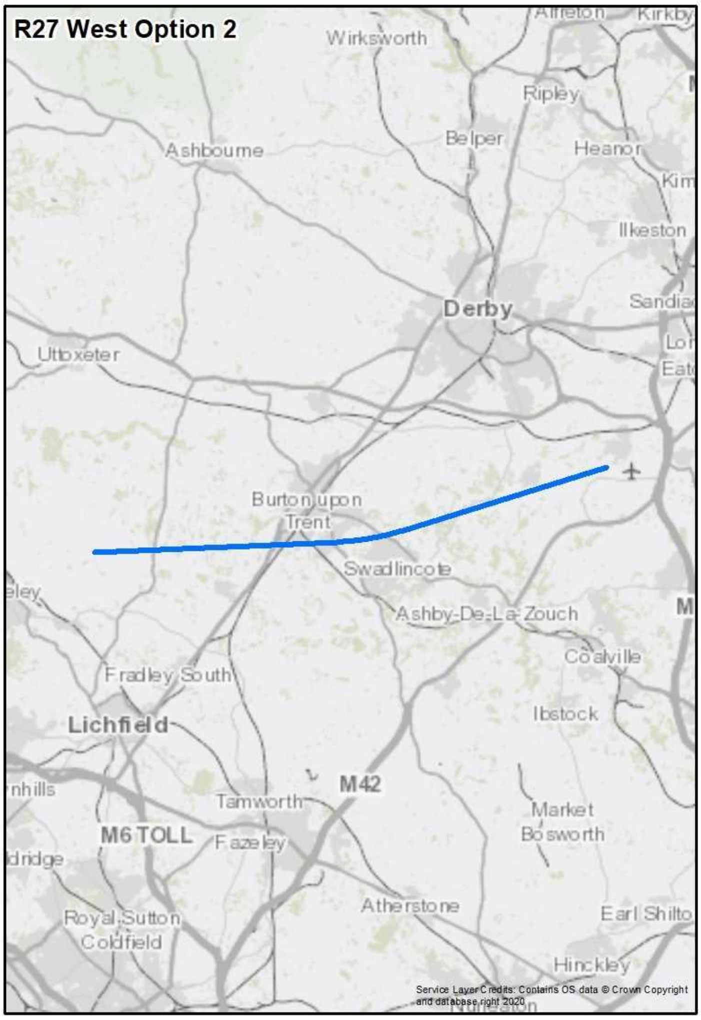
18.5. Runway 27 West Option 2

Description

Option 2 has a 15° southerly offset to avoid Melbourne before routing west to avoid both Swadlincote and Burton upon Trent.

The 15° offset results in the route passing south east of Melbourne and it continues on this heading for approximately 7.5nm passing north west of Wilson. A right turn is made to head west passing just north of Swadlincote and south of Burton upon Trent. The route terminates south east of Abbots Bromley.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations.

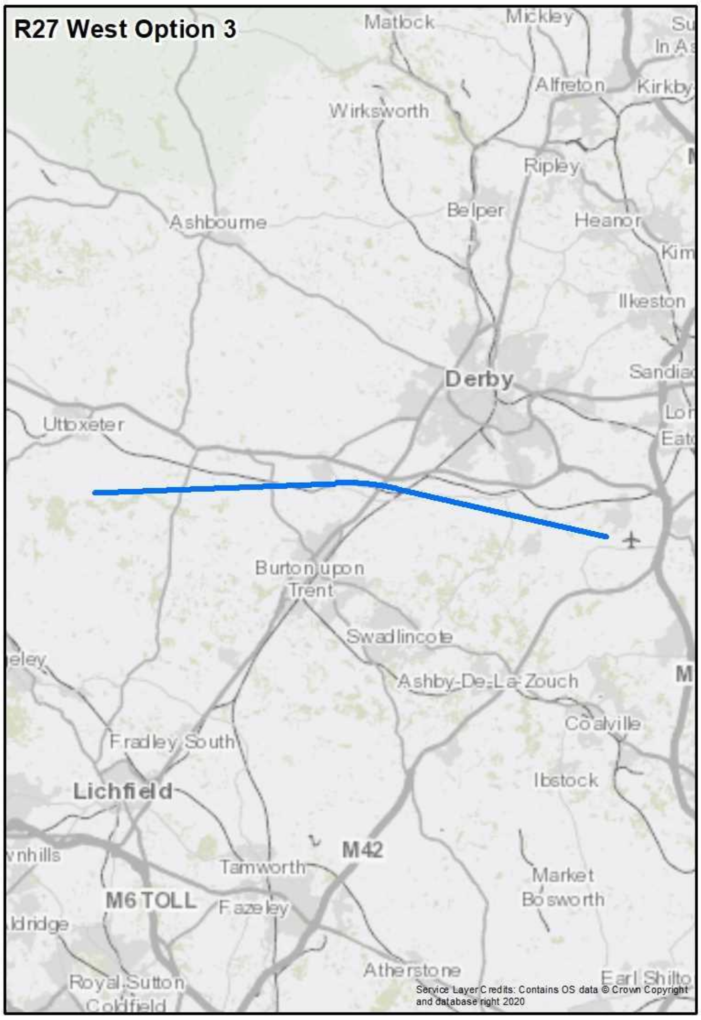
Noise N3: Aims to reduce the impact of noise by routing north of Swadlincote and south of Burton upon Trent.

The 15° southerly offset aims to avoid overflight of communities close to the extended runway centreline.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

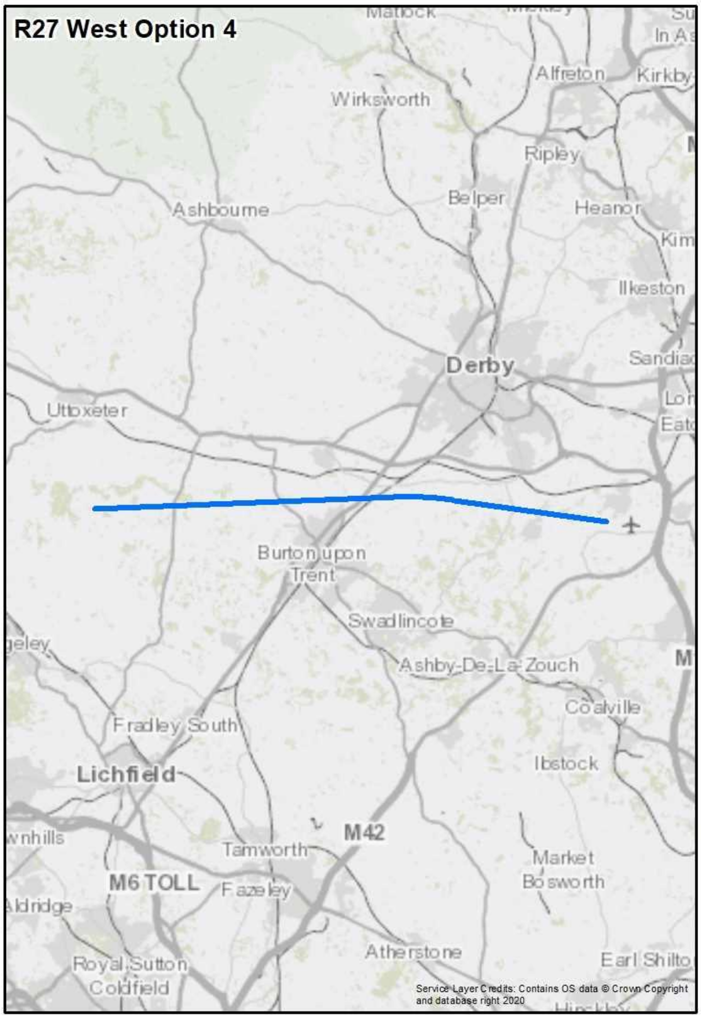
18.6. Runway 27 West Option 3

Description	Reason for inclusion
Option 3 has a 15° northerly offset to avoid Melbourne and has been created to avoid both Derby and Burton upon Trent. The 15° offset results in the route passing north of Melbourne and it continues on this heading for approximately 7.5nm until a point north of Willington and close to Derby aerodrome. A left turn is made to head west, passing north of Burton upon Trent and terminating north east of Abbots Bromley and south of Uttoxeter. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Noise N3:** Aims to reduce the impact of noise by routing south of Derby and north of Burton upon Trent. A 15° northerly offset aims to avoid overflight of communities close to the extended runway centreline including Melbourne. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



18.7. Runway 27 West Option 4

Description	Reason for inclusion
Option 4 has a 10° northerly offset and has a track that is a hybrid of Options 1 and 3 avoiding Burton upon Trent. The 10° northerly offset results in the route passing north of Melbourne and it continues on this heading until south of Willington where it makes a turn left to head west, routing just north of Burton upon Trent terminating north east of Abbots Bromley. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. Noise N3: Aims to reduce the impact of noise by routing south of Derby and north of Burton upon Trent. A 15° northerly offset aims to avoid overflight of communities close to the extended runway centreline including Melbourne. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



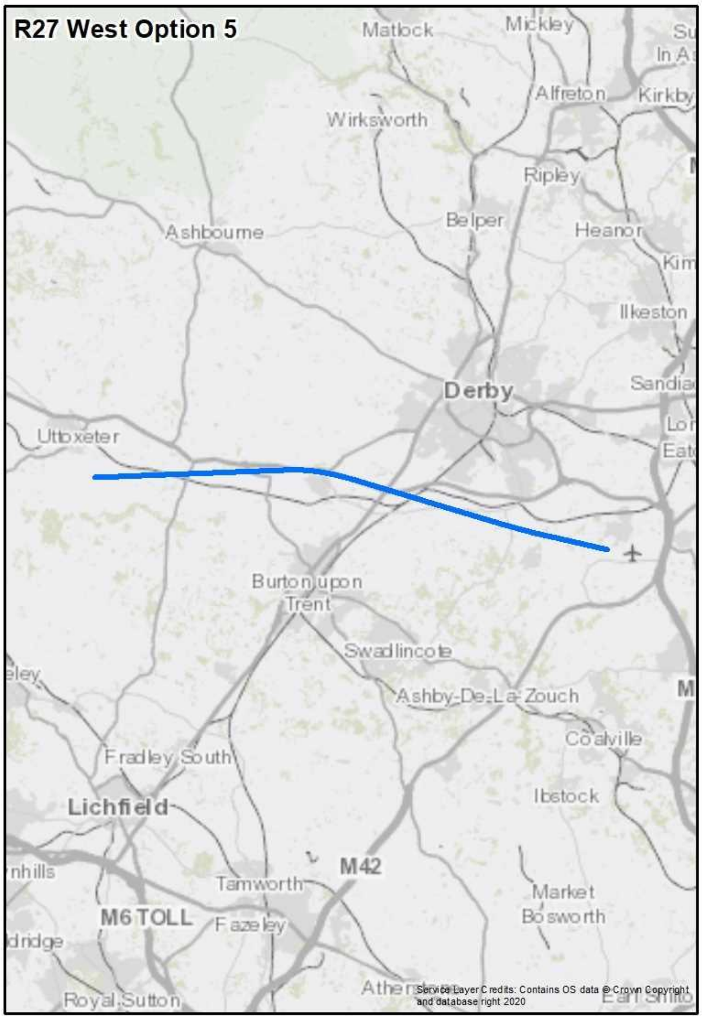
18.8. Runway 27 West Option 5

Description

Option 5 is similar to Option 3 but deviates slight further north west and is the most northerly option in this envelope.

A 15° northerly offset results in the route passing north of Melbourne and it continues on this heading until the vicinity of Hilton on the A50 where it makes a turn left to head west following the line of the A50 and terminating just south of Uttoxeter.

The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.



Reason for inclusion

Continuity: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations.

Noise N2: Aims to follow the line of the A50 which already has a higher level of ambient noise.

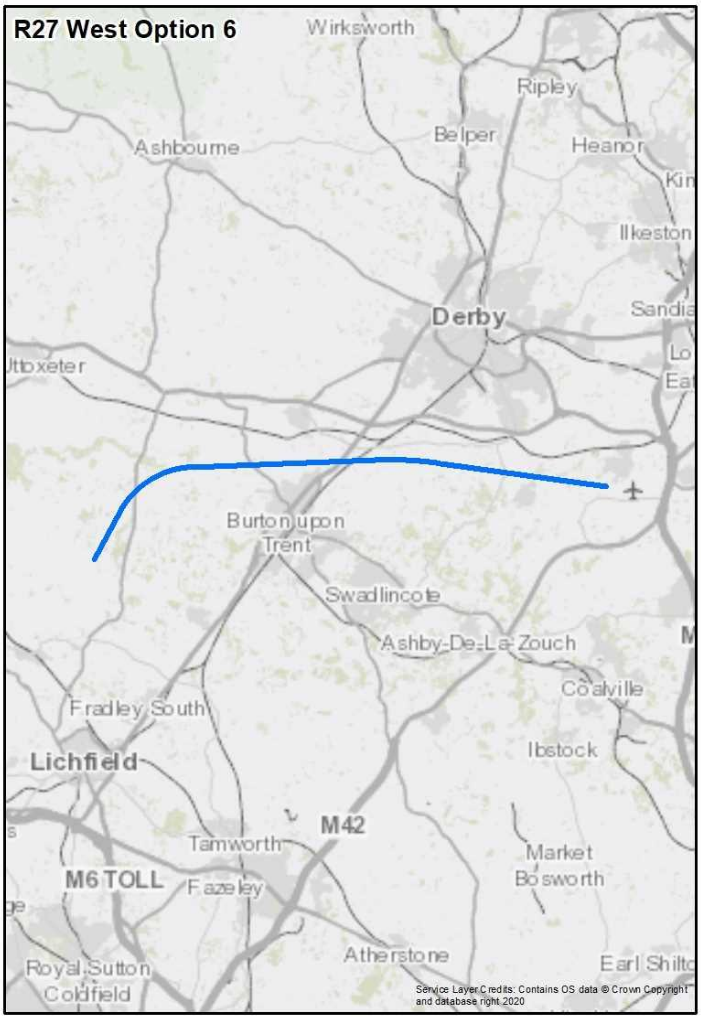
Noise N3: Aims to reduce the impact of noise by routing south of Derby and north of Burton upon Trent.

A 15° northerly offset aims to avoid overflight of communities close to the extended runway centreline including Melbourne.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

18.9. Runway 27 West Option 6

Description	Reason for inclusion
This option is the same as Option 4 until north west of Burton upon Trent where it turns south by south west to provide an alternative joining point. The 10° northerly offset results in the route passing north of Melbourne and it continues on this heading until south of Willington where it makes a turn left to head west, routing just north of Burton upon Trent. Once north west of Burton upon Trent the route turns south by south west and terminates to the south east of Abbots Bromley. The route has a constant climb gradient of 6%, terminating at 7,000ft and the CAP 778 recommended speed of 210 KIAS has been applied to the first turn.	**Continuity**: It has the potential to aid runway departure utilisation and separation, as it provides an additional SID when on easterly operations. **Noise N3:** Aims to reduce the impact of noise by routing south of Derby and north of Burton upon Trent. A 15° northerly offset aims to avoid overflight of communities close to the extended runway centreline including Melbourne in response to stakeholder feedback. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



18.10. Runway 27 West Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A7	S	P	C

Description: This option makes a 90 degree right turn overhead Derby, commencing a left turn to continue over north west Derby in a south westerly direction towards Uttoxeter.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network. By overflying Derby, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelope to the north and north west. This would not enable best use of runway capacity.

Option	Safety	Programme	Continuity
B8	S	P	C

Description: This option makes an immediate right-hand wrap-around turn after departure from runway 27, overflying southern Nottingham and then proceeding in a south westerly direction over Loughborough and Swadlincote.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network. By overflying south Nottingham Loughborough and Swadlincote, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes to the north and south east and may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

C9	S	P	C

Description: This option makes an immediate left-hand wrap-around turn after departure from runway 27and routing in an easterly direction over Loughborough and then north and west over southern Nottingham and south Derby.

Safety: This option fails to align with this design principle, because it is expected to conflict or present a hazardous interaction with arrivals to runway 27 and the runway 27 Missed Approach Procedure (MAP).

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network. By overflying Loughborough, south Nottingham and Derby, the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have an interaction with the departure envelopes to the north, north west and south east and may interact with arrivals to runway 27 from the south. This would not enable best use of runway capacity.

D10	S	P	C

Description: This option makes a 90-degree left turn over Ashby-de-la-Zouch, then making a gradual right turn over the M42 to a north westerly direction passing north of Lichfield.

Programme: This option fails to align with the environmental end of the AMS.

> *Environment:* The emissions generated by this option have been assessed as being greater due to the additional track length required to connect to the network. By overflying Ashby-de-la-Zouch the number of people impacted by noise for this option in comparison to other options does not show a material benefit.

Trade-offs: Without a material benefit in the number of people impacted by noise there is no trade-off to be made for the increased emissions. Similarly, simplification and integration do not offer material benefits that could be traded to justify an amber rating.

Continuity: This option fails to align with this design principle, because it would have a prolonged interaction with the departure envelope to the south and south west. This would not enable best use of runway capacity.

19. Arrival Designs – Introduction

19.1. Envelope and Design Option Details – Overview

Sections 19 to 29 of the DOR provide a technical overview of the arrivals design envelopes and a description of the design options within them. In line with CAP1616 guidance, the arrivals design options start at 7,000ft and end at the runway.

This section of the DOR contains details of:

- An overview of the process used to create the Arrivals Design Envelopes and Design Options (19.2).
- The process to create the viable arrivals design area (19.3).
- How the noise design principles were reflected in the arrivals design (19.4).
- The design criteria used for CDAs (19.5).
- An explanation of the arrival approach segments (19.6).
- An explanation of direct and indirect arrivals options (19.7).
- Constraints and considerations relating to arrivals (19.8).
- Other assumptions and considerations in designing the arrivals options (19.9).
- Details of the engagement with NATS on arrivals holds (19.10).
- The arrivals development strategy beyond this work and into Step 3A (19.11).
- An example description of the arrivals options layout (19.12).

The arrivals designs are split into three segments and a diagram to describe these is shown in section 19.6:

1. The Transition or Initial Approach: These start at the Initial Approach Fix (IAF), which for EMA is at 7,000ft to align with our design responsibilities under CAP1616.
2. The Intermediate segment which starts at the Intermediate Fix and finishes at the final Approach Fix (FAF). This forms part of the design of the Transitions.
3. The Final Approach: These commence at the Final Approach Fix (FAF) and finish at the runway.

The descriptions of arrivals options cover the scope of design including a diagram that displays the positions of all IAFs that form the comprehensive list of design options. These sections include a summary of both the Viable and Good Fit options and the Viable but Poor Fit options that were developed for each envelope.

19.2. Development of Arrival Options - Process

The arrivals design process was made up of a sequence of steps commencing with the creation of initial design envelopes (broad areas where it would be possible to design options) through to the development of a comprehensive list of design options that join the final approach to the runway.

As described in section 5.6 , the first step was to create a theoretical, circular omnidirectional arrivals boundary for arrivals which encompassed the current arrival holds at ROKUP and PIGOT.

In creating this boundary, the design principles on Noise and Emissions guided the process for where the boundary should be. The underlying rationale was that in order to limit the number of people adversely affected by noise (Design Principle Noise N3) and to limit and, where possible, reduce emissions (Design Principle Emissions), the most efficient design was through a CDA. CAA and ICAO guidance provides for a range of acceptable gradients for a CDA, but in this first phase a gradient of 5.24% or 3° was used as this is aligns with recommendations within both CAA and ICAO documentation.

This boundary was used to understand the broad area within which we would expect aircraft to be at 7,000ft and to assist in the identification of design constraints and considerations that may impact this area or limit the positioning of the Initial Approach Fix (IAF) – the position from which our arrivals from 7,000ft will start.

Further detail on these constraints and considerations are shown in section 5.7 and section 19.8.

The next step was to refine this initial omni directional design area and to create a viable area for the design options. This refinement was based upon the application of the Design Principle Programme which requires alignment to the AMS, and specifically the achievement of a CDA to both runway ends. Further details of the criteria and process for this are in section 19.3.

Details of this process, and this viable design area were presented during the first phase of stakeholder engagement. This included an explanation of the boundary for arrivals, the concept behind a CDA from 7,000ft and how this resulted in the creation of the viable design area for arrivals. Feedback collected in this phase of engagement was considered and informed the positioning of the IAF's and the creation of the arrivals design options within the design envelopes from 7,000ft to the runway.

This development process produced a comprehensive list of arrivals design options. These commence at an IAF which is located at 7,000ft in a position either north or south of the airfield and the full map of these IAFs is shown at section 21.2. All options were designed to PANS-OPS 8168 criteria and respond to both the design principles and the feedback received during Stage 2 stakeholder engagement. Information on the feedback received is detailed in the SER.

In line with the Design Principle Technology, all were designed to RNAV1 standard and in line with design principles Programme and Noise N3, all were created to provide a CDA to both runway directions. The options also sought to:

- Provide the opportunity for noise relief by varying the length of the Intermediate Segment of the approach. This has the effect of creating multiple joining points onto the extended runway centreline to replicate the dispersion created under current operations by ATC vectoring. Further information on this is shown at section19.6.

- Reduce the interaction with EMA departure options in accordance with the Design Principle Safety.
- Ensure routes remain within airspace boundaries in accordance with the Design Principle Safety.
- Align to the known structure of the NATS airspace network in accordance with the AMS and the Design Principle Programme.
- Take account of known constraints and considerations associated with the current airspace.

These options were shared at the second phase of stakeholder engagement with visuals to show the IAF at 7,000ft and the route the aircraft would use before joining the final approach within a range of joining points at 2,000ft, 2,500ft or 3,000ft.

This engagement also covered the operational use of arrival routes in the future and the application of systemisation to reduce dispersal. It was also explained that some ATC vectoring would still be required to ensure aircraft are safely separated and runway capacity is maintained.

Feedback in this second phase of engagement was collected and informed post engagement revisions to the arrival options, including the creation of additional arrivals options with the ability to provide noise relief by varying the length of the intermediate segment, or noise respite through the use of direct and indirect routes. An explanation of these direct and indirect options is provided in section 19.7.

The complete list of all design options developed are detailed in sections 23 to 25 for runway 09 and in sections 26 to 29 for runway 27.

19.3. Arrival Design – Creating the Viable Design Area

The Design Principle Programme states that any changes must align with the broader national airspace modernisation strategy, comply with national, international and industry regulations and legislation, and align with current and future Airspace Change Programmes in the north and south of the UK through involvement in the Future Airspace Strategy Implementation groups. We sought guidance from three documents to inform this aspect of our design:

- The Transport Act 2000, which requires the CAA to take account of any guidance on environmental objectives given to it by the Secretary of State.
- The Air Navigation Guidance 2017 which includes a section on environmental objectives, which the CAA is required to take account of in respect of its air navigation functions and in accordance with the Transport Act 2000.
- CAP1711 AMS, which is also driven by the Transport Act 2000, chapter 2 sets out the ends that modernised airspace must deliver, derived from UK and international policies and laws.

These documents provide objectives on environmental aspects and managing noise and both the Air Navigation Guidance, and the AMS specifically highlight the use of CDAs as a means for achieving these objectives. We therefore concluded that any option that does not provide CDA for both runway ends would not be aligned to the 'must have' Design Principle Programme and can only be classed as Viable but Poor Fit. This also ensures that all our arrival options would be aligned with the Design Principle Technology.

The process followed was to create an arc for easterly arrivals to runway 09 and another for westerly arrivals to runway 27 which can be seen at Figure 27. The shape and dimensions of these arcs take account of the aircraft descent gradient and also the constraints and consideration relating to arrivals detailed at section 19.8 and in particular:

- The area to the east, the north east and south east of EMA where there is no controlled airspace and no connectivity to the NATS Upper Airspace Network.
- The area to the south west currently used for traffic to and from Birmingham airport.

The outer limit of the arcs are the furthest away an aircraft could be at 7,000ft and expect to achieve a consistent CDA to that runway end based upon the criteria described previously. The area within which the two arcs overlap is the area where this is possible to both runway ends, and this defined the viable design area for creating design options.

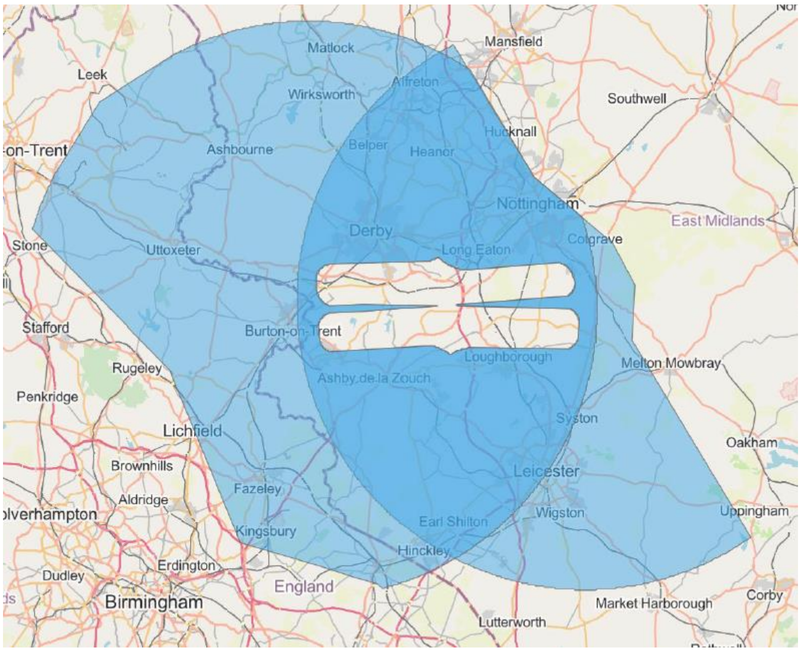


Figure 27: EMA Viable Design Area

Within these arcs, options can provide a CDA to both runway directions and these are classified as Viable and Good Fit.

Outside of these arcs, a CDA is only possible in one landing direction, runway 27 or runway 09. The use of IAFs that can only provide CDAs to one runway would misalign to the Design Principle Programme, and additionally to the Design Principle Safety in some operating configurations as described at section 19.9f). IAFs from this area have therefore been classified as Viable but Poor Fit.

Details of both the Viable and Good Fit and Viable but Poor Fit options are described in sections 24 to 29, and the classification for this viability process is explained in detail at section 5.11.

19.4. Arrivals Design – Noise Considerations

Both our design principles and the results of stakeholder engagement reflect the prominence of the consideration of noise to EMA operations and this airspace change. This is further supported by the AMS and the Air Navigation Guidance (ANG).

The table below provides a brief summary as to how our arrivals design options sought to address the main noise considerations within the design principles or have applied feedback from stakeholder engagement relating to noise to modify designs. References to where further detail can be found are included in the below table.

Sharing the load	Noise 1 (N1)	Flight paths should, where practical, be spread out to avoid concentration of aircraft activity to share any noise impacts. Stakeholders were keen that we explore opportunities for noise respite and relief in our arrival designs. In response to this we created arrivals options that: • Have different joining point onto the final approach. This was achieved by varying the length of the intermediate segment within the approach to create the ability to provide noise relief (section 19.6). • Have a route profile from the IAF that is classified as either direct or indirect, and which could be used to offer either noise respite or noise relief (section 19.7).
Responsive flight paths	Noise 2 (N2)	Where flight paths have to overfly communities, we will consider existing noise in the local area, and will select flight paths to mitigate effects on areas with relatively low levels of ambient noise. In response to this we have: • Created a range of IAF positions at 7,000ft, some of which are located over rural areas and some over urban areas including road and rail interchanges (section 21). • Designed the routes with different characteristics, some of which fly over urban areas. Where possible we have sought to create the overflight of urban areas in the portion of the flight above 7,000ft. If there is a link to this N2 design principle within a particular option , it is shown in the "Reason for Inclusion" column in sections 23 to 25 for runway 09 and in sections 26 to 29 for runway 27.

Limiting disturbance	Noise 3 (N3)	Flight paths should seek to limit and, where possible, reduce noise disturbance to communities – especially at night. In response to this we have: • Designed a range of options, some of which specifically avoid the overflight of large towns and urban areas. If there is a link to this N3 design principle within a particular option, it is shown in the "Reason for Inclusion" column in sections 23 to 25 for runway 09 and in Sections 26 to 29 for runway 27. • Created all arrivals options at a gradient capable of achieving a Continuous Descent Approach (CDA) to both runway directions. Where possible we have also sought to optimise these to align with CAA low noise arrivals criteria (Section 19.5). Reducing night noise is a consideration that will form part of how routes are operated as a system, rather than in the determination of their locations. As such, this is not a consideration of this DOR but will be addressed at Stage 3 and beyond as operating systems become developed, and further work is conducted on the appraisal of options including noise modelling. However, we have sought to provide opportunities to achieve this outcome through the creation of direct and indirect routes to provide noise respite or noise relief (Section 19.7).
Noise sensitive locations	Noise 4 (N4)	Flight paths should, where practical, avoid locations that are especially sensitive to noise. The impact of aircraft noise on most communities varies according to the wind direction and the runway in use. However, some communities, particularly those on the extended runway centreline, experience noise from either departing aircraft or arriving aircraft regardless of the wind direction, and for departures we have sought to create offset routes that deviate by up to 15° after take-off. For arrivals, there is a minimum stabilisation distance that is required within PANS-OPS rules that does not permit variations to the final approach path once below a certain altitude. We have created arrivals options that vary the joining point onto final approach to create noise relief (Section 19.6). These are at distances at, or beyond this minimum. The creation of curved or alternative arrival approaches through the use of RNP-AR (Authorisation Required) procedures was also investigated but not progressed. Further detail in relation to this can be found at section 19.9e).

19.5. CDA Design Criteria

A major government review of noise from arriving aircraft, published in 1999, identified that the use of Continuous Descent Arrivals was the primary means of reducing noise experienced on the ground beneath arriving aircraft. The report recommended the development of a code of practice to promote the use of CDAs and to monitor compliance. This was subsequently published in 2002 and a second edition published in 2006[5].

In 2017, research performed by CAA's Environmental Research and Consultancy Department (ERCD) identified that the original definition was not sufficiently sensitive to provide an effective noise measure. This has led to the development of CAP2302 A Low Noise Arrival Metric which refines the original definition of CDA. In particular this identified:

- Shallow angle approaches could be classified as a CDA but could be noisier at certain points on the approach compared to a traditional non-CDA approach.
- Newer aerodynamically efficient low drag aircraft cannot deliver optimal low noise arrivals with a higher gradient of CDA.

The arrivals options within this EMA airspace change have sought to apply this latest knowledge and guidance to the development of the options. Where possible, options have been aligned to the optimum CDA criteria described in CAP2302, but flexibility has been retained to respond to feedback and ongoing design discussions with stakeholders, including NERL and airlines in Stage 3.

The Viable and Good Fit arrivals options have therefore been created within the following range:

- An upper limit for a CDA of 3.5°.
- An optimum low noise gradient of between 2.3 to 2.7°.
- A lower limit of 1.5°.

These criteria are also aligned to the PANS-OPS recommended range for CDAs. Options or IAFs that would result in gradients outside of this range have been classified as Viable but Poor Fit.

Section 20 of this DOR provides tables showing the CDA profiles of all arrivals options. In addition, the CDA gradient is shown in the Options Summary Table for each arrivals set, and in the individual options descriptions in sections 23 to 25 for runway 09 and in sections 26 to 29 for runway 27.

[5] Noise from Arriving Aircraft: An Industry Code of Practice, 2nd Edition, Department for Transport (DfT) et al., November 2006

19.6. Arrivals Design – Approach Segments

As described in Figure 28 below the approach transitions start at an Initial Approach Fix (IAF) at 7,000ft which connects to an intermediate segment at the Intermediate Fix (IF) and then a final approach at the Final Approach Fix (FAF) which takes aircraft to the runway.

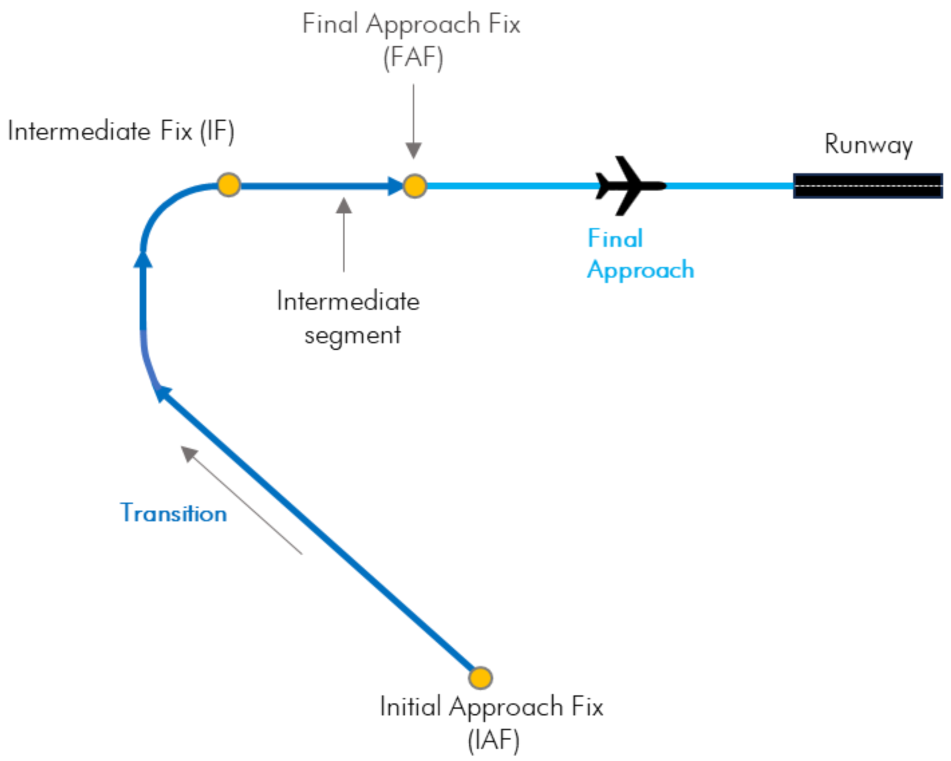


Figure 28: Segments within an arrivals option

The EMA arrivals designs have been created in accordance with PANS-OPS rules and comprise:

- Transition: The part of the arrival route between the IAF which is at 7,000ft and the FAF. The transition encompasses an initial approach and a short intermediate segment.
- Intermediate segment: A sub-section within the transition, this is the part of the arrivals between the IF and the FAF where a portion of level flight is required for aircraft stabilisation purposes. This does not impact the ability of the aircraft to fly a CDA. For the EMA arrivals options the length of this segment has been varied in order to provide an opportunity for noise relief. Varying this distance within the procedure has the effect of creating more than one joining point for aircraft onto the extended runway centreline which partially replicates the dispersion created by ATC vectoring under current operations. This is in line with the requirements of Design Principle Noise N1 to spread out flight paths, and Noise N3 to seek to limit noise disturbance.
  - For runway 09 the IF has been placed at either 3.85nm, 5.1nm or 6.9nm.
  - For runway 27, the IF has been placed at either 3.85nm or 5.1nm. No IF has been created at 6.9nm to ensure containment of routes within CAS.

- Final Approach: The route taken by the aircraft between the FAF and landing on the runway. This is a straight line, normally guided by the ILS.

The length of each of these segments is driven by the criteria contained within PANS-OPS8168, and this includes a consideration of the appropriate speeds of aircraft in this phase of flight. The UK AIP entry for EMA (section AD2.20) states that *'aircraft should be flown no faster than 250 KT from the Speed Limiting Points* ***and 250 KTS-210 KTS during the intermediate approach phase****'.*

This has been taken into account in the design of the EMA arrivals and the length of each of these segments, and by keeping segment lengths to a minimum, this ensures aircraft maintain the required separation from the boundaries of controlled airspace. This is in line with the Design Principle Safety and the CAA containment policy for the design of controlled airspace structures.

19.7. Direct and Indirect Routes

The EMA Design Principle Noise N1 states that "Flight paths should, where practical, be spread out to avoid concentration of aircraft activity to share any noise impacts".

The potential for noise relief has been created by varying the length of the intermediate segment as described in section 19.6.

However, the designs have also considered the concept of noise respite. This was described to stakeholders within the engagement process as a way to create a predictable period of either no overflight, or a reduced number of overflights at certain times. Whilst a method to operate respite routes safely and efficiently has not yet been developed, stakeholders were keen we explore opportunities for both concepts in our arrival designs.

This feedback resulted in the creation of additional arrivals options to provide a direct and indirect route option from each IAF to each IF.

- Direct Routes: Direct routes have been created to minimise the distance between the IAF and the final approach.

- Indirect Routes: Indirect routes have been designed to provide an alternative noise relief or noise respite option when compared to a 'direct' route.

Having these two distinct route types provides an opportunity to provide respite in a future operating system, and this idea is illustrated in the diagram at Figure 29.

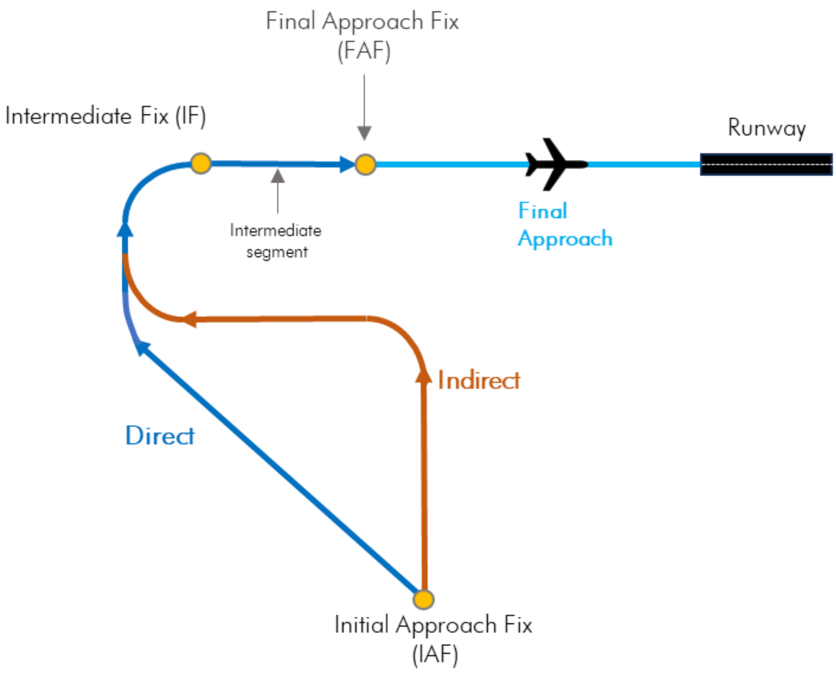


Figure 29: Direct and indirect arrival routes concepts

The concept is that from each IAF, there will be at least one direct and one indirect for aircraft to route to the arriving runway. The distance between the direct and indirect routes changes the areas being directly overflown with the aim of reducing noise impact on the ground and providing potential for noise respite to be achieved.

It should be noted that the PANS-OPS rules relating to IFP design, including turn radius and minimum stabilisation distances, constrain the scope for significant variations in the intermediate and final approach segments. Therefore, direct and indirect options have only been created in the segment between the IAF and the IF.

Tables that detail the direct and indirect route options for each arrivals design envelope are shown in section 23.3 for runway 09 and in section 27.3 for runway 27.

19.8. Arrival – Constraints and Considerations

As detailed in section 5.7, and as shown in Figure 30, the constraints and considerations for arrivals were developed by analysing the airspace and current operations in an area around EMA:

- **Constraints** were defined as aspects that have a direct impact on designs, or limit where we can place our arrival design options.
- **Considerations** were defined as aspects that do not limit our designs but which we need to take account of in creating arrivals options.

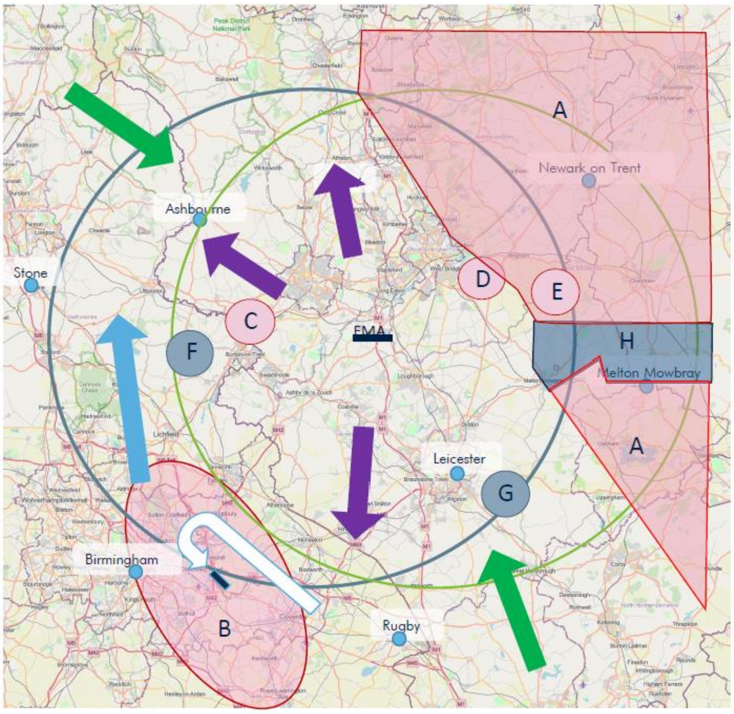


Figure 30: Arrivals constraints and considerations

The map above shows all constraints and considerations that were considered and presented as part of stakeholder engagement. The principal constraints for arrivals are:

- Area A – Uncontrolled airspace: This area of Class G airspace is used by the military and GA, and is not currently available to commercial flights, except through tactical coordination by ATC. The unavailability of this airspace was used as a constraint in the construction of the arrivals viable design area, shown in Figure 27 and in the placement of IAFs as shown in section 21.3. In particular, this constraint resulted in there being no arrivals design options being created that routed from the north IAFs and to the east of Nottingham because:

  - There is no CAS in this area, and the area is used extensively by GA traffic that is seeking to avoid EMA airspace.

  - The presence of parachuting operations at Langar (area E below).

  As a result, this is not an area currently under consideration for new CAS, and the creation of arrival options through this area would be misaligned with the Design Principle Safety.

- Area B – Birmingham Airport: The location of Birmingham airport influences the network traffic flow to EMA (shown by the green arrow to the south). There is a need to retain safe separation between this airspace and EMA arrivals, and this has potential to acts as a constraint on where IAF's to the south can be placed. However, in reality, the dimensions of the viable design area, shown in Figure 27 and the requirement to provide a CDA to both runway directions means that this was reduced to a consideration in the placement of Viable and Good Fit IAFs. However, it is listed as a constraint within the rationale for the Viable but Poor Fit IAFs shown in section 21.3.

- **Area E – Langar Parachute site**: As described above, the placement of IAF's and design options from the north and east to runway 27 need to ensure safe separation from this operation which can extend above 7,000ft. In line with the Design Principle Safety, this operation was treated as a constraint to the creation of design options that route to the east of Nottingham and has resulted in IAFs to the east being classified as Viable but Poor Fit as shown in section 21.3.

The principal considerations for arrivals are:

- **Area D - Nottingham Airport**: This is used by GA traffic and has airspace dedicated to it via an Aerodrome Traffic Zone (ATZ) up to 2,000ft. We have taken account of this when creating the vertical profiles of arrivals design options in this area to ensure safe separation is assured. No arrival option will be created at an altitude below 3,000ft in the region of this ATZ.
- **Area G – Leicester Airport:** This is used by GA traffic and has airspace dedicated to it via an Aerodrome Traffic Zone (ATZ) up to 2,000ft. We have taken account of this when creating the vertical profiles of arrivals design options in this area to ensure safe separation is assured. No arrival option will be created at an altitude below 3,000ft in the region of this ATZ.
- **Area H – Potential new controlled airspace (CAS):** As noted above, there are significant environmental benefits for flights to the east associated with creating additional CAS in this area. Following engagement, an IAF was created at the point 'SYSTO' to the north east of Leicester to potentially accommodate these flights, but analysis concluded this would not permit a viable CDA descent profile to both runways. The rationale for discontinuing this IAF is detailed in section 21.3. EMA will continue to collaborate with NERL to agree how this traffic, which is arriving from a direction not frequently used, can be safely integrated to EMA arrivals flows below 7,000ft.

19.9. Arrivals Design- Other Assumptions and Considerations

Assumptions and considerations applied to arrivals were:

a) PBN application to arrivals: The Design Principle Technology states that the route designs should be based upon the latest aircraft technology widely available. Based on the results from the fleet equipage survey, the arrivals designs would meet the requirements of all PBN mandates by utilising RNAV1 as the design standard for arrivals.

b) Systemisation and ATC vectoring: Consistent with the design principles Programme and Technology, the arrival design options have been designed to accommodate the principle of systemisation (minimal ATC intervention). However, ATC vectoring will still be required to ensure safe spacing between aircraft is consistently maintained, either for wake turbulence, arrival-departure-arrival separation, or in periods of adverse weather. ATC vectoring may also be a tool to aid the provision of noise relief in line with Design Principle Noise N1 by using ATC instructions to vary the joining point onto final approach. This concept has been reflected in the construction of the multiple joining points onto final approach that are described in section 19.6 and by the ability to offer respite being designed into the arrival options through the use of direct and indirect routes as described in section 19.7.

c) Current arrivals noise procedures: To present a comprehensive list of viable design options, the design process has not been constrained by the existing Noise Abatement procedures. Any changes required to these procedures would be addressed separately as required.

d) 'Do minimum' for arrivals: As detailed in section 4.4.2 no replicated 'do minimum' design options for arrivals have been created because there are no existing intermediate approaches to replicate.

   Under the arrivals 'do minimum' scenario, aircraft would continue to be vectored from the hold to the final approach as they are today.

e) Required Navigation Performance - Authorisation Required (RNP-AR): During the engagement process, some stakeholders asked us to consider implementing curved approaches, which are created through the implementation of RNP-AR procedures. Only certain types of aircraft are capable of this procedure which also requires specialist aircrew training. Both the entry requirements of these approaches and the procedures that would need to be implemented were determined to be misaligned with a number of our design principles. This is because:

   - Curved approaches require aircraft technology, which was not widely identified as available within our fleet equipage survey, as well as needing specialist aircrew training. For this reason, they do not align with our Design Principle Embracing Technology which leads us to design to the latest, widely available navigational technology.

   - To implement a mix of ILS approaches with only a very limited number of aircraft flying curved approaches would not align with our 'must have' Design Principle Continuity. This is because the flow of ILS arrivals would have to be paused to enable RNP-AR approach to safely take place. This would cause inefficiencies by delaying arriving traffic and would increase the incidence of arrival traffic holding to land.

   However, we will continue to work with airlines to understand developments in their fleet equipage, that could enable consideration of curved approaches, in the future.

f) Runway dependant arrivals IAFs: Our process has created a spread of IAFs within the design envelopes and then created route design options that are capable of being flown to both runway directions. During the design development process, feedback was received regarding the concept of runway dependent IAFs and whether any benefit could be gained. Under this concept, each IAF is allocated to a specific runway in use, but not to both.

Following discussions with NERL, the conclusion of this analysis was:

- Airspace design and how the network operates is based upon ensuring the highest level of safety through risk mitigation and avoidance, a principle that ensures safety by design.
- The EMA concept of having IAFs that serve both runways means that airlines can flight plan and fuel plan to a common arrival fix, and also that both ATC

and the arriving aircraft share the same information on the intended routing and arrival point. This is especially important in the event of radio failure where ATC need to be assured of an aircraft's intended routing to provide safe separation.

- If runway dependant IAFs were used, this shared understanding and certainty may be removed. This is particularly the case if there is a runway change combined with a radio failure. Safety and hazard analysis work conducted by NATS has concluded that, with runway dependant IAFs, there is an increased risk of an aircraft flying an incorrect routing to either the wrong runway or the wrong IAF if a runway change occurred. Without the ability to communicate to the aircraft, it is not possible to correct the aircraft course, which increases the potential for aircraft collision, and which is not in line with either the NERL or EMA design principles in relation to Safety.

On the basis of safety, NERL have advised against the use of independent IAFs , and this concept has not been taken forward.

19.10. Engagement with NATS NERL on Arrivals Holds

Bilateral engagement meetings have been held with NERL to discuss the factors affecting the placement of the EMA arrivals holding structure and the 7,000ft starting point for our arrivals, taking account of our requirements and design principles.

These discussions produced the following assumptions in relation to arrivals:

a) Whilst EMA sits between both FASI-N and FASI-S, it has been agreed that the EMA change will be deployed as part of the MTMA deployment cluster.

b) As described in section 3 the designs within this DOR have been created via a combination of airspace development workshops, involvement of NERL as a stakeholder as part of the formal Stage 2 engagement process and by NERL fast time visualisation simulations. This work has focussed on operations to the north, meaning that arrivals from the south have not been discussed in detail because this airspace is still being developed by NERL as part of the FASI-S project. However, we continue to work with NERL to align EMA designs to the network interface and airspace changes to the south as part of the national airspace master plan.

c) There are constraints to the direction in which traffic can fly within the NERL network based upon the UK Traffic Orientation Structure (TOS), established to smooth traffic flows and decrease the safety risks associated with crossing traffic. The TOS dictates a direction of flow (via a one-way system in certain areas of airspace) and takes account of traffic demand, agreements with adjacent Flight Information Regions (FIRs), constraints on controlled airspace and the needs of the military.

d) The NERL network is not considering major changes to the UK network COP. Traffic flows to UK airspace from airspace outside will therefore remain substantially unchanged, although new COPs may be created following negotiation between NERL and adjacent airspace authorities.

e) Some changes to the arrivals patterns for EMA arriving traffic is expected as NERL create a network within their ACP that is both more efficient and which creates fuel savings.

This work will impact the placement of the arrivals structures above 7,000ft, and will have the ability to influence the placement of arrivals transitions to create safe separation. It may also impact departures as routes may need to be modified to create safe separation between departures and arrivals holds. This work will be conducted within Step 3A detailed design activities.

f) Arrivals holds will continue to be a design feature for contingency/resilience. These holds will be above 7,000ft and are therefore the responsibility of NERL.

g) Work conducted by NERL as part of their network ACP has investigated the use different types of arrivals holds across the network. This work has investigated:

   - The creation of a point merge structure or structures
   - A combination of conventional type holds to PBN standard and point merge.
   - The use of conventional type holds to PBN standard only.

   The conclusion of this work was that point merge structures would not offer a fuel benefit to EMA above 7,000ft and the EMA designs have therefore assumed the use of conventional type holds to PBN standard. The current ROKUP and PIGOT holds have already been converted to this standard, however, the position of the holds in a future network is not yet determined and may change.

Further information on engagement with NERL can also be found in section 3 of this DOR and details of these meetings can be found in Stakeholder Engagement Report.

19.11. Arrival Development Strategy – Step 3A

Whilst we have considered the current path of departures from EMA to help inform the position of IAF's and the placement of routes, we have not designed our arrival design options as part of a network with our departures.

As a result of this process and the comments from the engagement process, we are carrying forward a comprehensive list of arrivals design options to the DPE. However, as the NERL designs progress, it's possible that some of our design options will either be misaligned or conflict with their choices. This may also be the case for the routes to and from Birmingham or other airports. The result is that some design options may need to be further refined or amended in response to the progress of their work. We will continue to work in bilateral discussions across the MTMA and in partnership with NERL and other airports to respond to any such interactions.

For arrivals the following matters will need to be considered further at Step 3A:

- Arrivals from the north: Simulations conducted by NERL have suggested several locations and orientations for the placement of the northern hold above 7,000ft. The final location will be a product of collaboration and alignment between the designs of the NATS upper airspace network that feed the hold, and the EMA IAFs and design options which receive traffic from the hold and take it to the runway.
- Arrivals from the south: No simulations have yet been conducted by the FASI-S project to determine the optimal position of the southern hold, although early concepts indicate a position similar to that used currently. However, as with the north, a

collaborative process of aligning the upper airspace network designs with our IAFs and design options will determine the final location.

- Arrivals from the east: Should new airspace to the east become available for use by EMA traffic (as described at section 19.8) we will need to collaborate with NERL to agree how this traffic, which is arriving from a direction not frequently used, is integrated to EMA arrivals flows below 7,000ft.

Further work is anticipated to involve a series of collaborative design workshops involving EMA and NERL and these will examine both departure and arrivals options. In some cases, it may not be possible to provide the required connectivity from the network which may result in either IAFs or design options being re-classified as Viable but Poor Fit. In such a scenario, our assessment of these design options would be discontinued.

Within Step 3A of the CAP1616 process we will seek to optimise each aspect (departures and arrivals) and develop a system that encompasses departures and arrivals and takes account of other ACPs within the MTMA cluster and FASI-S. We will then use the process of bilateral discussions with NERL, to agree network connectivity and optimal positions that align with both the EMA design principles and the available airspace within the network, but also consider the cumulative impact of change. This process will also allow us to consider controlled airspace requirements and the needs of the wider aviation community including GA.

19.12. Arrival Option Description – Example Layout

Sections, 22 to 29, detail the arrivals design envelopes and the design options created within them. Each section includes an introduction, followed by a description and graphic for the design envelope.

An options summary table is then provided which shows the comprehensive options for each design envelope. This includes design options from the numbered list (Viable and Good Fit), the lettered list (Viable but Poor Fit) and any Unviable options we have considered but discounted.

This is followed by a more detailed description of each route. The graphic below provides an example of the summary table used for this description, and an explanation of the information contained within it.

The runway the option applies to, either RWY 09 or RWY 27

'Transition' denotes that this relates to an arrival option

Whether the IAF is north or south of the airport

The option number for this route.

Runway 09 Transition North Option 2

Description	Rational for inclusion
This section provides a written description of the option including the criteria it has been designed to, and any features or benefits of the design such as turning points or areas the route avoids, or overflies.	This is the reason why we have included the route as an option. It doesn't evaluate the design, but just provides a reason why it is in the list of options when compared to the design principles.

Figure 31: Example arrival design option table

20. Arrival Options – Continuous Descent Approach (CDA) Gradients

As detailed in section 19.5, the arrivals options for this airspace change have been designed to permit the use of Continuous Descent Approaches. These have been identified as an effective means of reducing noise experienced on the ground beneath arriving aircraft.

Guidance on the criteria for CDAs is contained within PANS-OPS 8168 and CAP CA2302, and by applying these criteria the EMA Viable and Good Fit arrivals options have been created within the following range:

- An upper limit for a CDA of 3.5°
- An optimum low noise gradient of between 2.3 to 2.7°
- A lower limit of 1.5°

The tables in the following sections provide a consolidated view of the CDA gradients for all arrivals options. Further detail on the route taken can be found in the individual options descriptions in sections 23 to 25 for runway 09 and in sections 26 to 29 for runway 27.

20.1. CDA Gradients Runway 09

Runway 09 - North			CDA	
Option	IAF	Route type	Descent Angle (%)	Descent Gradient (°)
Option 1	ROKUP	Direct	6.0%	3.4
Option 2	ROKUP	Direct	4.7%	2.7
Option 3	ROKUP	Indirect	3.4%	2.0
Option 4	ROKUP	Indirect	2.7%	1.6
Option 4A	ROKUP	Direct	5.4%	3.1
Option 5	DIPSO	Indirect	3.1%	1.8
Option 6	DIPSO	Indirect	2.5%	1.4
Option 7	DIPSO	Direct	4.5%	2.6
Option 8	DIPSO	Direct	3.5%	2.0
Option 8A	DIPSO	Direct	3.8%	2.2
Option 9	IAF4	Direct	5.0%	2.9
Option 10	IAF4	Direct	3.8%	2.2
Option 10A	IAF4	Direct	4.4%	2.5
Option 11	IAF3	Direct	4.5%	2.6
Option 12	IAF3	Direct	3.5%	2.0
Option 12A	IAF3	Direct	3.8%	2.2
Option 13	IAF2	Indirect	3.8%	2.2
Option 14	IAF2	Indirect	3.0%	1.7
Option 15	IAF5	Direct	5.5%	3.2
Option 16	IAF5	Direct	4.9%	2.8
Option 17	IAF1	Indirect	3.5%	2.0
Option 18	IAF1	Indirect	2.9%	1.7
Option 19	IAF1	Direct	3.8%	2.2
Option 20	IAF1	Direct	3.1%	1.8
Option 20A	IAF1	Direct	3.5%	2.0
Option 21	IAF2	Direct	4.3%	2.5
Option 22	IAF2	Direct	3.4%	1.9
Option 22A	IAF2	Direct	3.9%	2.2
Option 23	IAF3	Indirect	4.1%	2.4
Option 24	IAF3	Indirect	3.2%	1.8
Option 25	IAF4	Indirect	3.4%	2.0
Option 26	IAF4	Indirect	2.7%	1.6
Option 27	IAF5	Indirect	3.5%	2.0
Option 28	IAF5	Indirect	2.8%	1.6
Option 29	DIPSO	Indirect	3.7%	2.1
Option 30	DIPSO	Indirect	2.9%	1.7

Table 8: Runway 09 North CDA gradients

Runway 09 - South			CDA	
Option	IAF	Route type	Descent Angle (%)	Descent Gradient (°)
Option 1	JUNCK	Direct	3.7%	2.1
Option 2	JUNCK	Direct	3.4%	1.9
Option 3	JUNCK	Indirect	3.2%	1.8
Option 4	JUNCK	Indirect	2.9%	1.7
Option 5	LEICE	Direct	3.6%	2.1
Option 6	LEICE	Direct	3.3%	1.9
Option 7	JUNCK	Indirect	3.1%	1.8
Option 8	JUNCK	Indirect	2.8%	1.6
Option 9	JUNCK	Direct	3.5%	2.0
Option 10	JUNCK	Direct	3.2%	1.9
Option 11	LEICE	Indirect	3.0%	1.7
Option 12	LEICE	Indirect	2.7%	1.6
Option 13	EYEHO	Direct	3.8%	2.2
Option 14	EYEHO	Direct	3.5%	2.0
Option 15	STAPL	Direct	4.2%	2.4
Option 16	STAPL	Direct	3.8%	2.2
Option 17	JUNCK	Direct	3.6%	2.1
Option 18	JUNCK	Direct	3.3%	1.9
Option 21	STAPL	Indirect	3.4%	1.9
Option 22	STAPL	Indirect	3.1%	1.8
Option 23	EYEHO	Indirect	3.1%	1.8
Option 24	EYEHO	Indirect	2.8%	1.6

Table 9: Runway 09 South CDA gradients

20.2. CDA Gradients Runway 27

Runway 27 - North			CDA	
Option	IAF	Route type	Descent Angle (%)	Descent Gradient (°)
Option 1	ROKUP	Direct	3.7%	2.1
Option 2	ROKUP	Direct	3.4%	1.9
Option 3	ROKUP	Indirect	3.4%	2.0
Option 4	ROKUP	Indirect	3.2%	1.8
Option 5	DIPSO	Direct	4.5%	2.6
Option 6	DIPSO	Direct	4.1%	2.3
Option 7	DIPSO	Direct	4.5%	2.6
Option 8	DIPSO	Direct	4.0%	2.3
Option 9	IAF4	Direct	3.8%	2.2
Option 10	IAF4	Direct	3.4%	2.0
Option 11	IAF3	Indirect	3.3%	1.9
Option 12	IAF3	Indirect	3.0%	1.7
Option 13	IAF2	Direct	3.8%	2.2
Option 14	IAF2	Direct	3.5%	2.0
Option 15	IAF5	Direct	3.8%	2.2
Option 16	IAF5	Direct	3.5%	2.0
Option 17	IAF1	Direct	4.0%	2.3
Option 18	IAF1	Direct	3.6%	2.1
Option 19	IAF1	Indirect	3.2%	1.8
Option 20	IAF1	Indirect	2.9%	1.7
Option 21	IAF2	Indirect	3.3%	1.9
Option 22	IAF2	Indirect	3.0%	1.7
Option 23	IAF3	Direct	3.8%	2.2
Option 24	IAF3	Direct	3.5%	2.0
Option 25	IAF4	Indirect	3.4%	2.0
Option 26	IAF4	Indirect	3.1%	1.8
Option 27	IAF5	Indirect	3.7%	2.1
Option 28	IAF5	Indirect	3.3%	1.9
Option 29	DIPSO	Indirect	3.7%	2.1
Option 30	DIPSO	Indirect	3.3%	1.9

Table 10: Runway 27 North CDA gradients

Runway 27 - South			CDA	
Option	IAF	Route type	Descent Angle (%)	Descent Gradient (°)
Option 1	JUNCK	Direct	4.8%	2.8
Option 2	JUNCK	Direct	3.9%	2.2
Option 3	JUNCK	Indirect	3.2%	1.9
Option 4	JUNCK	Indirect	2.7%	1.5
Option 5	LEICE	Indirect	4.9%	2.8
Option 6	LEICE	Indirect	4.0%	2.3
Option 7	JUNCK	Direct	4.9%	2.8
Option 8	JUNCK	Direct	4.1%	2.3
Option 9	JUNCK	Indirect	3.9%	2.2
Option 10	JUNCK	Indirect	3.2%	1.8
Option 11	LEICE	Indirect	3.9%	2.2
Option 12	LEICE	Indirect	3.2%	1.8
Option 13	EYEHO	Indirect	3.0%	1.7
Option 14	EYEHO	Indirect	2.7%	1.6
Option 15	STAPL	Direct	4.0%	2.3
Option 16	STAPL	Direct	3.3%	1.9
Option 19	STAPL	Indirect	2.9%	1.7
Option 20	STAPL	Indirect	2.6%	1.5
Option 21	EYEHO	Direct	3.7%	2.1
Option 22	EYEHO	Direct	3.1%	1.8
Option 23	LEICE	Direct	5.6%	3.2
Option 24	LEICE	Direct	4.6%	2.6

Table 11: Runway 27 South CDA gradients

21. Placement of Initial Approach Fixes (IAF)

21.1. Introduction

As described at section 19.6 the IAF is the start of the approach procedure, with an altitude of 7,000ft which aligns with our design responsibilities under CAP1616.

This section details the geographical position of all IAFs that were considered as part of the comprehensive list of design options.

- Section 21.2 covers the IAFs that have been classified as Viable and Good Fit and which were used to create the design options.
- Section 21.3 covers IAFs that were considered as Viable but Poor Fit and from which no design options were created. It also describes the rationale for discounting these IAFs at this stage.

The map at Figure 32 shows the placement of these IAFs which took consideration of:

- The location of the current holds at ROKUP and PIGOT.
- The ability to align with one or more of the design principles.
- The ability to provide separation from departure options.
- Alignment to the NATS upper network traffic flows
- The ability to provide a viable CDA to both runway directions (runway 27 and runway 09) as defined by the arrivals design envelope.
- The arrivals constraints and considerations detailed at section19.8.

As described in section 19.9f), there are no independent IAFs that serve one runway only. This design assumption has been adopted for safety reasons.

Multiple arrivals design options were created from each of these points in order to create the comprehensive list of options detailed at sections 24 to 29.

21.2. Viable and Good Fit IAFs

The map below shows the geographical position of the IAFs that were used to create the comprehensive list of design options and their position relative to the design envelopes. The position reflects the criteria listed in section 21.1 including the required to provide a CDA to both runway directions.

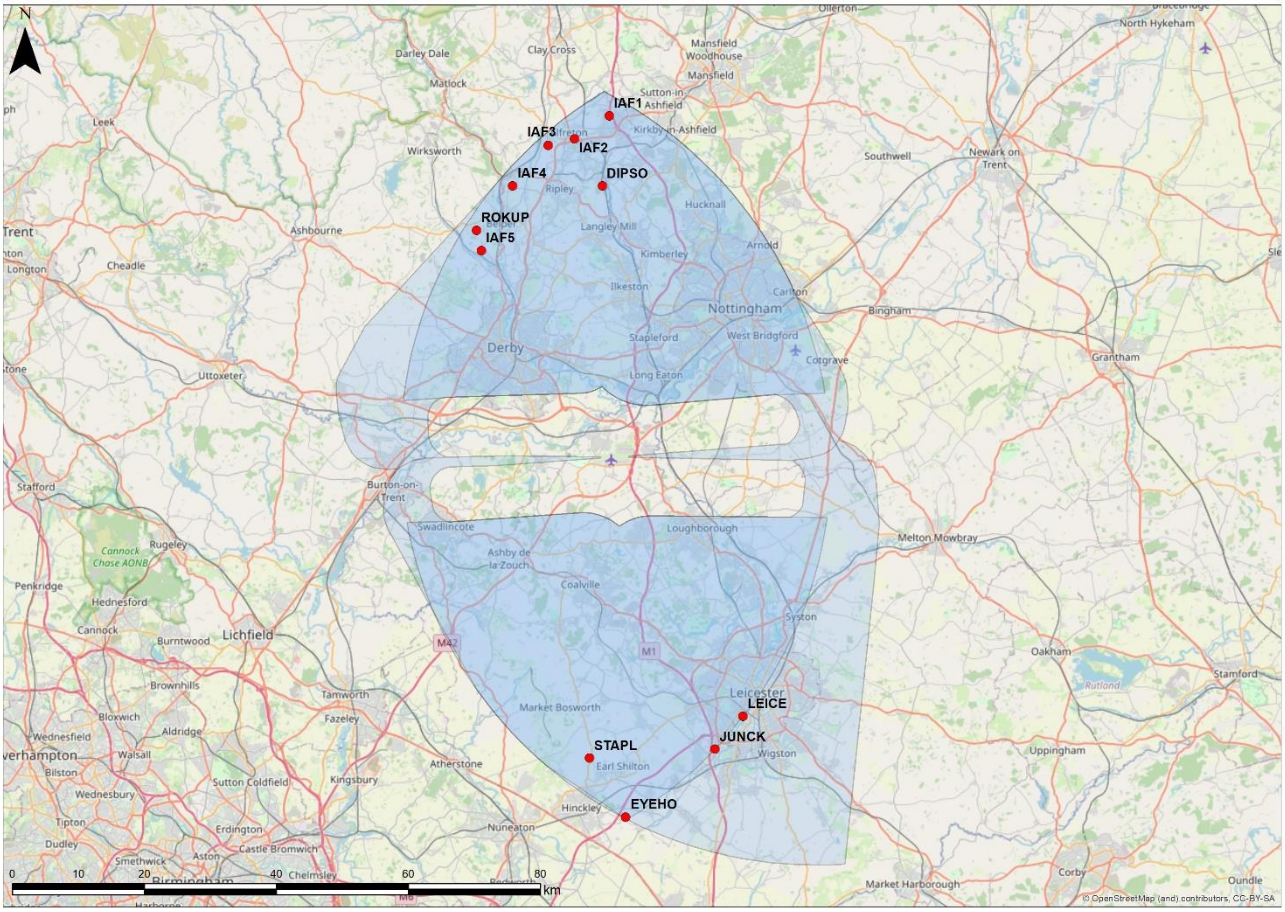


Figure 32: Geographic location of all Intermediate Approach Fixes (IAFs)

21.3. Viable but Poor Fit IAFs

Not all of the possible IAF locations identified during the early phase of design have proven to be in a location that aligns with the mandatory design principles Safety, Programme and Continuity or misaligns to the design constraints identified for arrivals in section 19.8.

On that basis, and in line with the description of viability outlined in section 5.11, those IAF locations were categorised as "Viable but Poor Fit" and no arrivals design options have been created from them.

This section provides a summary of each of these IAFs including a description of the IAF location and how it misaligns with these mandatory design principles.

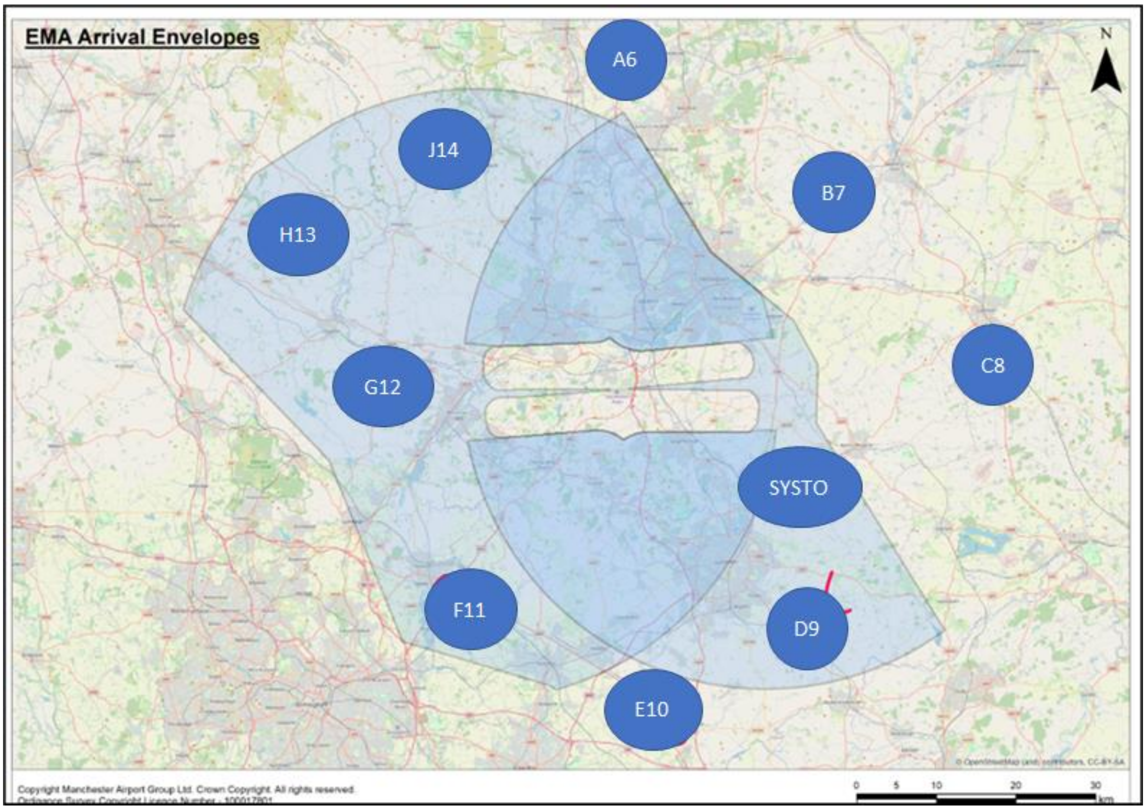


Figure 33: Viable but Poor Fit IAF map

Option	Safety	Programme	Continuity
IAF A6	S	P	C

Description: This IAF option is the most northerly option, located between Mansfield and Chesterfield in the vicinity of M1 Junction 29.

Safety: This option fails to align with this design principle, because the IAF is not contained within the boundaries of controlled airspace.

Programme: This option fails to align with the integration and environmental ends of the AMS.

> *Integration*: This option would require additional airspace to mitigate the safety risk of potentially operating in Class G airspace. This additional airspace would be required 24x7 and therefore would impact other airspace users.
>
> *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

Option	Safety	Programme	Continuity
IAF B7	S	P	C

Description: This IAF option is the north easterly option, located west of Newark-on-Trent.

Safety: This option fails to align with this design principle, because the IAF is not contained within the boundaries of controlled airspace.

Programme: This option fails to align with the integration and environmental ends of the AMS.

> *Integration*: This option would require additional airspace to mitigate the safety risk of potentially operating in Class G airspace. This additional airspace would be required 24x7 and therefore would impact other airspace users.
>
> *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

Option	Safety	Programme	Continuity
IAF C8	S	P	C

Description: This IAF option is the easterly option, located to the west of Stoke Rochford.

Safety: This option fails to align with this design principle because it would locate the IAF at a point in direct conflict with EMA departures to the east, creating an inbuilt hazard and is not contained within the boundaries of controlled airspace. In addition, it is situated in an area with intense non-commercial activity with parachute flights from Langar airfield.

Programme: This option fails to align with the integration and environmental ends of the AMS.

> *Integration*: This option would require additional airspace to mitigate the safety risk of potentially operating in Class G airspace and the interaction with Langar parachute operations. This additional airspace would be required 24x7 and therefore would impact other airspace users.

> *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved. Furthermore, the conflict with departures to the east would require ATC intervention to resolve. This is likely to be in the form of level restrictions (to either departures or arrivals) which would have an adverse impact on noise below 7,000ft.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

IAF D9 (current PIGOT hold)	S	P	C

Description: This IAF option is the south easterly option, located to the south east of Leicester. This represents the location of the current PIGOT hold and is included as a "do nothing" option.

Programme: This option fails to align with the environmental end of the AMS.

> *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

IAF E10	S	P	C

Description: This IAF option is the southerly option, located west of Lutterworth and north east of Coventry.

Programme: This option fails to align with the environmental end of the AMS.

> *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

IAF F11	S	P	C

Description: This IAF option is the south westerly option, located over east Tamworth.

Safety: This option fails to align with this design principle because it would locate the IAF at a point in direct conflict with arrivals to the CHASE hold for Birmingham airport, creating an inbuilt hazard. Programme: This option fails to align with the simplification and environmental ends of the AMS. *Simplification*: This option is likely to interact with both departures and arrivals to the CHASE hold for Birmingham Airport. *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved. *Trade-offs*: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.			
IAF G12	S	P	C
Description: This IAF option is the westerly option, located in the vicinity of Newchurch and the A515 which are due west of Burton upon Trent. Safety: This option fails to align with this design principle because it would locate the IAF at a point in direct conflict with arrivals to the CHASE hold for Birmingham airport, creating an inbuilt hazard. Programme: This option fails to align with the simplification and environmental ends of the AMS. *Simplification*: This option is likely to interact with departures and arrivals from Birmingham Airport. *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved. Furthermore, the conflict with departures to the west would require ATC intervention to resolve. This is likely to be in the form of level restrictions (to either departures or arrivals) which would have an adverse impact on noise below 7,000ft. *Trade-offs*: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.			
IAF H13	S	P	C
Description: This IAF option is the north westerly option, located to the north of Cheadle. Safety: This option fails to align with this design principle because it would locate the IAF at a point in direct conflict with EMA departures to the north west, creating an inbuilt hazard. Programme: This option fails to align with the simplification and environmental ends of the AMS. *Simplification*: This option could cause interactions with departures from Birmingham Airport and inbounds to the CHASE hold for Birmingham. *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved.			

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.			
IAF J14	S	P	C

Description: This IAF option is the north-north westerly option, located in the vicinity of Wirksworth.

Programme: This option fails to align with the simplification and environmental ends of the AMS.

> *Simplification*: This option is likely to cause interactions with arrivals to the south (DAYNE) hold at Manchester Airport.
>
> *Noise*: The IAF is located outside of the area within which a CDA could be achieved to both runway ends, therefore not aligning to the AMS. A CDA is lower in noise impact than a non-CDA, hence this option cannot therefore align with the ANG to minimise noise impacts below 7,000ft. This option therefore performs worse than those from an IAF within the area from which CDAs to both runway ends can be achieved.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

SYSTO	S	P	C

Description: This IAF option is to the south east, located in the vicinity of Syston which is on the boundary of the area within which a CDA could be achieved to both runway ends. Further investigation showed that the IAF is too close to the FAF for runway 27 and creates a CDA gradient that is significantly above the range for low noise approaches and the range for CDAs defined within ICAO guidance and described at section 19.5.

This IAF was originally created in the comprehensive list of Arrivals options but changed to Viable Poor Fit following the above analysis. All options from this IAF to runway 27 were therefore re-classified as Viable but Poor Fit (as detailed at section 29.24). This led to all options for runway 09 from this IAF also being classified as Viable but Poor Fit (as detailed in section 25.24) and as described below.

Safety: As detailed at section 19.9f), the use of runway dependant IAFs i.e. Those that only have the ability to provide arrivals procedures to only one runway instead of both runway 27 and runway 09, has been identified as having safety concerns. This is because of a potentially unsafe scenario within the network for an aircraft to fly an incorrect routing to the wrong IAF (when following the STAR) if a runway change occurs following an aircraft radio failure.

Therefore, without the ability to provide viable options to runway 27, any arrivals options from this IAF to runway 09 are therefore also classified as Viable but Poor Fit.

Programme: This option fails to align with the environmental ends of the AMS.

> *Noise*: The IAF is located on the boundary of the area within which a CDA could be achieved to both runway ends. However, further investigation showed that the IAF is too close to runway 27 and produced a CDA gradient of between 3.8 and 5.1 depending on joining point to final approach. As such it is significantly above the upper boundary of 3.5° for a CDA. A CDA is lower in noise impact than a non-CDA, hence this option cannot align with the ANG to minimise noise impacts below 7,000ft. The extension of the routes necessary to achieve an acceptable descent gradient for a CDA would work against the AMS end to minimise emissions.

Trade-offs: The trade-off analysis against other AMS ends did not identify other material benefits sufficient to offset a red categorisation.

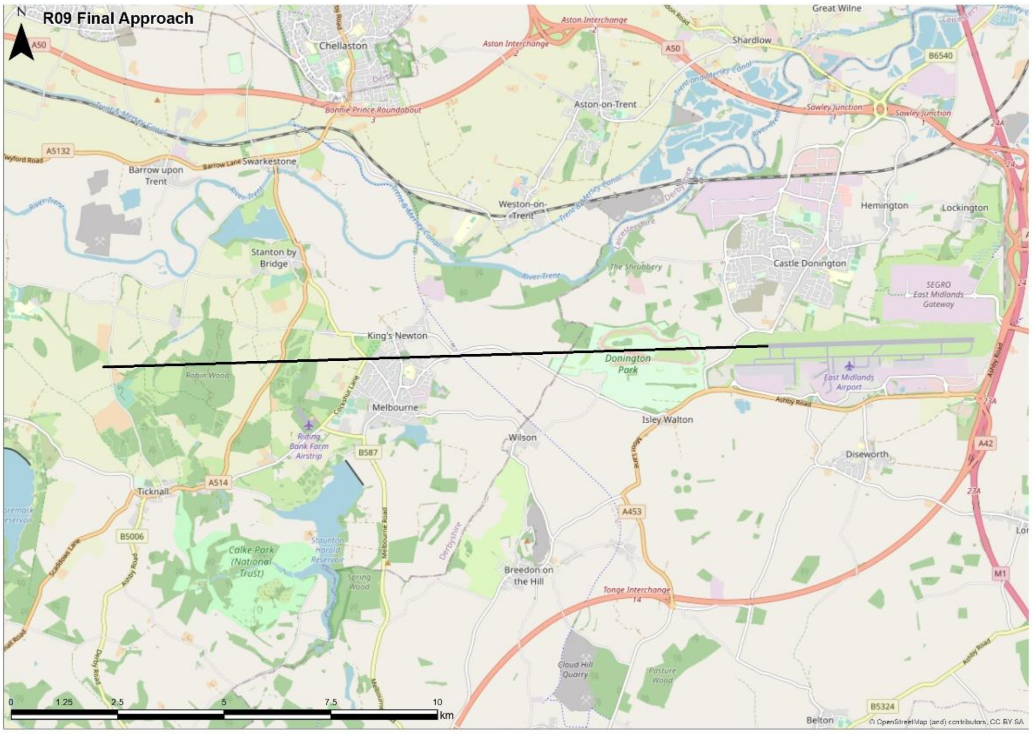
22. Final Approach Runway 09

As described in section 19.6, for each runway direction there is single final approach segment that takes aircraft from the FAF to the runway. This final approach segment allows the aircraft to establish a safe and stable approach to the runway, and for this reason it is created as a single line aligned to the runway centreline.

The final approach for runway 09 commences at the FAF located at 2,000ft and from this point the final approach has a descent gradient of 3°. The approach is aligned with the track of the current published ILS procedure for runway 09.

The intermediate segment length that precedes this the final approach segment caters for any turns in the transition at the Intermediate Fix (IF) of up to 90°, which provides sufficient distance for turn anticipation and the Minimum Stabilisation Distance (MSD).

A diagram and narrative describing these segments can be found at section 19.6.



23. Runway 09 – Approach Transitions

23.1. Introduction to 09 Approach Design Envelopes

This envelope has been created for traffic routing to the RNP approach for runway 09. It covers the transitions from an IAF at 7,000ft and the design of the final approach.

In current operations for arrivals from the north, ATC radar vector aircraft onto the Final Approach from the ROKUP hold which is located to the west of Belper. Traffic is routed downwind to the north and west of the airfield to a base leg to the north of Burton upon Trent.

From the south, ATC radar vector aircraft from the PIGOT hold which is located south east of Leicester, to a base leg position over Burton upon Trent.

Maps of both these traffic patterns can be seen in the section that describes current operations at section 2.5.

The design options for both runway 09 and runway 27 have been created with these operations in mind, and to adhere to the UK CAA Containment Policy for RNAV1 STARs; 'Specified nominal tracks designed to RNAV 1 (RNP 1) standard should not be less than 3Nm from the limits of controlled/advisory airspace'.

Section 19.6 describes the design process which has created a set of transitions starting at the IAFs at 7,000ft. Each option flies an initial descent before making a turn at the IF to connect to the intermediate segment, and thereafter onto the final approach segment. The length of each of these segments is driven by the criteria contained within PANS-OPS 8168 and includes a consideration of the appropriate speeds of aircraft in this phase of flight.

Although these future airspace options have been developed on the principle of minimising ATC vectoring (the process known as systemisation described in section 19.9b), some ATC vectoring will still be required in order to ensure safe separation and to maintain capacity. This is in line with the design principles Safety and Continuity.

23.2. Methodology

As detailed in section 19.3, arrivals to EMA are predominantly from the north and south. To ascertain an area of airspace for an arrival method that could accommodate approaches to both runways, an arc with a given radius was predicated on the IF of an approach procedure, based on a FAF altitude of 2,000ft. This process was replicated for runway 27, and the two overlapping arcs produce a common area, within which we have placed IAFs which define the start of the arrivals design options.

The options for runway 09 were designed to the current FAF of 2,000ft.

Additionally, the arrivals design options took account of the constraints and considerations in section 19.8 which means that not all the design envelope area can be used as potential airspace to design within.

23.3. Runway 09 Direct and Indirect Routes

The EMA Design Principle Noise N1 states that "Flight paths should, where practical, be spread out to avoid concentration of aircraft activity to share any noise impacts". One method of achieving this is through the provision of noise respite.

As described in section 19.7, both direct and indirect options have been created from each IAF, and this concept is intended to create an opportunity for noise respite.

Table 12 and Table 13 below detail the direct and indirect option numbers from each IAF for runway 09:

RUNWAY 09 NORTH IAFs	DIRECT Options			INDIRECT Options			
IAF1	19	20	20A	17	18		
IAF2	21	22	22A	13	14		
IAF3	11	12	12A	23	24		
IAF4	9	10	10A	25	26		
IAF5	15	16		27	28		
ROKUP	1	2	4A	3	4		
DIPSO	7	8	8A	5	6	29	30

Table 12: Runway 09 North IAFs direct and indirect options

RUNWAY 09 SOUTH IAFs	DIRECT Options						INDIRECT Options			
STAPL	15	16					21	22		
EYEHO	13	14					23	24		
JUNCK	1	2	9	10	17	18	3	4	7	8
LEICE	5	6					11	12		

Table 13: Runway 09 South IAFs direct and indirect options

23.4. Runway 09 Design Envelopes and IAF Location Map

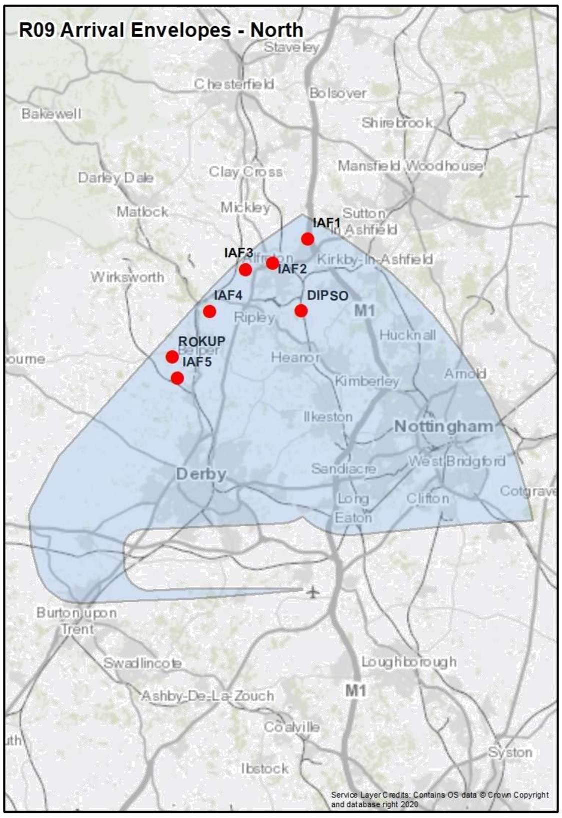


Figure 34: Runway 09 North arrival envelope and IAFs

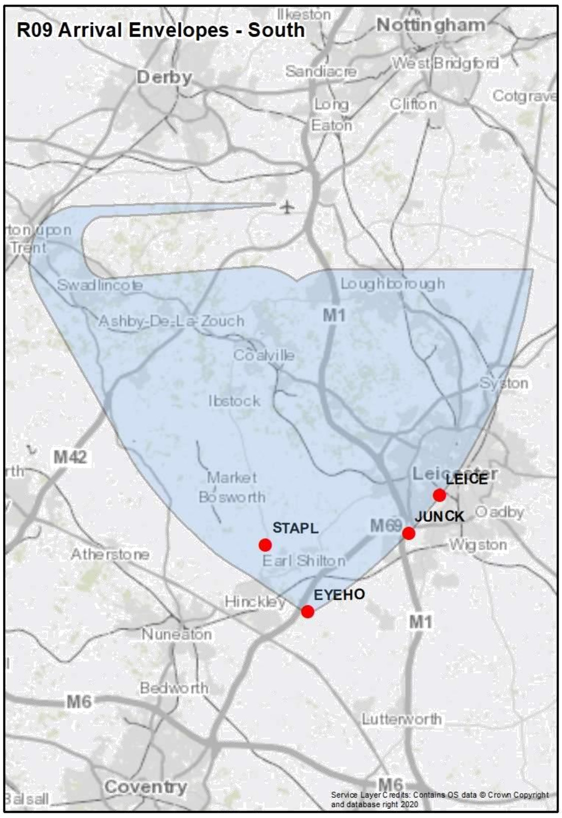


Figure 35: Runway 09 South arrival envelope and IAFs

24. Runway 09 – North

24.1. Runway 09 North, Options Summary Table

Viable and Good Fit		Viable but Poor fit		Unviable	
1	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 3.45° The route style is 'direct'			U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for non-compliance. These cover options that may be non-compliant with PANS-OPS in relation to: • MSD and the turn onto final approach. • Descent gradients above the PANS-OPS maximum. • Turn radius based on speed, altitude, and descent gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 2.7° The route style is 'direct'				

3	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.96° The route style is 'indirect'				
4	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.57° The route style is 'indirect'				
4A	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 3.06° The route style is 'direct'				
5	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.77° The route style is 'indirect'				
6	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.44° The route style is 'indirect'				
7	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.56° The route style is 'direct'				

8	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 2° The route style is 'direct'				
8A	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.16° The route style is 'direct'				
9	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.87° The route style is 'direct'				
10	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 2.19° The route style is 'direct'				
10A	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.53° The route style is 'direct'				
11	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.56° The route style is 'direct'				

12	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 2.01° The route style is 'direct'				
12A	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.16° The route style is 'direct'				
13	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.17° The route style is 'indirect'				
14	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.71° The route style is 'indirect'				
15	IAF = **IAF5** north of Duffield The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 3.15° The route style is 'direct'				
16	IAF = **IAF5** north of Duffield The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 2.8° The route style is 'direct'				

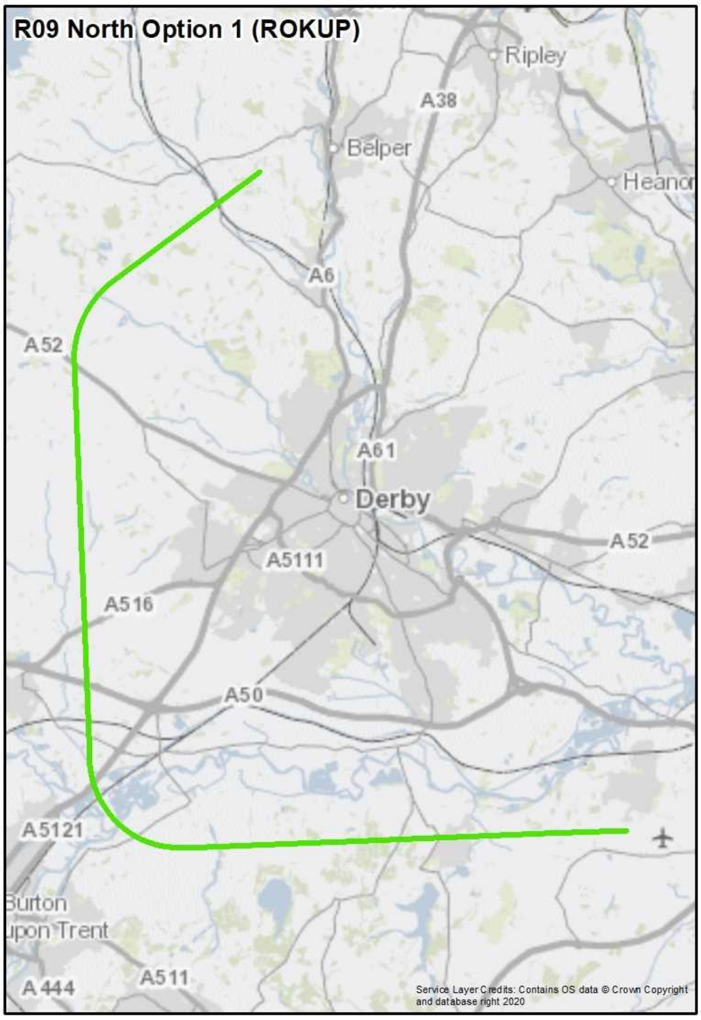
17	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.03° The route style is 'indirect'				
18	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.67° The route style is 'indirect'				
19	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.17° The route style is 'direct'				
20	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.79° The route style is 'direct'				
20A	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2° The route style is 'direct'				
21	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.46° The route style is 'direct'				

22	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.95° The route style is 'direct'				
22A	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.21° The route style is 'direct'				
23	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.35° The route style is 'indirect'				
24	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.83° The route style is 'indirect'				
25	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.95° The route style is 'indirect'				
26	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.55° The route style is 'indirect'				

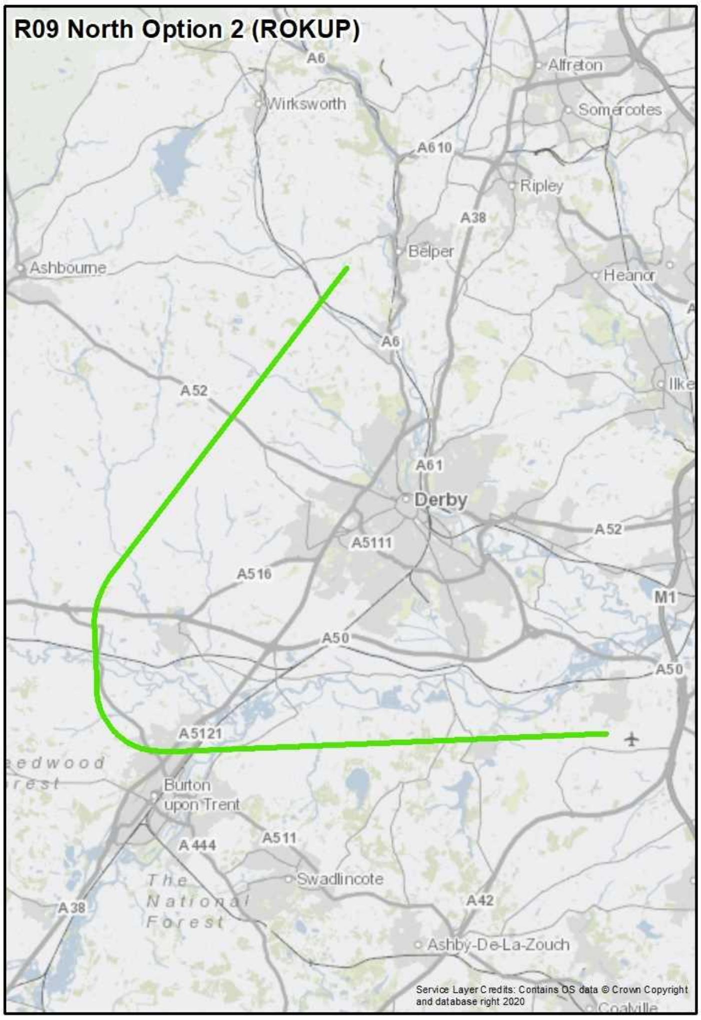
27	IAF = IAF5 north of Duffield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.02° The route style is 'indirect'				
28	IAF = IAF5 north of Duffield The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.59° The route style is 'indirect'				
29	IAF = DIPSO, east of Ripley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.12° The route style is 'indirect'				
30	IAF = DIPSO, east of Ripley The length of the Intermediate Segment (IF to FAF) is 6.9nm CDA descent gradient = 1.66° The route style is 'indirect'				

24.2. Runway 09 North, Option 1

Description	Reason for inclusion
This option starts at IAF ROKUP which is the hold currently used for arrivals from the north. The style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF ROKUP which is situated to the south west of Belper and the route initially tracks south west turning to a southerly heading just north of the A52 and passing west of Derby. The route turns to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 3.45° which is above the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Aligns to current operations as a "do minimum" option. **Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Offers potential to provide noise respite when combined with indirect options from ROKUP. **Noise N3**: Aims to reduce the impact of noise by routing west of Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

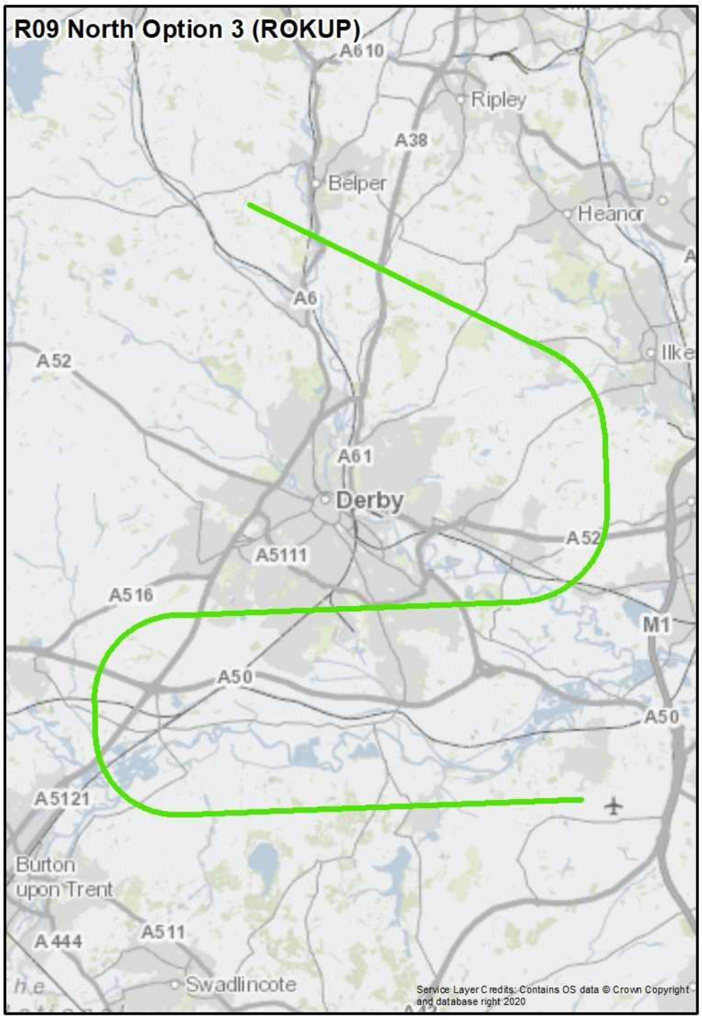


24.3. Runway 09 North, Option 2

Description	Reason for inclusion
Option 2 starts at IAF ROKUP which is the hold currently used for arrivals from the north. The style of the route is 'direct' which means the distance to the final approach has been minimised. It is similar to Option 1 but has a longer final approach. The option starts at IAF ROKUP which is situated to the south west of Belper and the route tracks west of Derby before turning onto a southerly heading just north of Hatton before turning to join the extended runway centreline and over flying Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.7° which is within the optimum range for low noise approaches and the acceptable range for CDAs defined within ICAO guidance. 	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Offers potential to provide respite when combined with indirect options from ROKUP. **Noise N3:** Provides an optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Derby and routing north of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

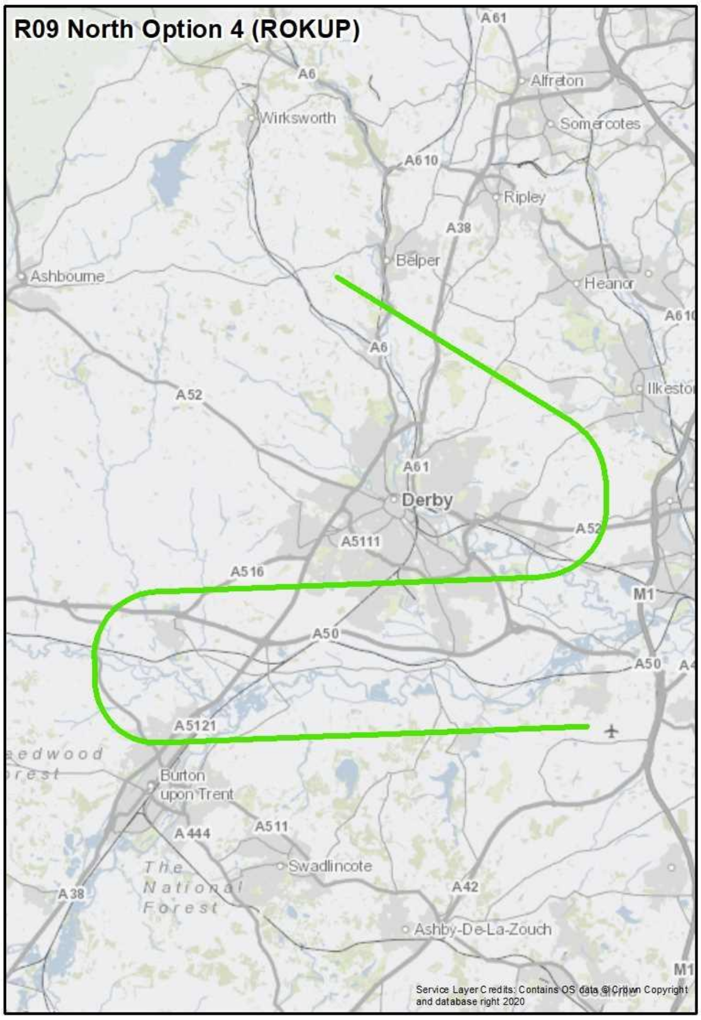
24.4. Runway 09 North, Option 3

Description	Reason for inclusion
The IAF for this option is ROKUP and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF ROKUP which is situated to the south west of Belper and the route tracks south east between Derby and Nottingham, turning south over West Hallam, before turning west between Derby and Long Eaton. To the south west of Derby the route turns south before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.96° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Offers potential to provide respite when combined with direct options from ROKUP. **Noise N3:** Aims to reduce the impact of noise by avoiding Nottingham and central Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.5. Runway 09 North, Option 4

Description	Reason for inclusion
The IAF for this option is ROKUP and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It is similar to Option 3 but has a longer final approach. The option starts at IAF ROKUP which is situated to the south west of Belper and the route tracks south east between Derby and Nottingham, turning south to the west of Stapleford, before turning west between Derby and Long Eaton. To the north of Burton upon Trent and Hatton the route turns south before turning to join the extended runway centreline and over flying Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.57° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Offers potential to provide respite when combined with direct options from ROKUP. **Noise N2**: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas. **Noise N3:** Aims to reduce the impact of noise by avoiding Derby after leaving the IAF. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.6. Runway 09 North Option 4A

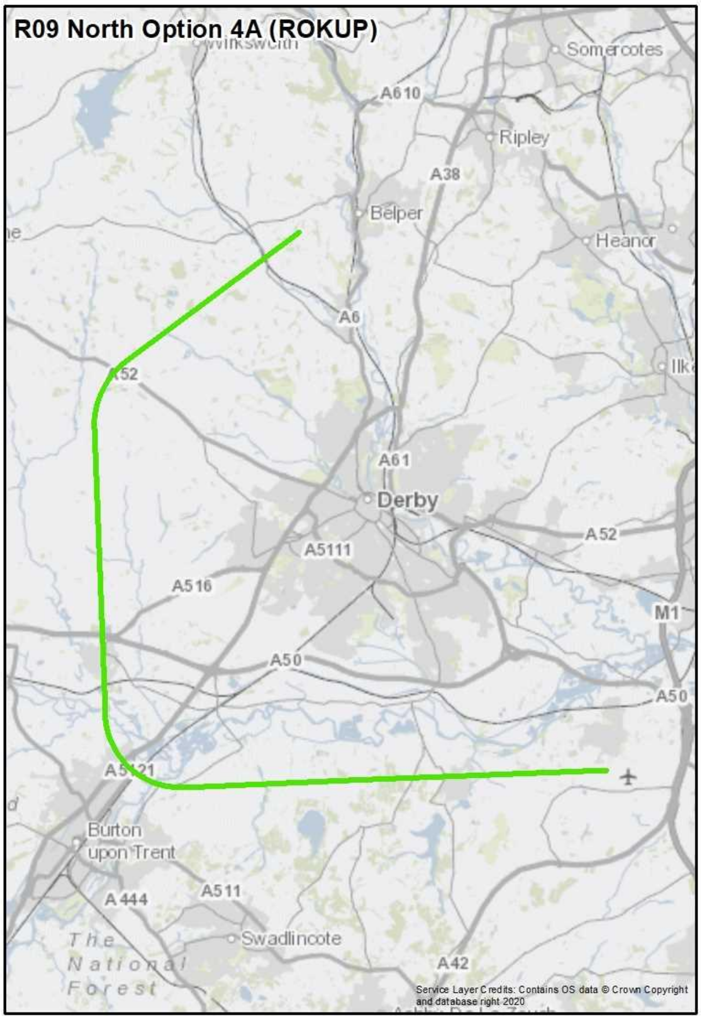
Description

The IAF for this option is ROKUP and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option has an IF at 2,500ft which is at a point 5nm from the FAF, thereby falling mid-way between the 3.85nm and 6.9nm utilised by other arrival options to runway 09 from the North.

The option starts at IAF ROKUP which is situated to the south west of Belper and the route tracks south west from ROKUP before turning onto a southerly heading as the track crosses the A52 mid-way between Ashbourne and Derby. The option routes directly south, over Hilton, and turns to join the extended runway centreline at a point north east of Burton upon Trent.

This RNAV 1 arrival connects the IAF to the IF, at 2,500ft, which is placed as close as possible to the FAF (5nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 3.06° which is above the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

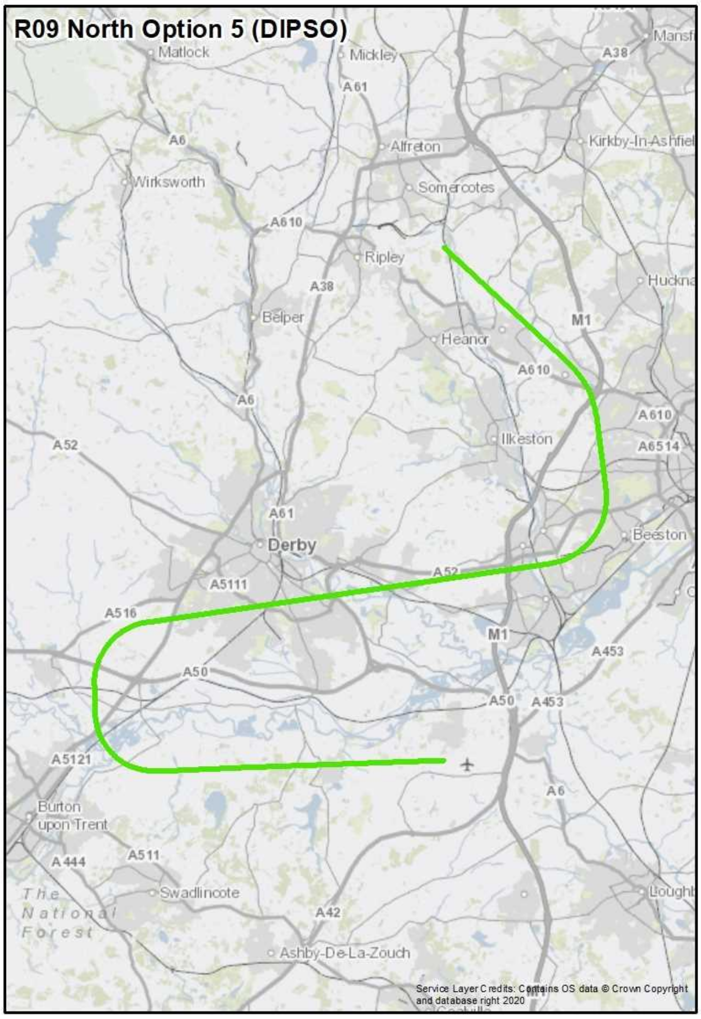
Noise N1: Offers potential to provide respite when combined with indirect options from ROKUP.

Noise N3: Aims to reduce the impact of noise by avoiding Derby and routing north east of Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

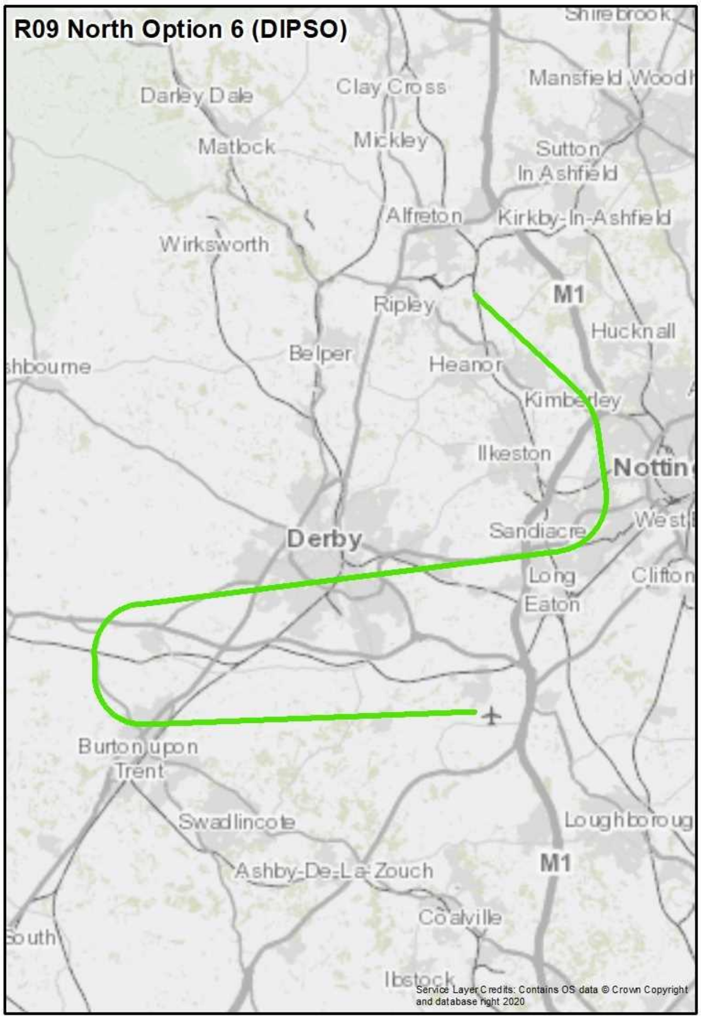
24.7. Runway 09 North Option 5

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF DIPSO which is east of Ripley and tracks south east towards Nottingham turning south over Hucknall, before turning before turning west parallel to the final approach path at Beeston. It overflies southern Derby and to the south west of Derby the route turns south before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.77° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from DIPSO. **Noise N2**: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



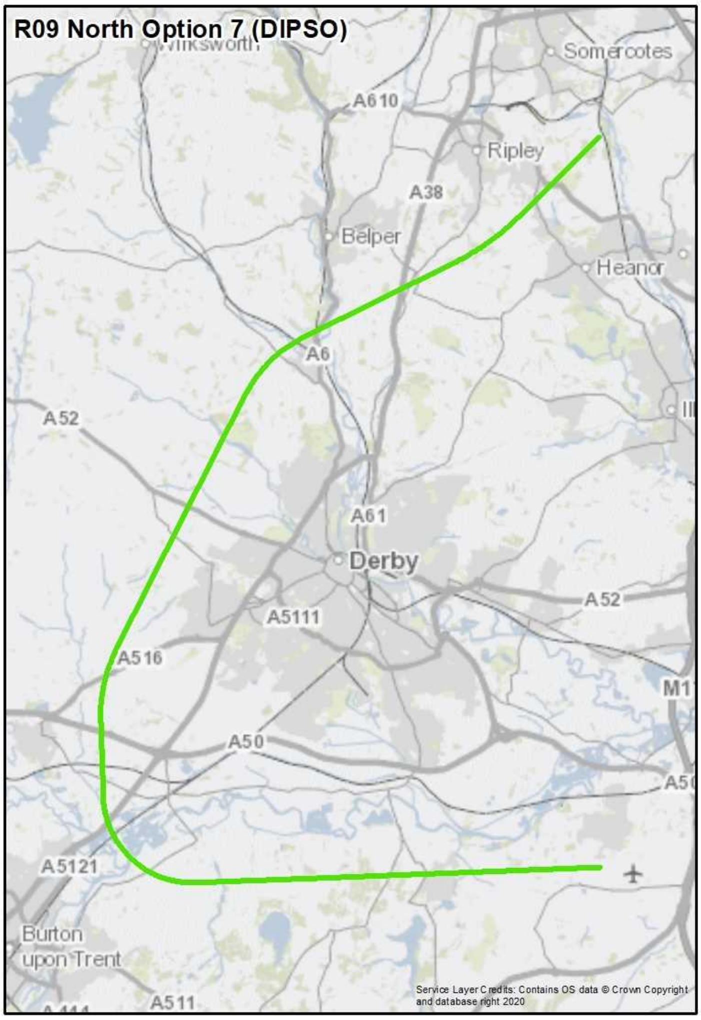
24.8. Runway 09 North Option 6

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It is similar to Option 5 but has a longer final approach. The option starts at IAF DIPSO which is east of Ripley and tracks south east towards Nottingham turning south over Hucknall, before turning before turning west parallel to the final approach path at Beeston. It overflies southern Derby and to the north west of Burton upon Trent it turns south before turning to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.5° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from DIPSO. The longer final approach provides an opportunity for noise relief. Noise N2: Routes over Derby which has a higher level of ambient noise than surrounding rural areas. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



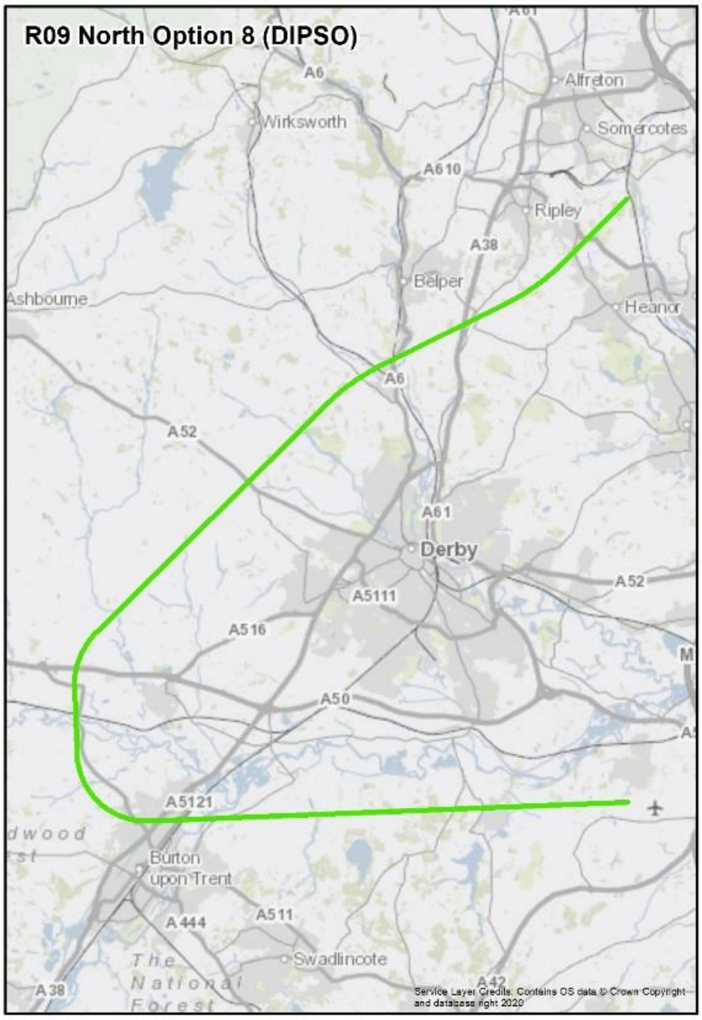
24.9. Runway 09 North, Option 7

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF DIPSO which is east of Ripley and tracks south west avoiding Belper. After passing Duffield it turns south and tracks west of Derby before turning over Etwall onto a southerly heading before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.56° which is within the optimum range for low noise approaches and the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from DIPSO. **Noise N3:** Optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper, Derby and routing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



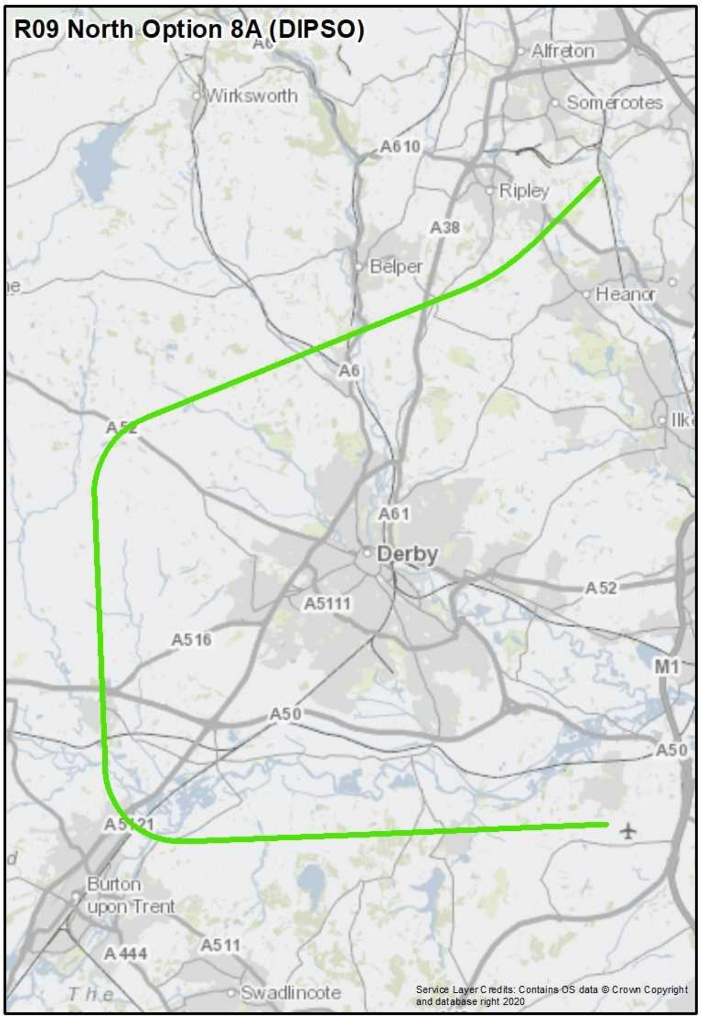
24.10. Runway 09 North, Option 8

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'direct' which means the distance to the final approach has been minimised. It is initially similar to Option 7 but diverges south of Belper to give a longer final approach. The option starts at IAF DIPSO which is east of Ripley and tracks south west avoiding Belper. It continues on this heading beyond Duffield and until Church Broughton where it turns onto a southerly heading before turning to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from DIPSO. **Noise N3:** Aims to reduce the impact of noise by avoiding Belper and Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



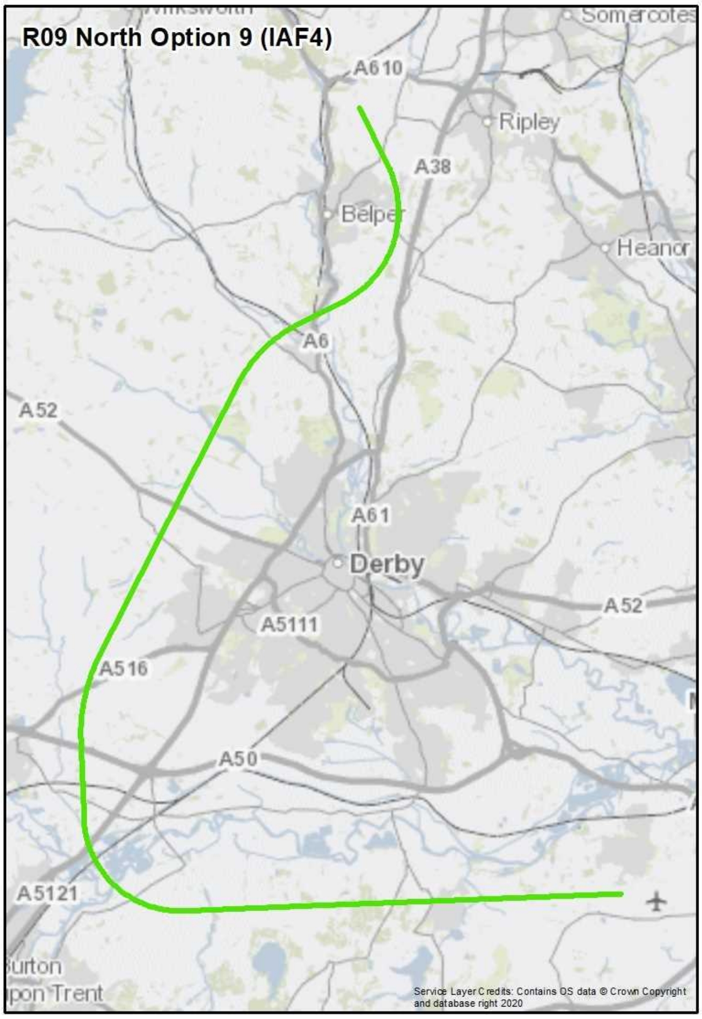
24.11. Runway 09 North, Option 8A

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option has an IF at 2,500ft which is at a point 5nm from the FAF, thereby falling mid-way between the 3.85nm and 6.9nm utilised by other arrival options to runway 09 from the North. The option starts at IAF DIPSO which is east of Ripley and tracks south west similar to Options 7 and 8, staying to the south west of Belper before turning onto a southerly heading as the track crosses the A52 mid-way between Ashbourne and Derby. The option routes directly south over Hilton and turns to join the extended runway centreline at a point north east of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF, at 2,500ft, which is placed as close as possible to the FAF (5nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.16° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from DIPSO. Noise N3: Aims to reduce the impact of noise by avoiding Belper, Derby and routing north east of Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



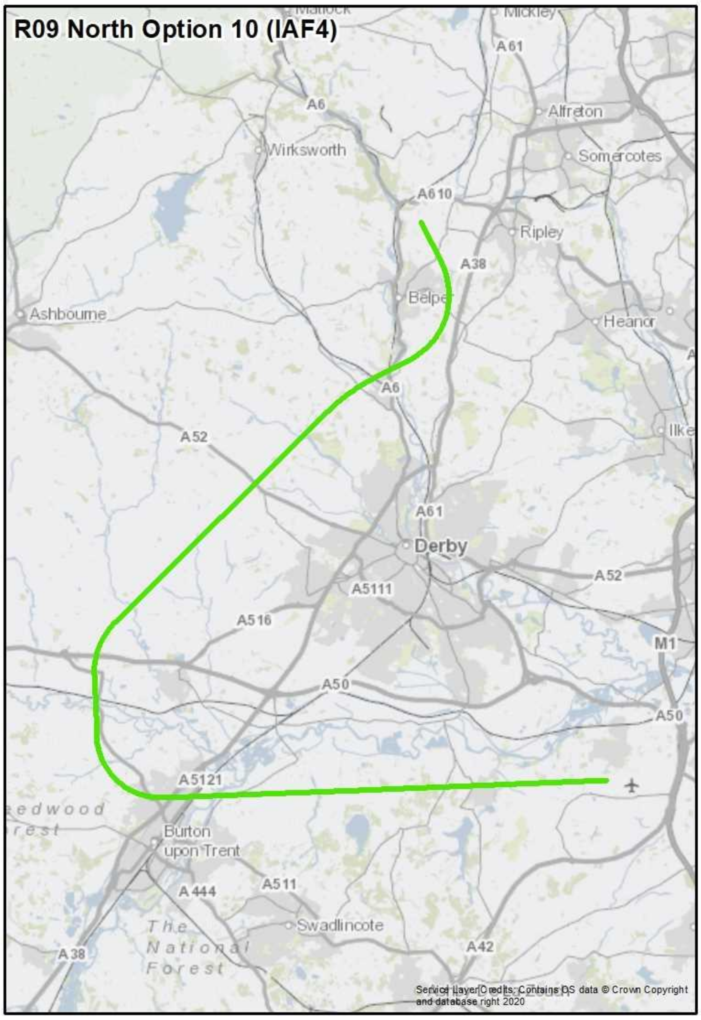
24.12. Runway 09 North, Option 9

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF4 which is north of Belper and from this point it tracks around Belper to the east and then south passing just north of Duffield and routing to the west of Derby. The option turns over Etwall, onto a southerly heading before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.87° which is close to the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF4. **Noise N3:** Close to the optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper, Derby and routing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



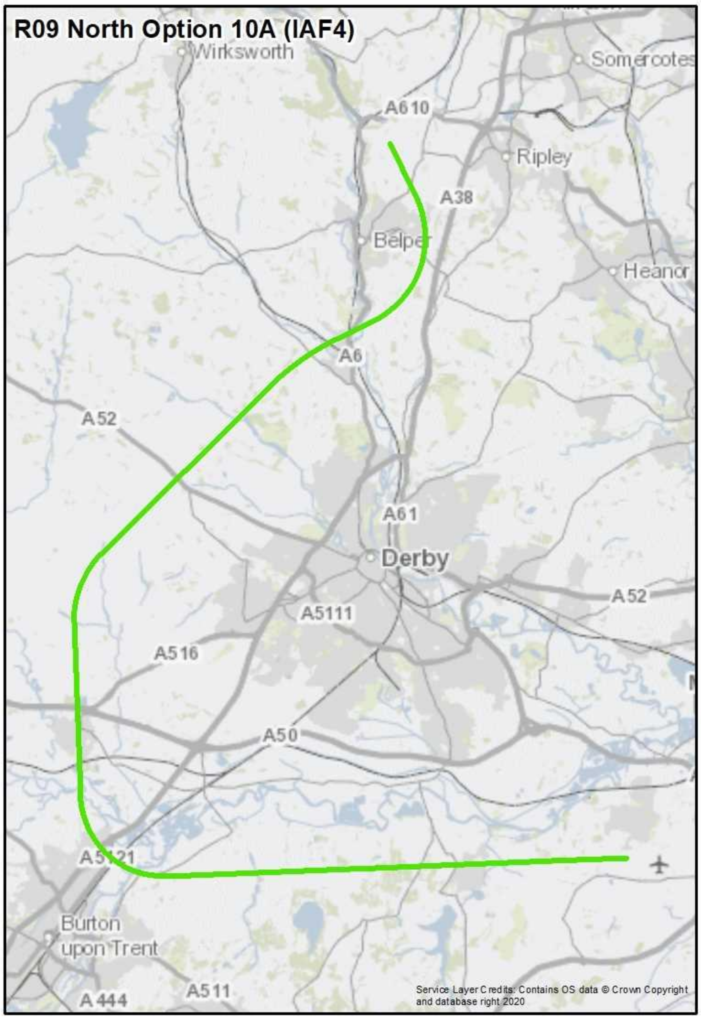
24.13. Runway 09 North, Option 10

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It is initially the same as option 9 but takes a more westerly track after Duffield to take the same track as Option 8. The option starts at IAF4 which is north of Belper and from this point it tracks around Belper to the east and then south passing just north of Duffield. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.19° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from IAF4. **Noise N3**: Close to the optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper and Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



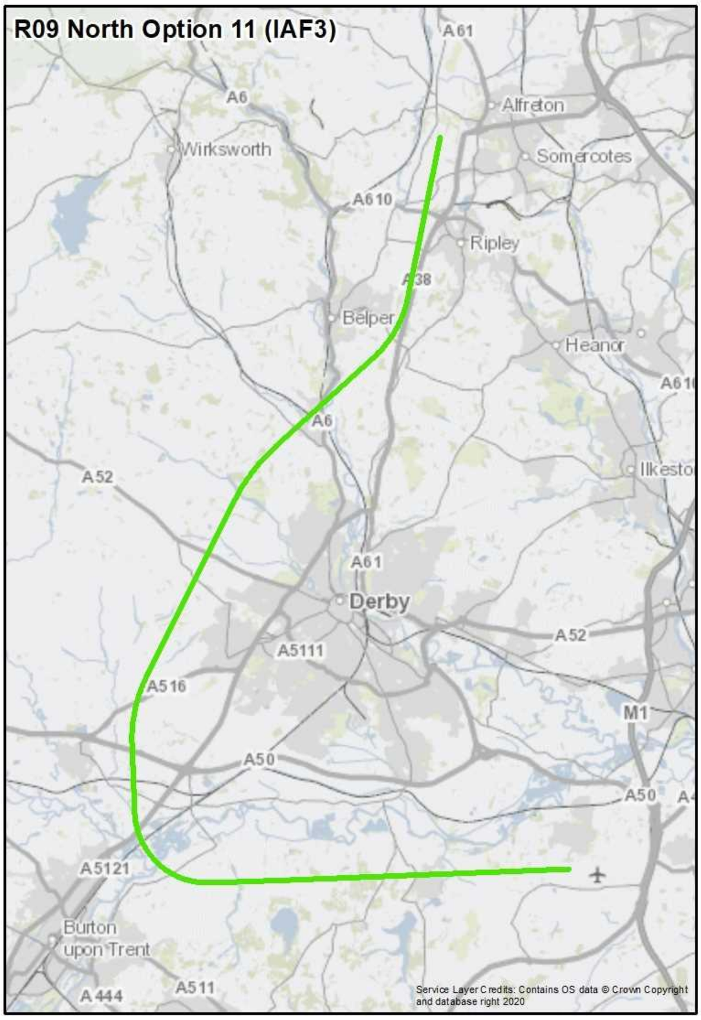
24.14. Runway 09 North, Option 10A

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option has an IF at 2,500ft which is at a point 5nm from the FAF, thereby falling mid-way between the 3.85nm and 6.9nm utilised by other arrival options to runway 09 from the North. It initially routes on the same track as Option 10 but the slightly more easterly track helps avoid the overflight of Burton upon Trent The option starts at IAF4 which is north of Belper and from this point it tracks around Belper to the east and then south passing just north of Duffield. It continues on heading until north of Hilton and then overflies Hilton before turning left to join the extended runway centreline and passing just north east of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.5° which is within the optimum range for low noise approaches and the acceptable range for CDAs defined within ICAO auidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF4. **Noise N3:** Descends at the optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper and Derby and passing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



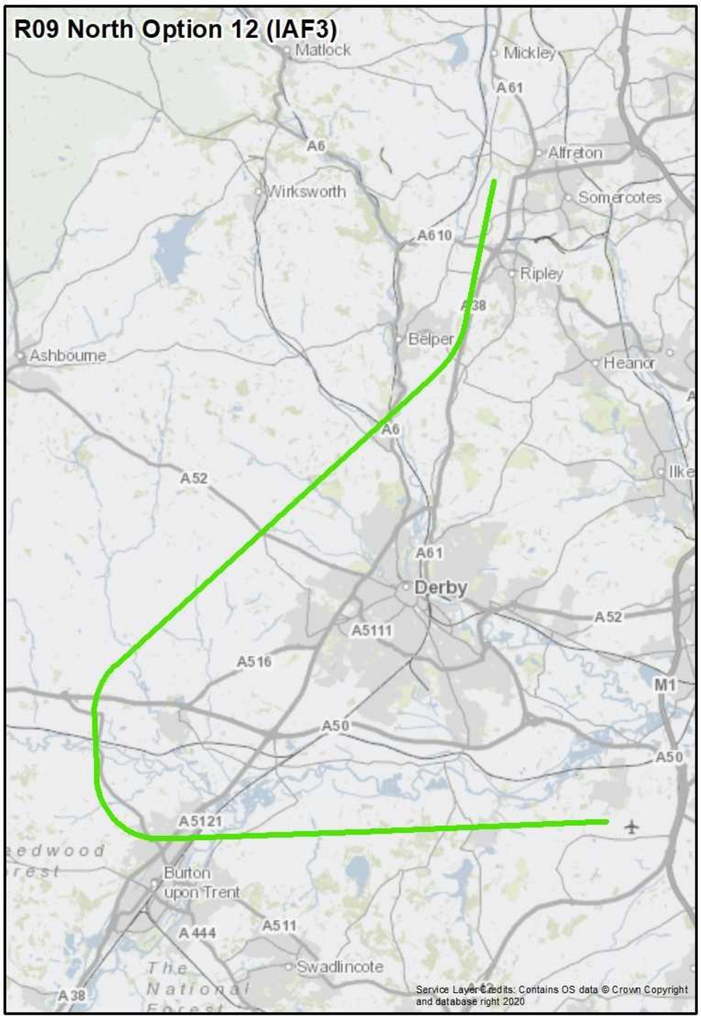
24.15. Runway 09 North, Option 11

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF3 which is west of Alfreton and from this point it routes between Ripley and Belper and turns south west passing overhead Duffield. It then turns slightly left to pass to the west of Derby, turning onto a southerly heading over Etwall, before turning to join the extended runway centreline north east of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (3.85nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.56° which is within the optimum range for low noise approaches and the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF3. **Noise N3:** Descends at the optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper and Derby and passing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



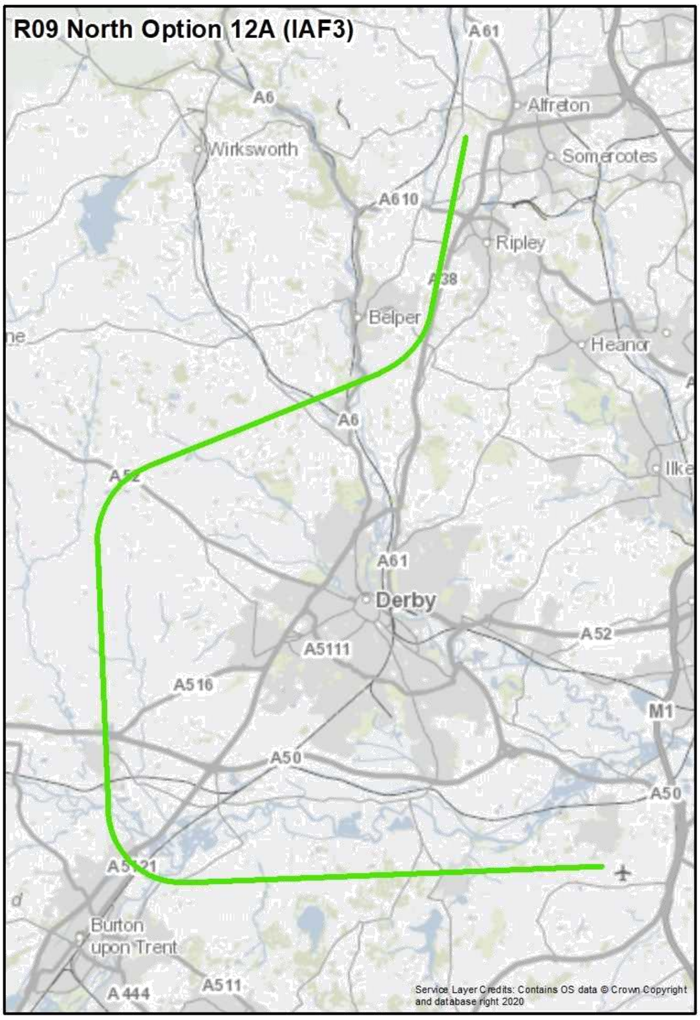
24.16. Runway 09 North, Option 12

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It is initially the same as option 11 but takes a more westerly track after Duffield. The option starts at IAF3 west of Alfreton and from this point and from this point it routes between Ripley and Belper and turns south west passing overhead Duffield. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.01° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF3. **Noise N3:** Aims to reduce the impact of noise by avoiding Belper and Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



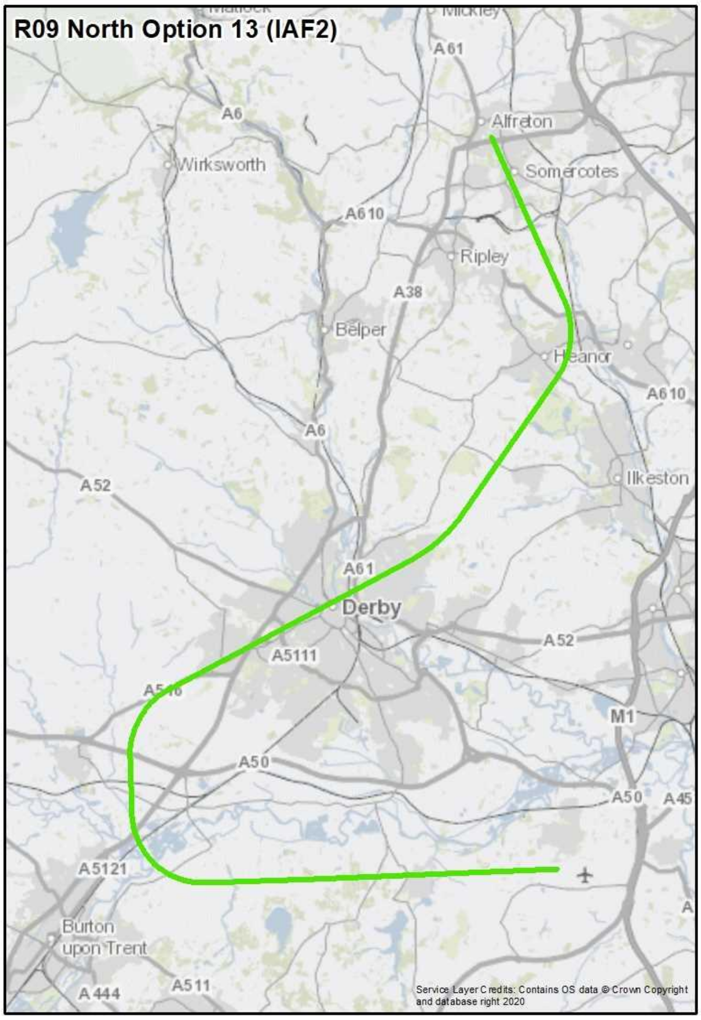
24.17. Runway 09 North, Option 12A

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option has an IF at 2,500ft which is at a point 5nm from the FAF, thereby falling between the 3.85nm and 6.9nm utilised by other arrival options to runway 09 from the North. It initially routes on the same track as Option 12 but the slightly more easterly track helps avoid the overflight of Burton upon Trent. The option starts at IAF3 west of Alfreton and from this point it routes between Ripley and Belper and turns south west passing north of Duffield. It continues on this heading until the track crosses the A52 mid-way between Ashbourne and Derby. The option routes directly south and overflies Hilton before turning left to join the extended runway centreline and passing just north east of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF, at 2,500ft, which is placed as close as possible to the FAF (5nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.16° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF3. **Noise N3:** Descends at the optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper and Derby and passing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



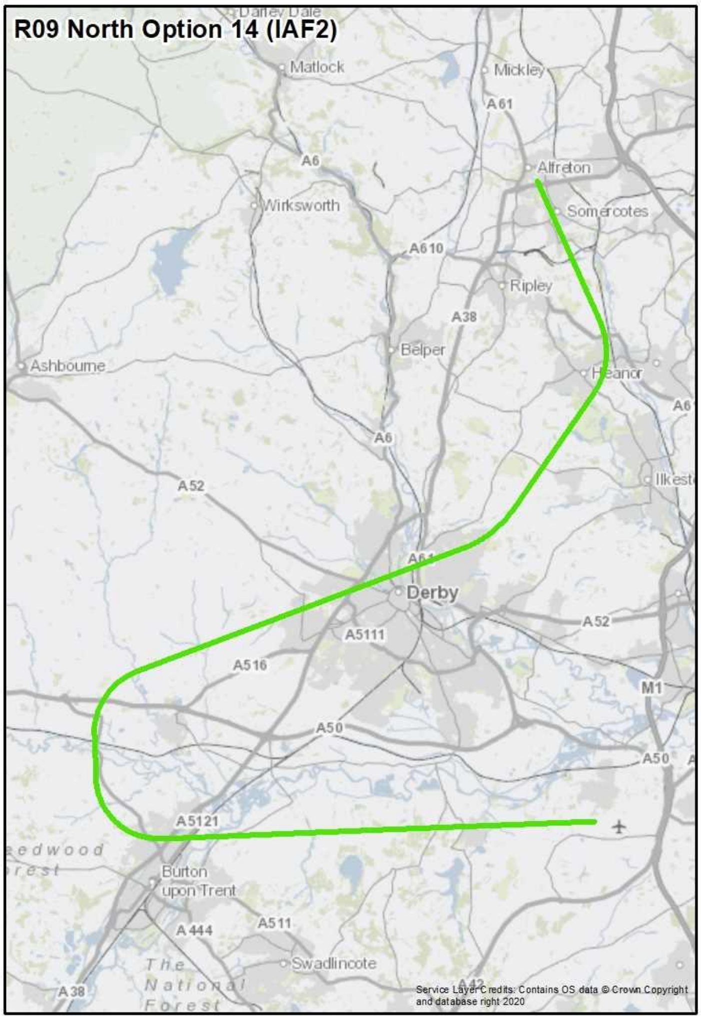
24.18. Runway 09 North, Option 13

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. This option starts at IAF2 near Alfreton and track south towards Heanor prior to turning south by south west to pass north of West Hallam. At the north east edge of Derby it turns to a south west heading and overflies central Derby and once over Etwall it turns left onto a southerly heading before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.17° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from IAF2. **Noise N2**: Routes over Derby which has a higher level of ambient noise than surrounding rural areas. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



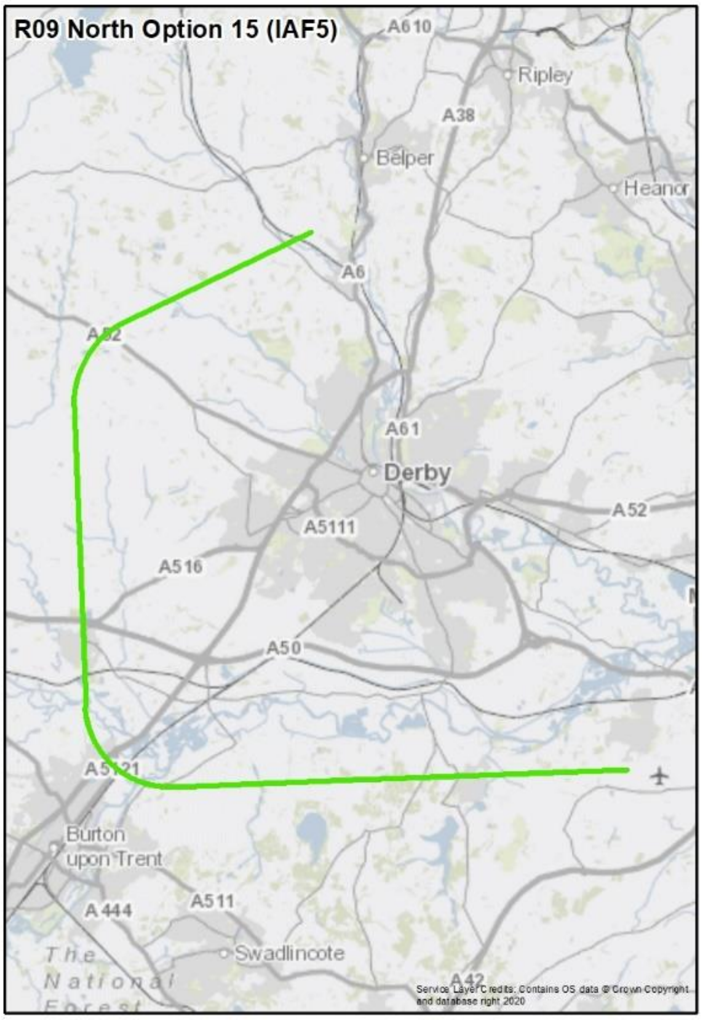
24.19. Runway 09 North, Option 14

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It initially routes on the same track as Option 13 but takes a more westerly track after passing Derby. This option starts at IAF2 near Alfreton and track south towards Heanor prior to turning south by south west to pass north of West Hallam. At the north east edge of Derby it turns to a south west heading and overflies north Derby. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.71° which is within the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from IAF2. **Noise N2**: Routes over Derby which has a higher level of ambient noise than surrounding rural areas. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.20. Runway 09 North, Option 15

Description	Reason for inclusion
The IAF for this option is IAF5 and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF5 north of Duffield and initially routes south west, crossing the A52 close to Ednaston, where it turns to track south and to the west of Derby and over flying Hilton. South of Hilton the route turns to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (5nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 3.15° which is above the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF5. **Noise N3:** Aims to reduce the impact of noise by avoiding Derby and passing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.21. Runway 09 North, Option 16

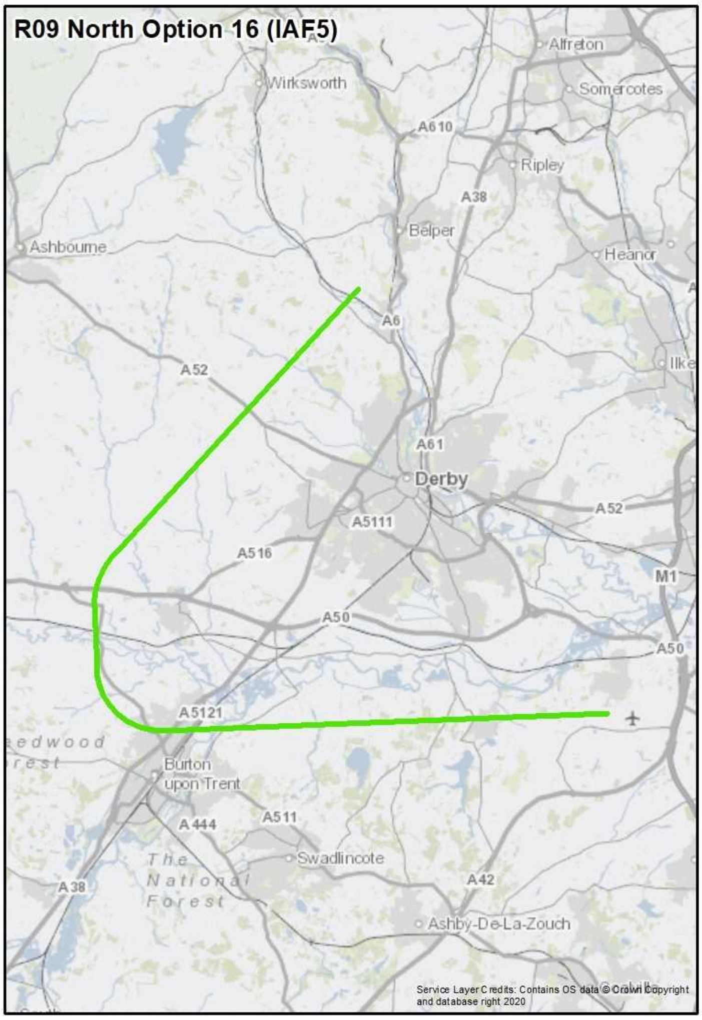
Description

The IAF for this option is IAF5 and the style of the route is 'direct' which means the distance to the final approach has been minimised.

The option starts at IAF5 north of Duffield and heads in a south west direction to route west of Derby before turning onto a southerly heading just north of Hatton and joining the extended runway centreline west of Burton upon Trent.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 2.8° which is close to the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from IAF5.

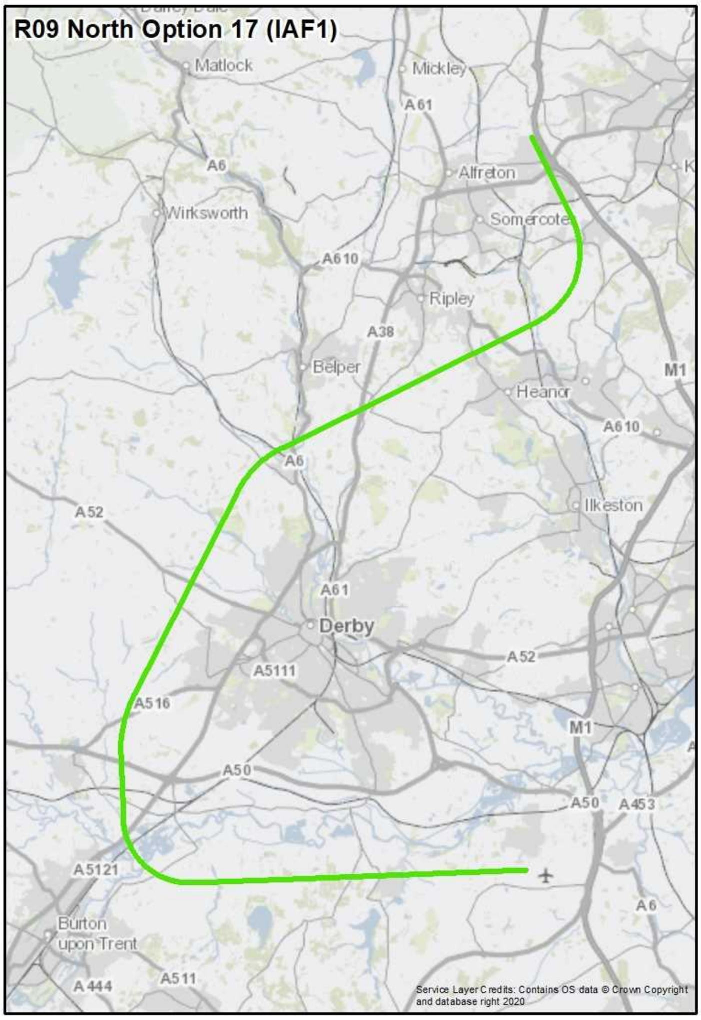
Noise N3: Optimal low noise CDA gradient.

Aims to reduce the impact of noise by avoiding Derby.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

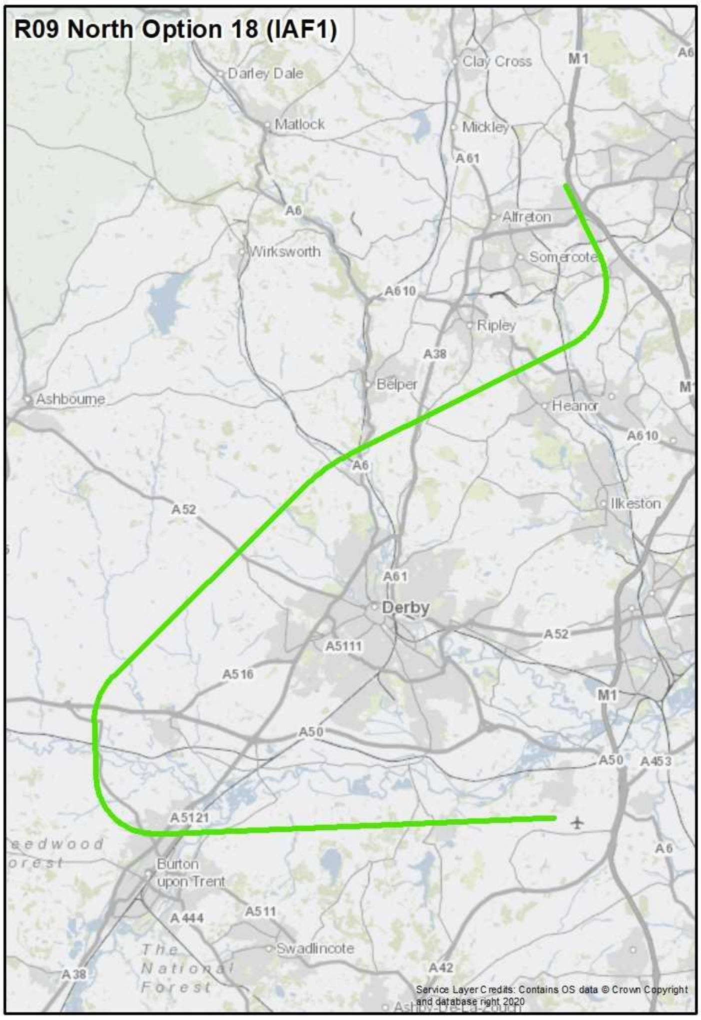
24.22. Runway 09 North, Option 17

Description	Reason for inclusion
The IAF for this option is IAF1 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF1, west of Sutton-in-Ashfield and initially tracks south east before turning south west and routing between Heanor and Ripley and south of Belper. North of Duffield the route turns south by south west and tracks west of Derby before turning over Etwall onto a southerly heading and turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.03° which is below the optimum range for low noise approaches but within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from IAF1. **Noise N3:** Aims to reduce the impact of noise by avoiding Ripley, Belper, Derby and Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.23. Runway 09 North, Option 18

Description	Reason for inclusion
The IAF for this option is IAF1 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It initially routes on the same track as Option 17 but takes a more westerly track after passing Duffield. The option starts at IAF1, west of Sutton-in-Ashfield and initially tracks south east before turning south west and routing between Heanor and Ripley and south of Belper. North of Duffield the route turns slightly south and continues on this heading until Church Broughton where it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.67° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from IAF1. **Noise N3:** Aims to reduce the impact of noise by avoiding Ripley, Belper and Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.24. Runway 09 North, Option 19

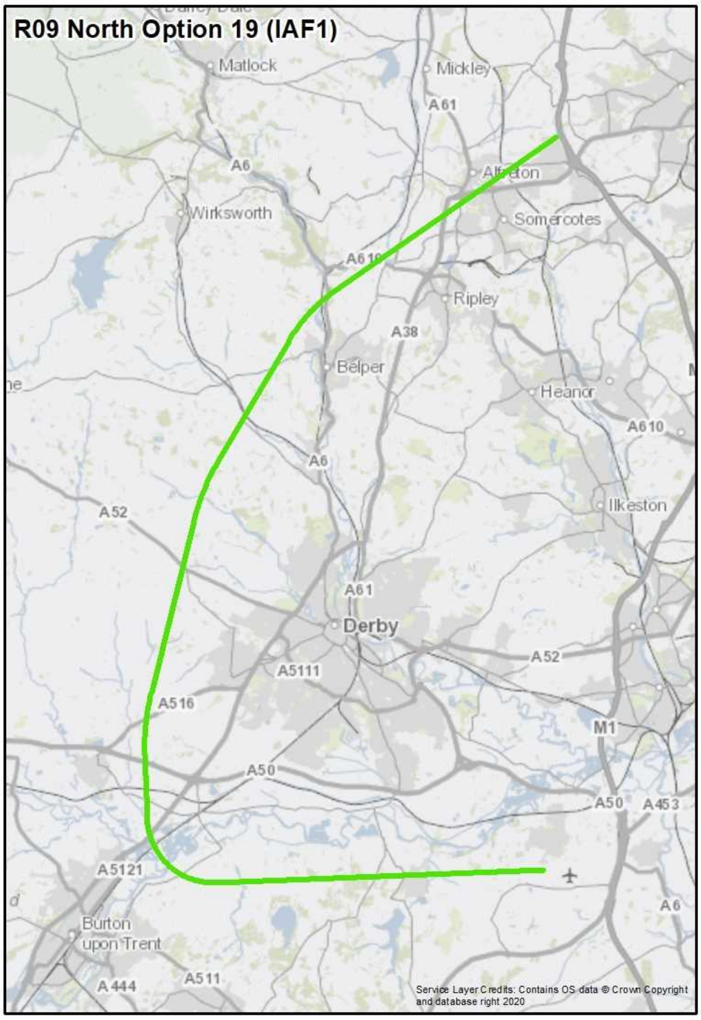
Description

The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised.

The option starts at IAF1, west of Sutton-in-Ashfield and tracks south west over Alfreton passing north of Ripley and west of Belper. It then turns slightly left onto a south west heading to route to the west of Derby. The route turns over Etwall onto a southerly heading before turning to join the extended runway centreline east of Burton upon Trent.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 2.17° which is close to the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from IAF1.

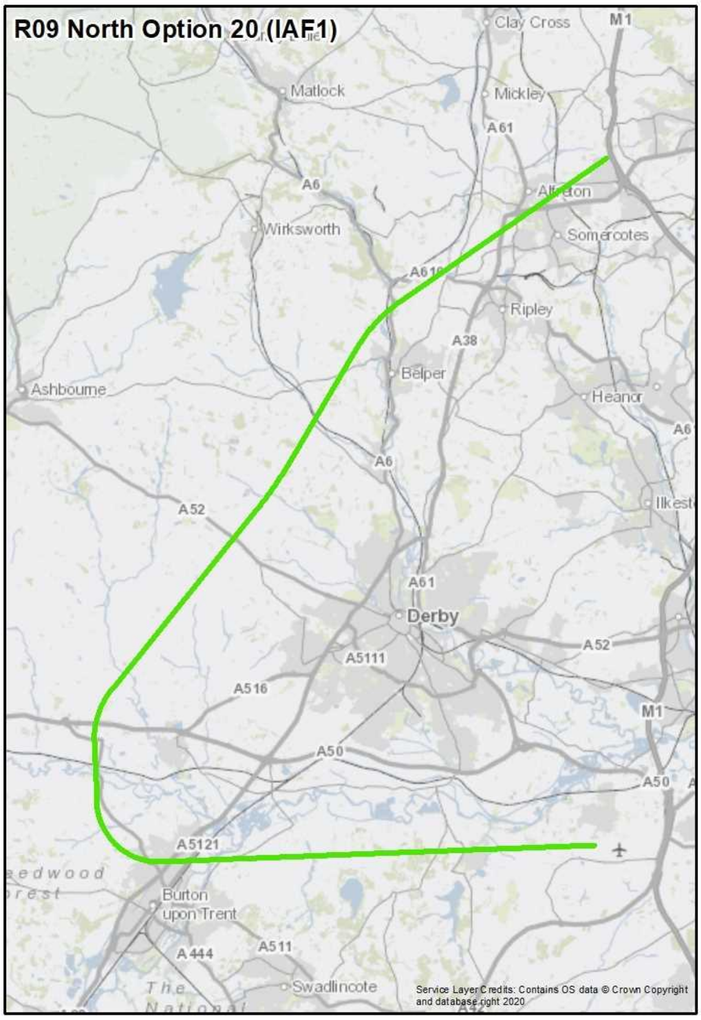
Noise N3: Close to the optimal low noise CDA gradient.

Aims to reduce the impact of noise by avoiding Ripley, Belper, Derby and routing east of Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

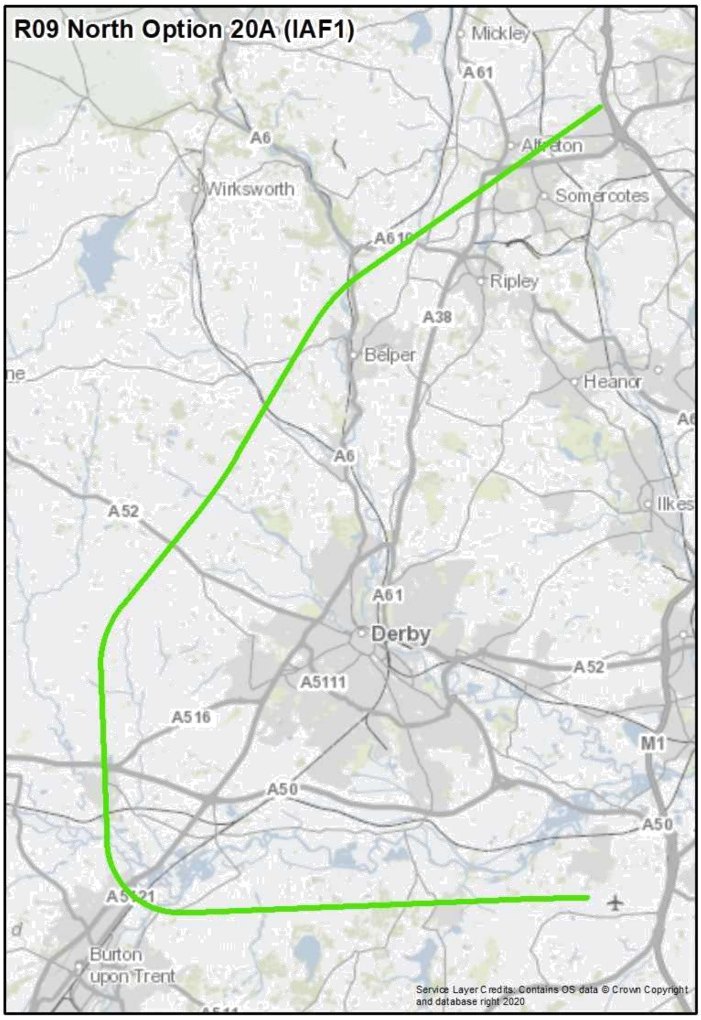
24.25. Runway 09 North, Option 20

Description	Reason for inclusion
The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It initially routes on the same track as Option 19 but takes a more westerly track after passing Duffield. The option starts at IAF1, west of Sutton-in-Ashfield and tracks south west over Alfreton passing north of Ripley and west of Belper. It then turns slightly left onto a south west heading to route north west of Derby and continues on this heading until Church Broughton. Here it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.79° which is below the optimum range for low noise approaches but within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF1. **Noise N3:** Aims to reduce the impact of noise by avoiding Ripley, Belper and Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

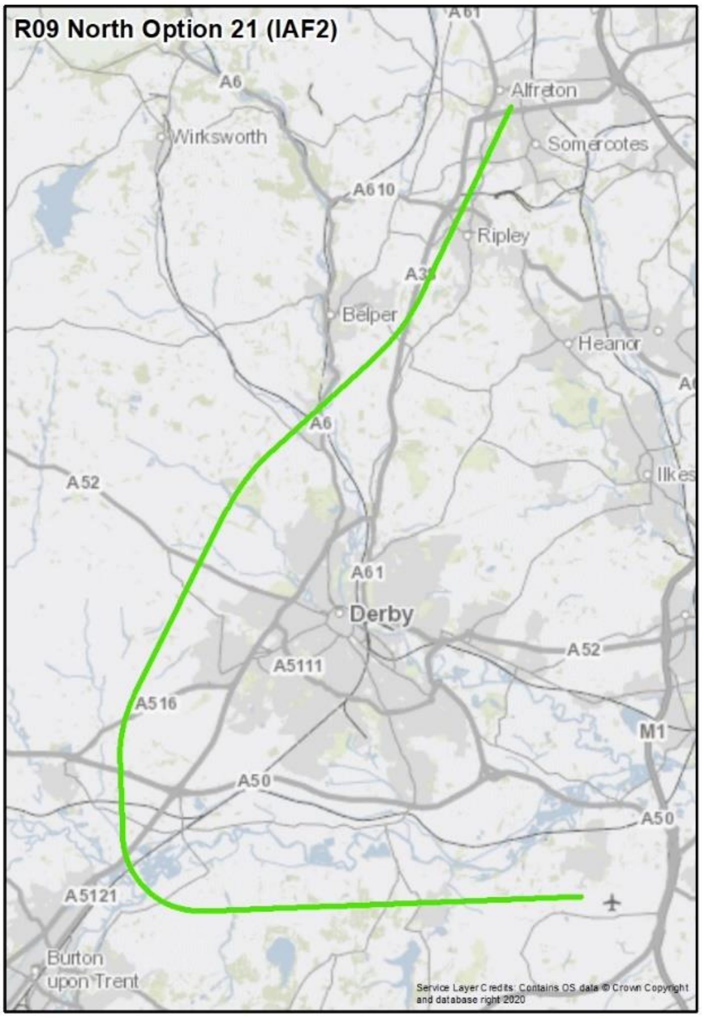


24.26. Runway 09 North, Option 20A

Description	Reason for inclusion
The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option has an IF at 2,500ft which is at a point 5nm from the FAF, thereby falling between the 3.85nm and 6.9nm utilised by other arrival options to runway 09 from the North. It initially routes on the same track as Option 20 but the slightly more easterly track helps avoid the overflight of Burton upon Trent. The option starts at IAF1, west of Sutton-in-Ashfield and tracks south west over Alfreton passing north of Ripley and west of Belper. It then turns slightly left onto a south west heading to route north west of Derby. Once west of Derby it turns directly south and overflies Hilton before turning left to join the extended runway centreline and passing just north east of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2° which is below the optimum range for low noise approaches but within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from IAF1. **Noise N3:** Aims to reduce the impact of noise by avoiding Ripley, Belper and Derby and passing north east of Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

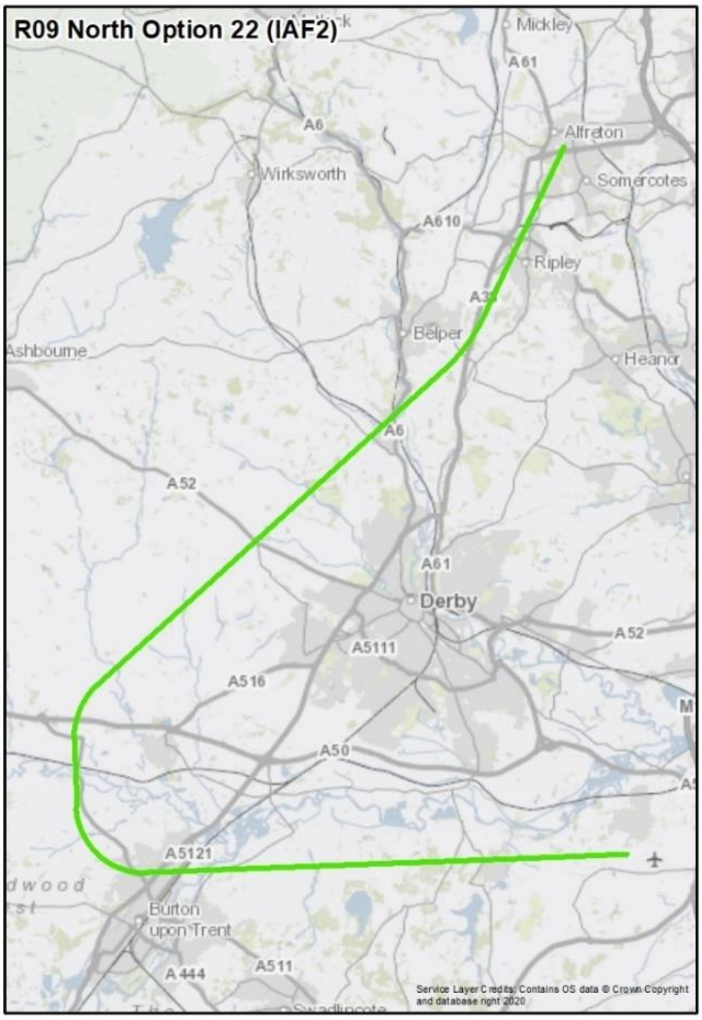


24.27. Runway 09 North, Option 21

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF2 near Alfreton and initially follows the line of the A38 south to pass over Ripley and south of Belper where it turns slightly south west to track to the west of Derby. The option turns, over Etwall, onto a southerly heading before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.46° which is within the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance. 	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from IAF2. Noise N2: Initially follows the line of the A38 which has a higher level of ambient noise than surrounding rural areas. Noise N3: Provides an optimal low noise CDA gradient. Aims to reduce the impact of noise by avoiding Belper, Derby and routing east of Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

24.28. Runway 09 North, Option 22

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It initially routes on the same track as Option 21 but takes a more westerly track after passing Duffield. The option starts at IAF2 near Alfreton and initially follows the line of the A38 south to pass over Ripley and south of Belper where it turns slightly south west to track to the west of Derby. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for unway 09 approaches. The descent gradient to the FAF is 1.95° which is within the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF2. **Noise N2:** Initially follows the line of the A38 which has a higher level of ambient noise than surrounding rural areas. **Noise N3:** Aims to reduce the impact of noise by avoiding Belper and Derby. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.29. Runway 09 North, Option 22A

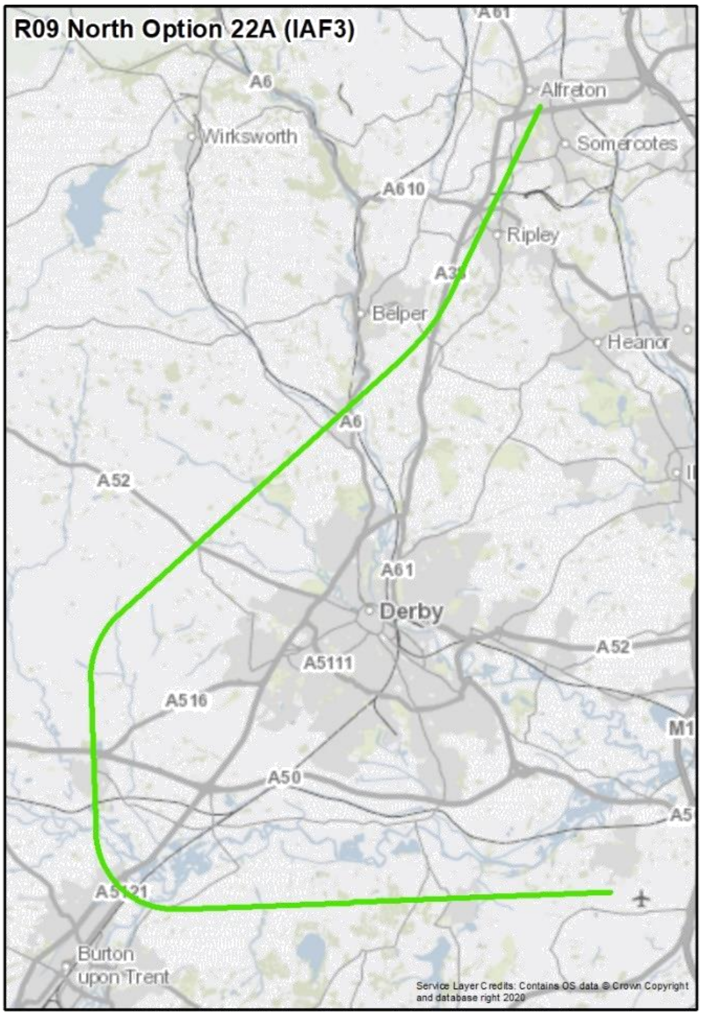
Description

The IAF for this option is IAF2 and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option has an IF at 2,500ft which is at a point 5nm from the FAF, thereby falling between the 3.85nm and 6.9nm utilised by other arrival options to runway 09 from the North. It initially routes on the same track as Option 22 but the slightly more easterly track helps avoid the overflight of Burton upon Trent.

The option starts at IAF2 near Alfreton and initially follows the line of the A38 south to pass over Ripley and south of Belper where it turns slightly south west to track to the west of Derby. It continues on this heading until north of Hilton where it makes a left turn south and overflies Hilton before turning to join the extended runway centreline over north east Burton upon Trent.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 2.21° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from IAF2.

Noise N2: Initially follows the line of the A38 which has a higher level of ambient noise than surrounding rural areas.

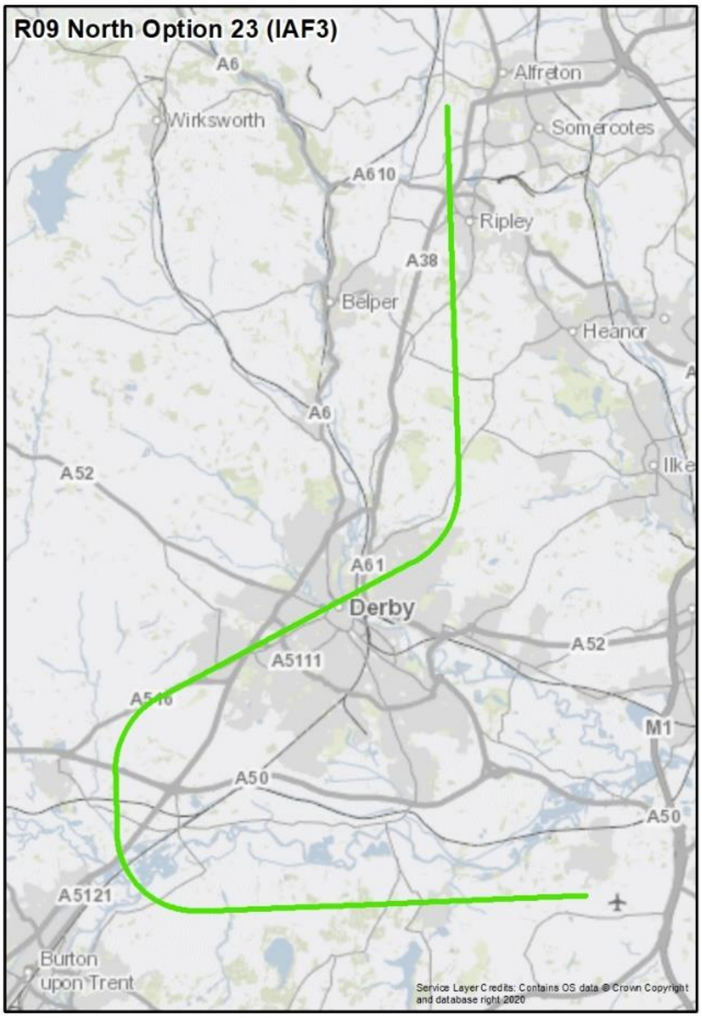
Noise N3: Close to an optimal low noise CDA gradient.

Aims to reduce the impact of noise by avoiding Belper and Derby and passes north east of Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

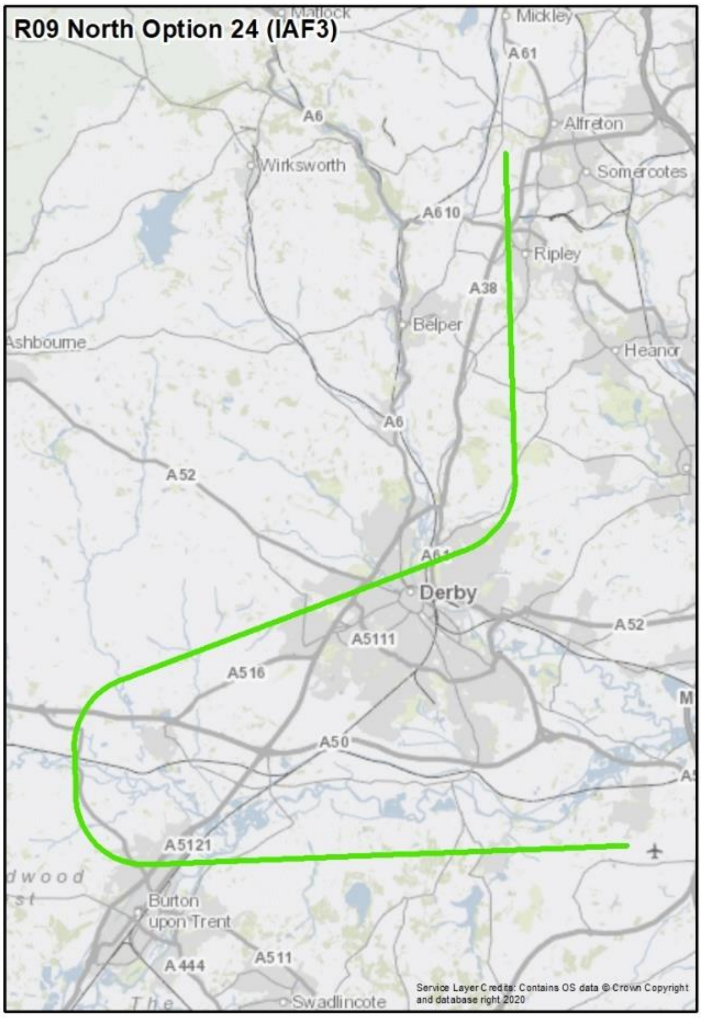
24.30. Runway 09 North, Option 23

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. This option starts at IAF IAF3 west of Alfreton and tracks almost direct south from the IAF, overflying west Ripley. On the north east boundary of Derby the route turns to a south west heading and overflies Derby. It turns left over Etwall, onto a southerly heading before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.35° which is within the optimum range for low noise approaches and the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF3. Noise N2: Routes over central Derby which has a higher level of ambient noise than surrounding rural areas. Noise N3: Provides an optimal low noise CDA gradient. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



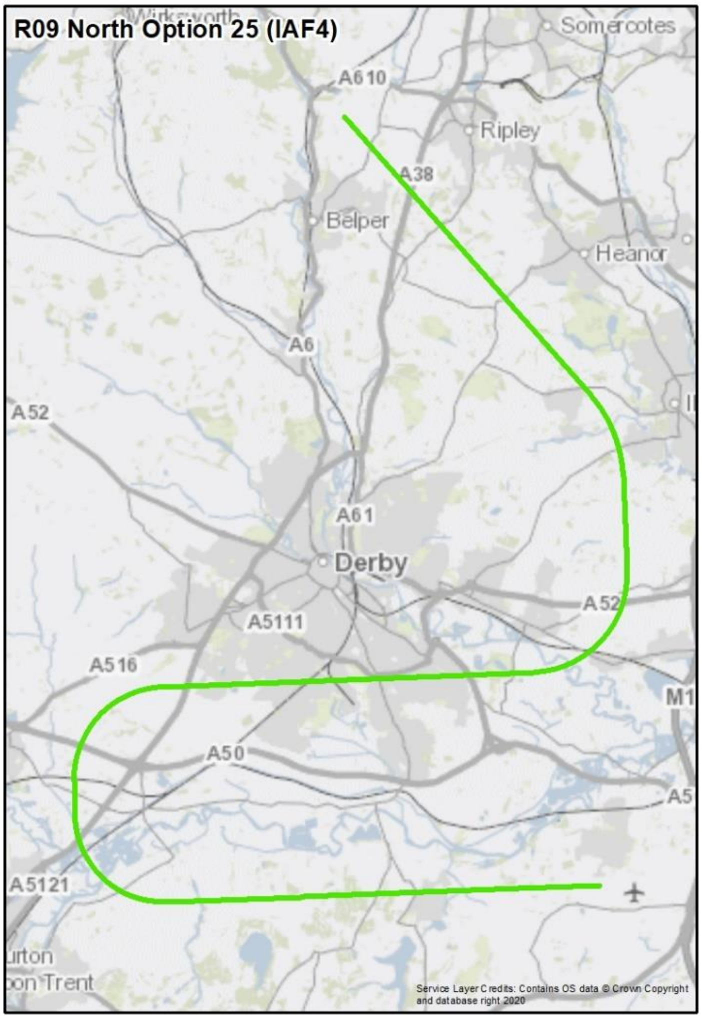
24.31. Runway 09 North, Option 24

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same track as Option 23 but routes further west on reaching Derby. This option starts at IAF3 west of Alfreton and tracks almost direct south from the IAF, overflying west Ripley. On the north east boundary of Derby the route turns to a south west heading and overflies Derby. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.83° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF3. Noise N2: Routes over central Derby which has a higher level of ambient noise than surrounding rural areas. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



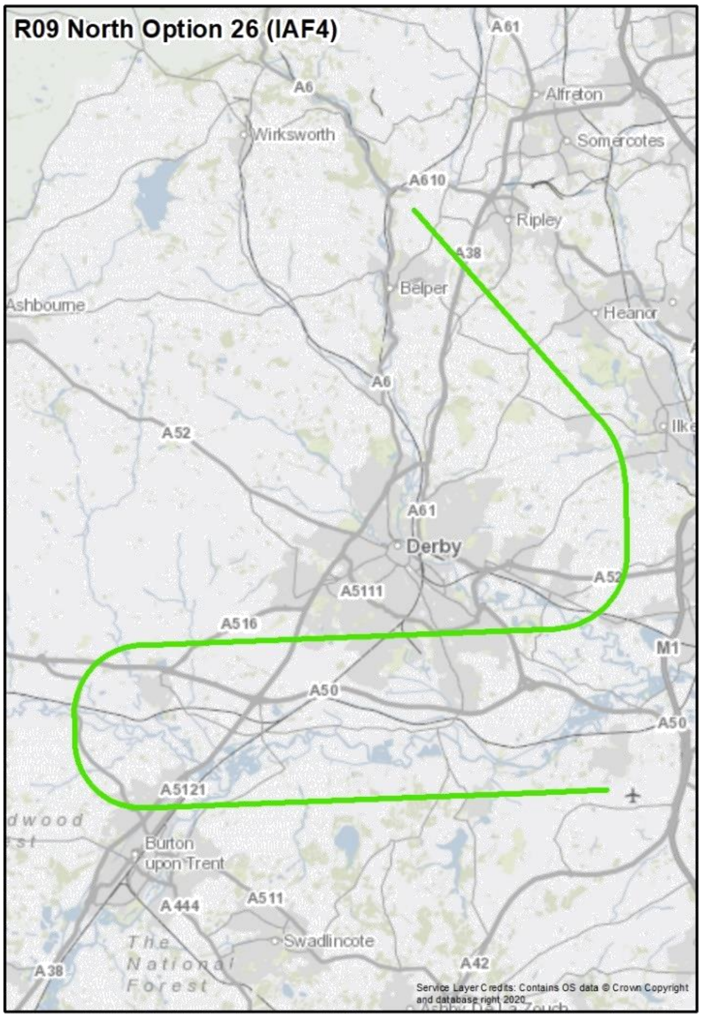
24.32. Runway 09 North, Option 25

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF4 north of Belper and initially tracks south east between Belper and Ripley until West Hallam where the route turns to a southerly heading and passes between West Hallam and Ilkeston. It continues south until it passes over the A52 near Risley where it turns west to track across the southern suburbs of Derby. It turns south close to Etwall before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.95° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF4. Noise N2: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas. Noise N3: Aims to reduce the impact of noise by avoiding Belper and Ripley, routing west of Nottingham, and east of Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.33. Runway 09 North, Option 26

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same track as Option 25 but routes further west before joining the final approach. The option starts at IAF4 north of Belper and initially tracks south east between Belper and Ripley until West Hallam where the route turns to a southerly heading and passes between West Hallam and Ilkeston. It continues south until it passes over the A52 near Risley where it turns west to track across the southern suburbs of Derby. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.55° which is not the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF4. Noise N2: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas. Noise N3: Aims to reduce the impact of noise by avoiding Belper and Ripley and routing west of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.34. Runway 09 North, Option 27

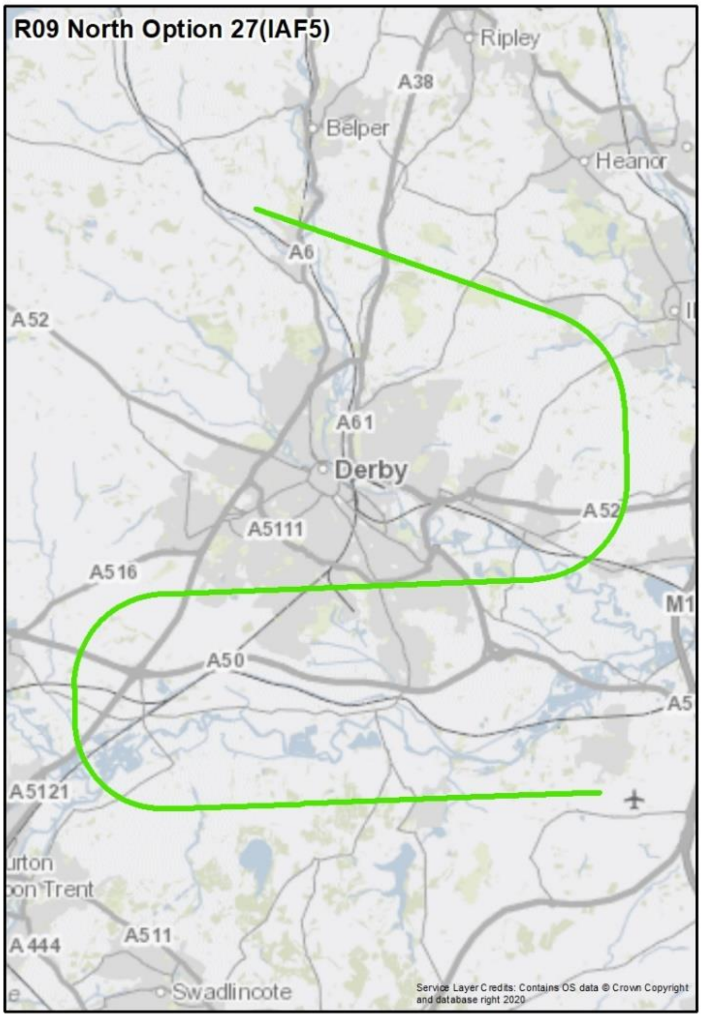
Description

The IAF for this option is IAF5 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route.

This option starts at IAF5 north of Duffield and tracks south east until West Hallam where the route turns to a southerly heading and passes between West Hallam and Ilkeston. It continues south until it passes over the A52 near Risley where it turns west to track across the southern suburbs of Derby. It turns south close to Etwall before turning to join the extended runway centreline east of Burton upon Trent.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 2.02° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Noise N1: Can provide respite when combined with other options from IAF5.

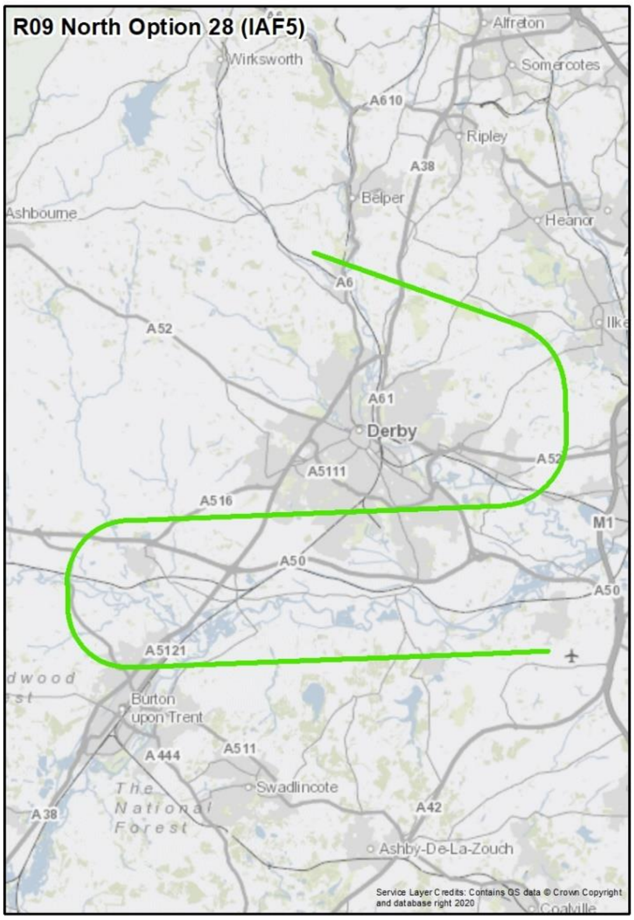
Noise N2: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas.

Noise N3: Aims to reduce the impact of noise by avoiding Belper and by routing west of Nottingham and east of Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

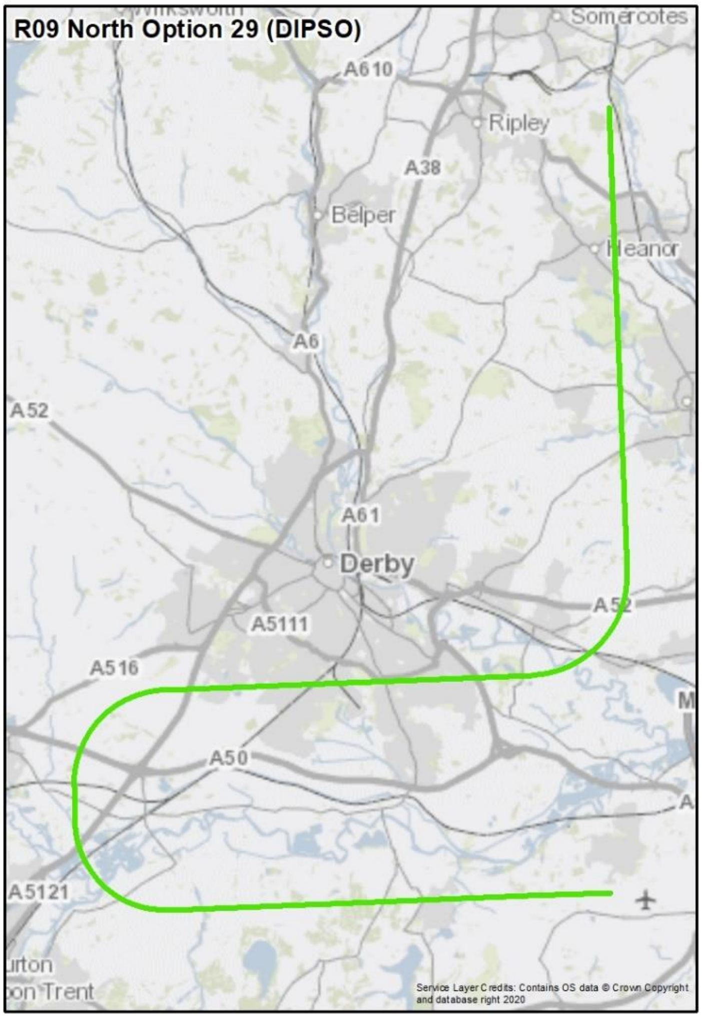
24.35. Runway 09 North, Option 28

Description	Reason for inclusion
The IAF for this option is IAF5 and the style of the route is ‘indirect’ which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a ‘direct’ route. It follows the same track as Option 27 but routes further west before joining the final approach. This option starts at IAF5 north of Duffield and tracks south east until West Hallam where the route turns to a southerly heading and passes between West Hallam and Ilkeston. It continues south until it passes over the A52 near Risley where it turns west to track across the southern suburbs of Derby. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.59° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF5. Noise N2: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas. Noise N3: Aims to reduce the impact of noise by avoiding Belper and by routing west of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.36. Runway 09 North, Option 29

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. This option starts at IAF DIPSO, east of Ripley and initially tracks directly south from the IAF passing over the western side of Langley Mill and between West Hallam and Ilkeston. It continues south until it passes over the A52 near Risley where it turns west to track across the southern suburbs of Derby. It turns south close to Etwall before turning to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.12° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from DIPSO. Noise N2: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas. Noise N3: Aims to reduce the impact of noise by routing west of Nottingham, and east of Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



24.37. Runway 09 North, Option 30

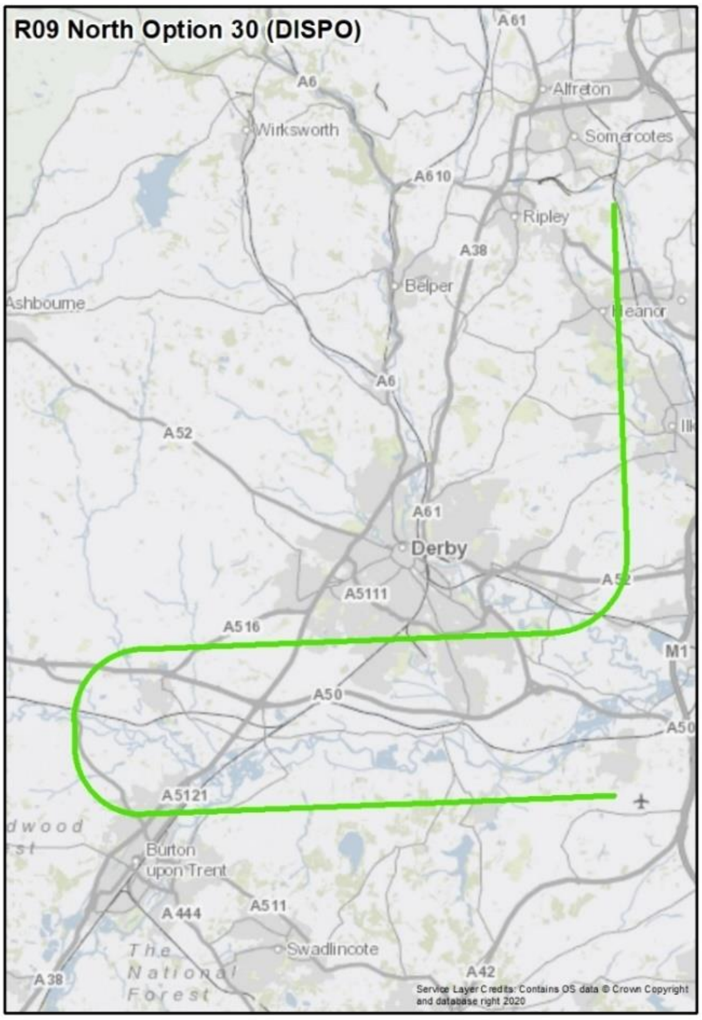
Description

The IAF for this option is DIPSO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same track as Option 29 but routes further west before joining the final approach.

This option starts at IAF DIPSO, east of Ripley and initially tracks directly south from the IAF passing over the western side of Langley Mill and between West Hallam and Ilkeston. It continues south until it passes over the A52 near Risley where it turns west to track across the southern suburbs of Derby. It continues on this heading until Church Broughton where it turns onto a southerly heading before turning left to join the extended runway centreline west of Burton upon Trent.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.9nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 1.66° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Noise N1: Can provide respite when combined with other options from DIPSO.

Noise N2: Routes over south Derby which has a higher level of ambient noise than surrounding rural areas.

Noise N3: Aims to reduce the impact of noise by routing west of Nottingham, and east of Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

25. Runway 09 – South

25.1. Runway 09 South, Options Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.11° The route style is 'direct'	A19	IAF **SYSTO** Originally Option 19 from an IAF located in the vicinity of Syston to the north of Leicester. Option fails to align to: • Safety	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for non-compliance. These cover options that may be non-compliant with PANS-OPS in relation to: • MSD and the turn onto final approach. • Descent gradients above the PANS-OPS maximum. • Turn radius based on speed, altitude, and descent gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.93° The route style is 'direct'	B20	IAF **SYSTO** Originally Option 19 from an IAF located in the vicinity of Syston to the north of Leicester. Option fails to align to: • Safety		

3	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.84° The route style is 'indirect'				
4	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.67° The route style is 'indirect'				
5	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.08° The route style is 'direct'				
6	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.91° The route style is 'direct'				
7	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.76° The route style is 'indirect'				
8	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.62° The route style is 'indirect'				

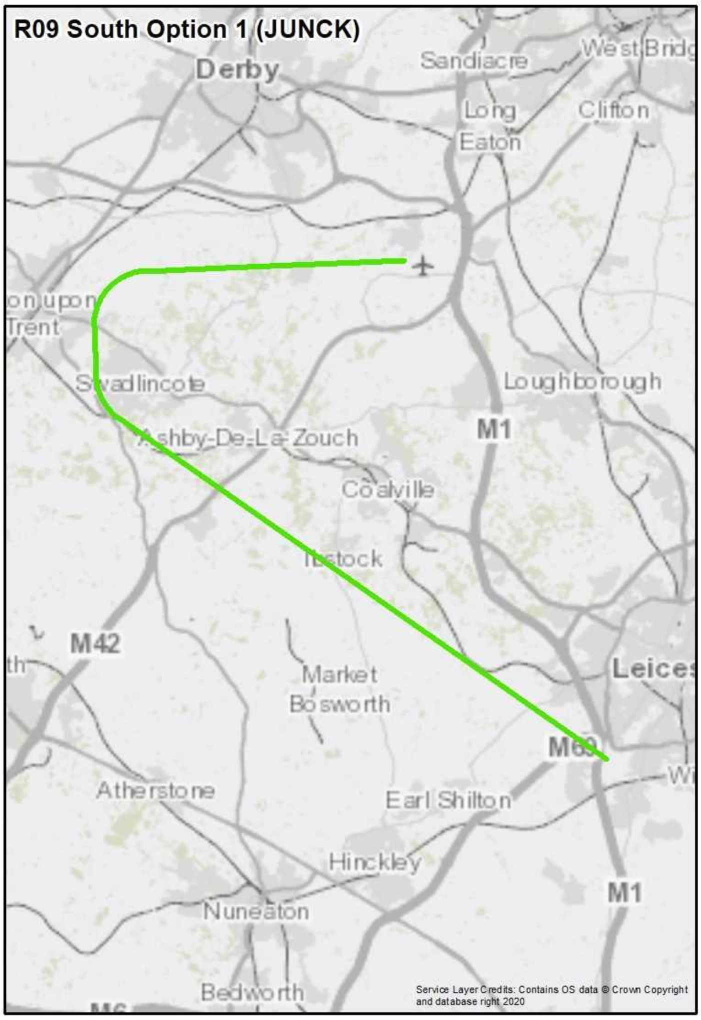
9	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.03° The route style is 'direct'				
10	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.86° The route style is 'direct'				
11	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.7° The route style is 'indirect'				
12	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.57° The route style is 'indirect'				
13	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.15° The route style is 'direct'				
14	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 2° The route style is 'direct'				

15	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.39° The route style is 'direct'				
16	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 2.18° The route style is 'direct'				
17	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.08° The route style is 'direct'				
18	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.91° The route style is 'direct'				
21	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.95° The route style is 'indirect'				

22	IAF = STAPL at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.76° The route style is 'indirect'				
23	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.75° The route style is 'indirect'				
24	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 5.1nm CDA descent gradient = 1.6° The route style is 'indirect'				

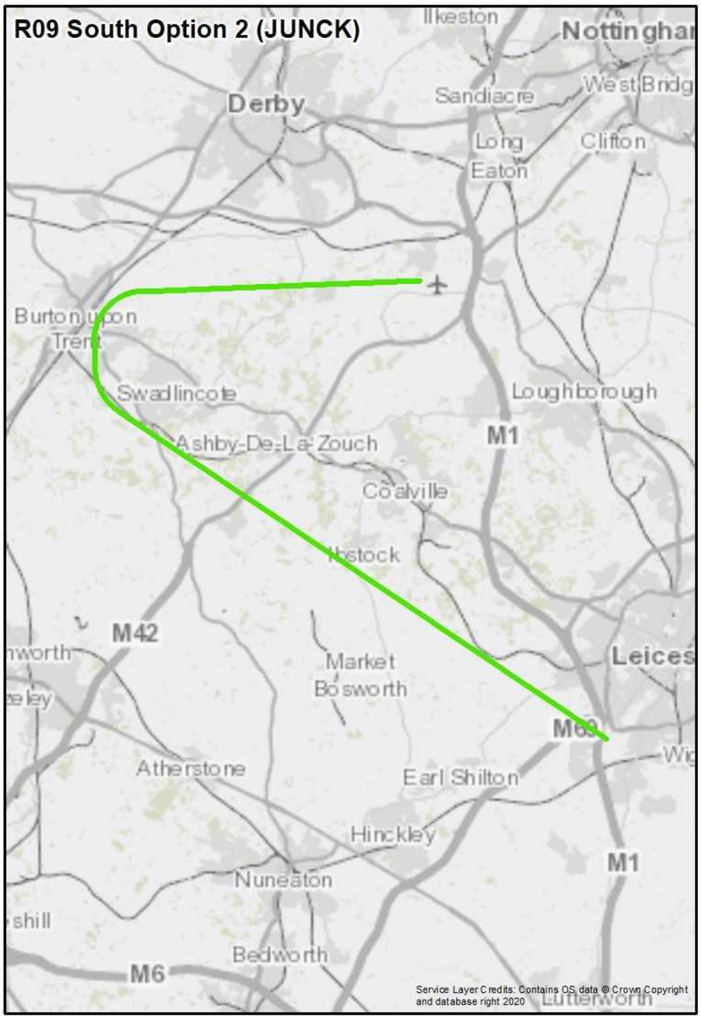
25.2. Runway 09 South, Option 1

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF JUNCK, southwest of Leicester from where the route tracks north west overflying the south western edge of Ibstock and turning north just to the west of Swadlincote before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.11° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF positioned close to the M1 & M69 junction, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by routing west of Swadlincote, and east of Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



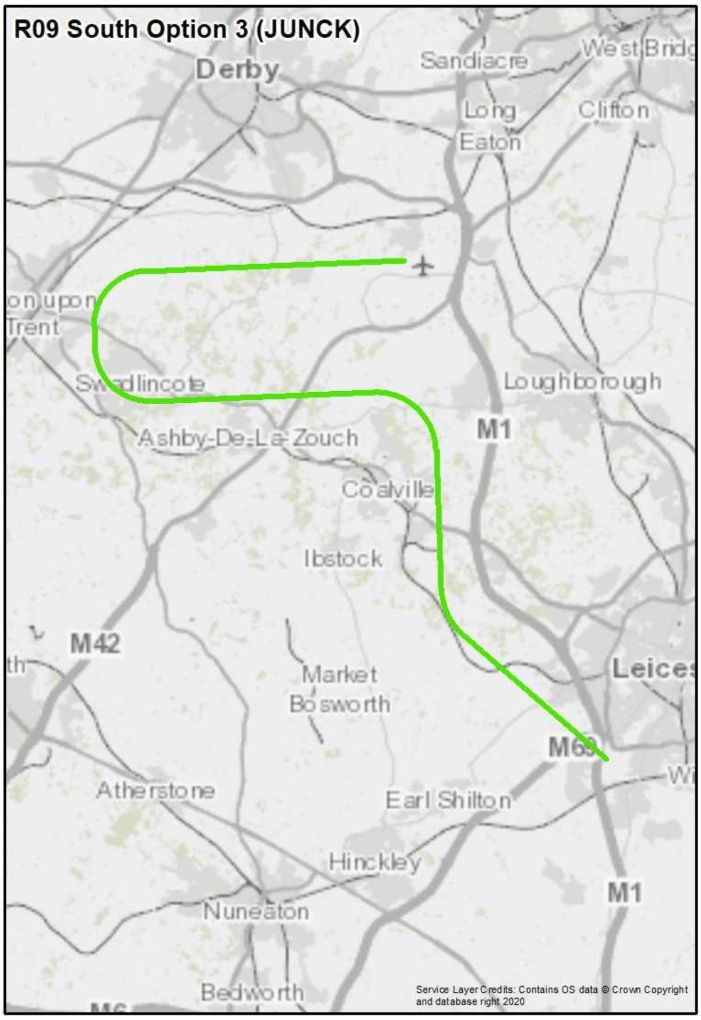
25.3. Runway 09 South, Option 2

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a near identical track as option 1 but routes further west before joining the final approach. This option starts at IAF JUNCK, southwest of Leicester from where the route tracks north west overflying the south western edge of Ibstock. The route turns north to the west of Swadlincote and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.93° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF positioned close to the M1 & M69 junction, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by routing between Swadlincote, and Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



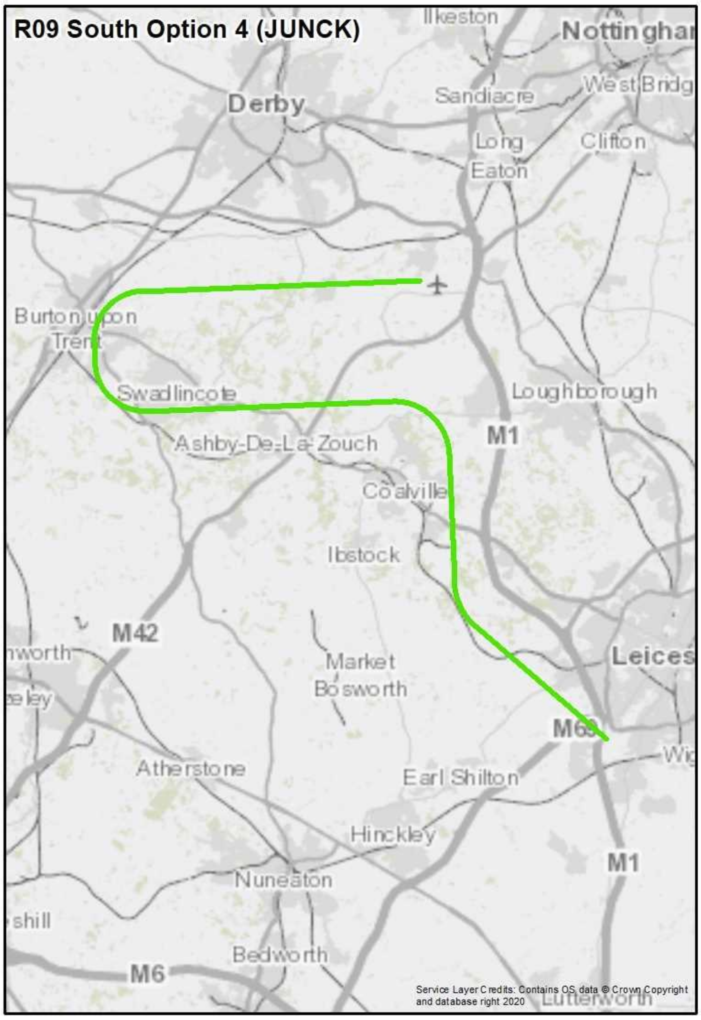
25.4. Runway 09 South, Option 3

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF JUNCK, southwest of Leicester from where it tracks north west before turning north to pass east of Coalville. The route then turns west and passes to the north of Ashby-de-la-Zouch and over the southern portion of Swadlincote, before turning right to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.84° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF positioned close to the M1 & M69 junction, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Coalville, Ashby-de-la-Zouch and Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



25.5. Runway 09 South, Option 4

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 3 but routes further west before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester from where it tracks north west before turning north to pass east of Coalville. The route then turns west and passes to the north of Ashby-de-la-Zouch and over the southern portion of Swadlincote, before turning right over the eastern edge of Burton upon Trent to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.67° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from JUNCK. **Noise N2**: IAF positioned close to the M1 & M69 junction, an area of higher ambient noise. **Noise N3:** Aims to reduce the impact of noise by avoiding Coalville and Ashby-de-la-Zouch. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



25.6. Runway 09 South, Option 5

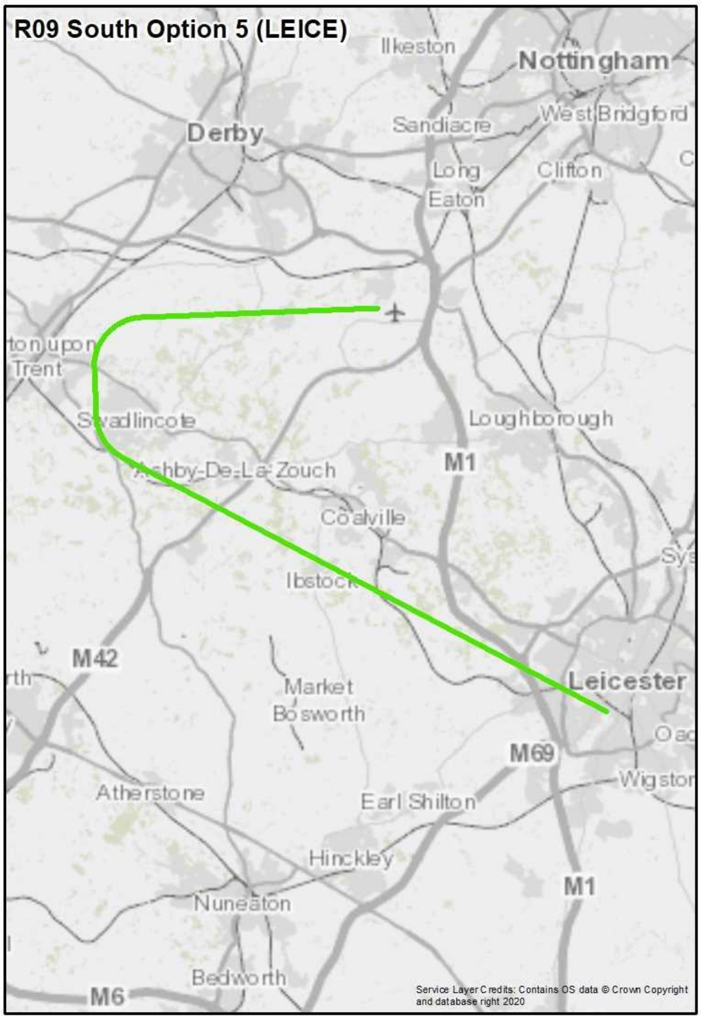
Description

The IAF for this option is LEICE and the style of the route is 'direct' which means the distance to the final approach has been minimised.

This option starts at IAF LEICE, near the King Power Stadium in Leicester from where the route tracks north west over the junction between the M1 and the A46 and passes the northern edge of Ibstock. The route turns north just to the west of Swadlincote before turning right to join the extended runway centreline east of Burton upon Trent.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 2.08° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

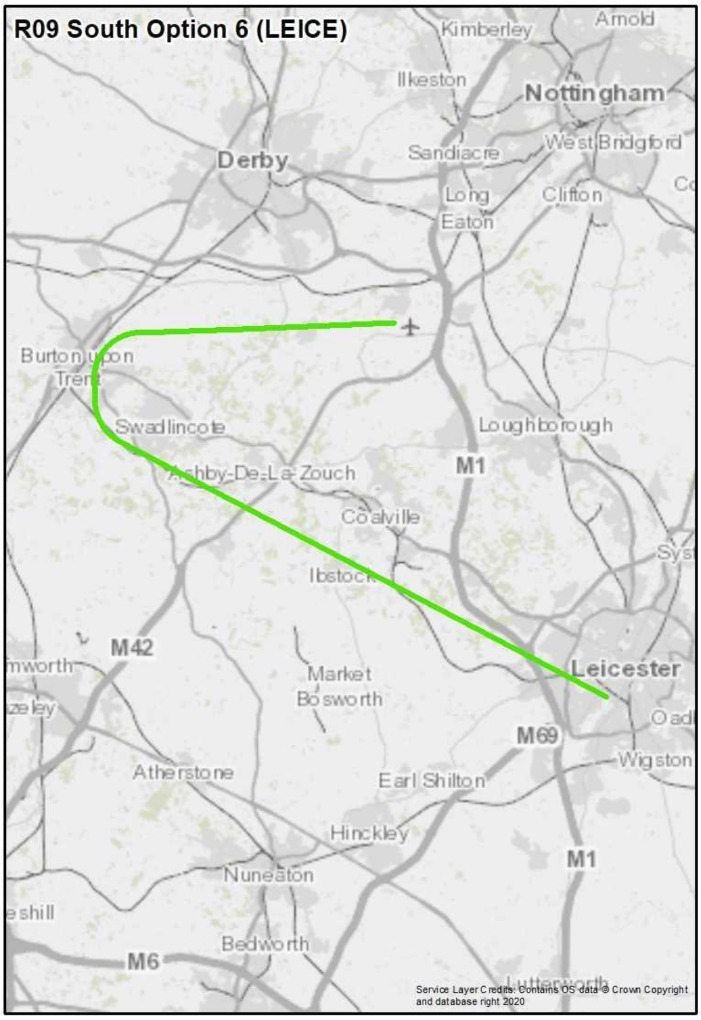
Noise N1: Can provide respite when combined with other options from LEICE.

Noise N2: The IAF is positioned close to railway lines and the major urban centre, an area of higher ambient noise.

Noise N3: Aims to reduce the impact of noise by routing south of Ashby-de-la-Zouch, west of Swadlincote, and east of Burton upon Trent.

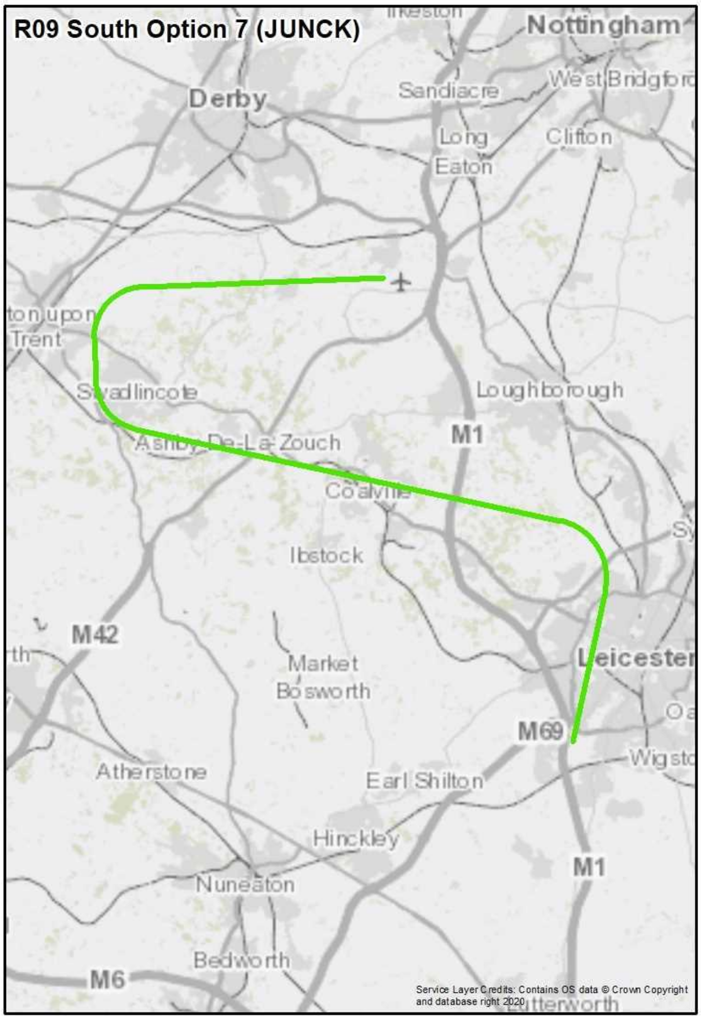
Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

25.7. Runway 09 South, Option 6

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a near identical track as Option 5 but routes further west before joining the final approach. The option starts at IAF LEICE, near the King Power Stadium in Leicester from where the route tracks north west over the junction between the M1 and the A46 and passes the northern edge of Ibstock. The route turns north to the west of Swadlincote and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.91° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.  	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from LEICE. **Noise N2:** The IAF is positioned close to railway lines and the major urban centre, an area of higher ambient noise. **Noise N3:** Aims to reduce the impact of noise by routing south of Ashby-de-la-Zouch and west of Swadlincote. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

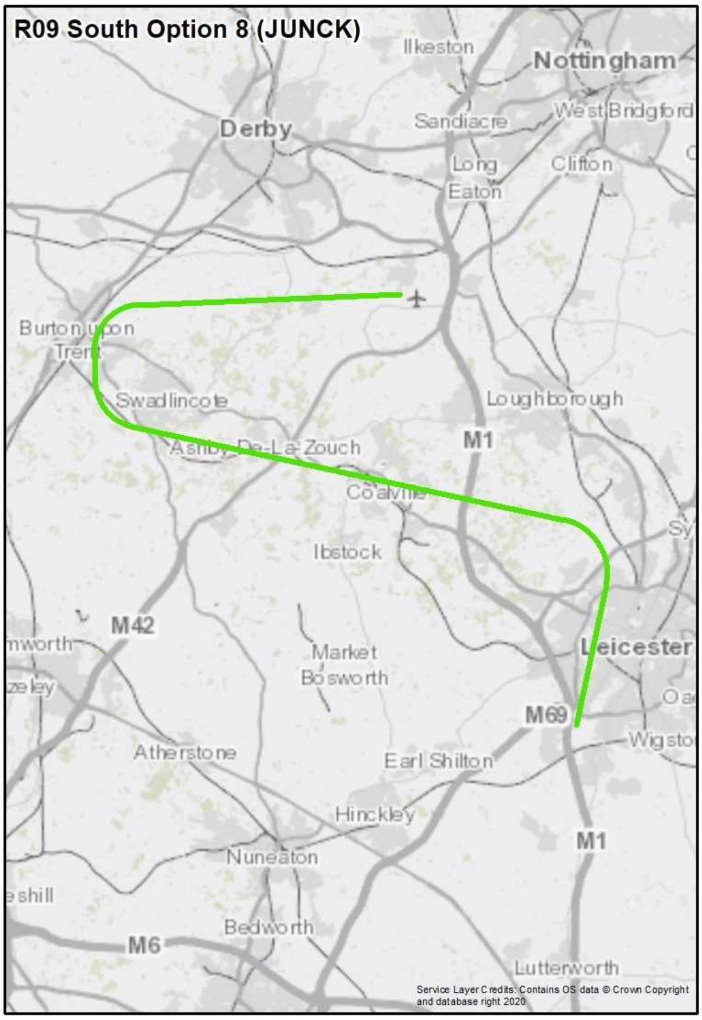
25.8. Runway 09 South, Option 7

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF JUNCK, southwest of Leicester and initially tracks north east and overflies the western portion of Leicester. To the north of Leicester the route turns north west passing over Coalville and the southern edge of Ashby-de-la-Zouch. The route turns north just to the west of Swadlincote before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.76° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF and the route are positioned close to major urban centres, and areas of higher ambient noise. Noise N3: Aims to reduce the impact of noise by routing west of Swadlincote, and east of Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



25.9. Runway 09 South, Option 8

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows an identical initial track as Option 7 but routes further west before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester and initially tracks north east and overflies the western portion of Leicester. To the north of Leicester the route turns north west passing over Coalville and the southern edge of Ashby-de-la-Zouch. The route turns north to the west of Swadlincote and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.62° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF and the route are positioned close to major urban centres, and areas of higher ambient noise. Noise N3: Aims to reduce the impact of noise by routing west of Swadlincote. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



25.10. Runway 09 South, Option 9

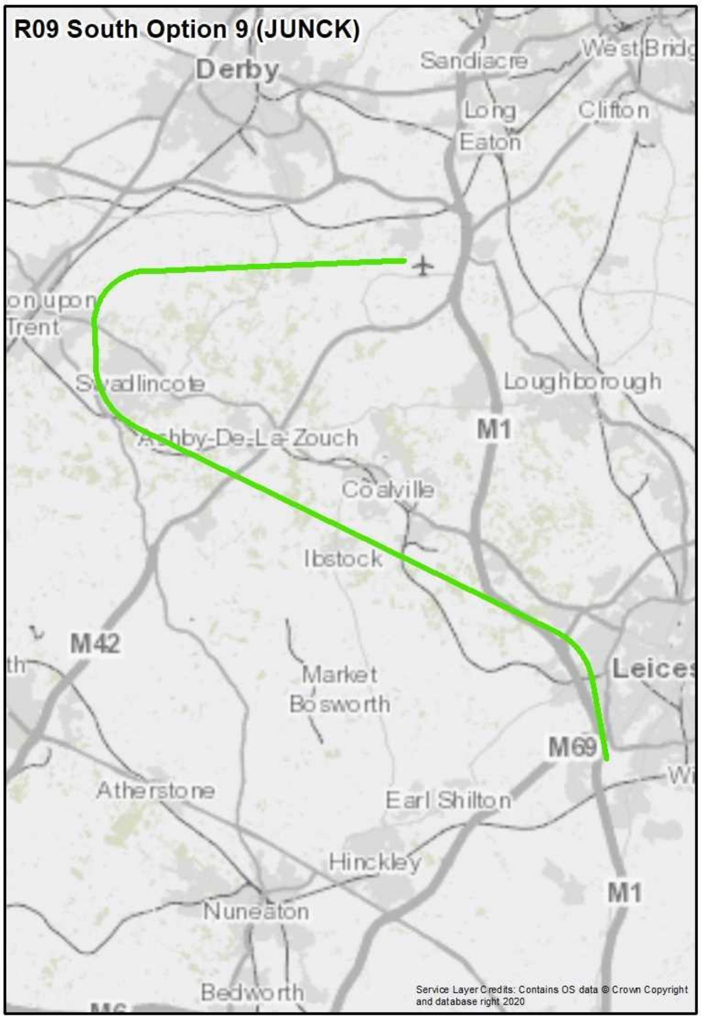
Description

The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised.

The option starts at IAF JUNCK, southwest of Leicester and tracks north following the line of the M1 and overflying the western edge of Leicester. The route turns north west at Ratby and continues to follow the M1 initially but continuing on this heading to track south of Coalville until south west of Swadlincote. The route turns north just to the west of Swadlincote before turning right to join the extended runway centreline east of Burton upon Trent.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches.

The descent gradient to the FAF is 2.03° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from JUNCK.

Noise N2: IAF and the route are positioned close to major urban centres, and areas of higher ambient noise.

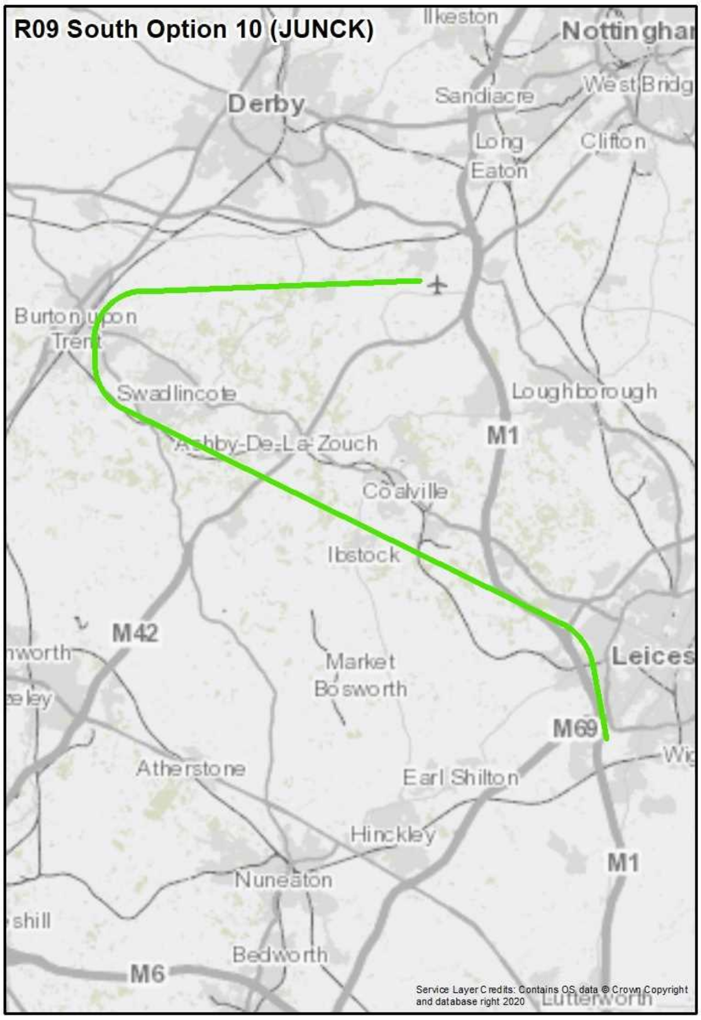
Follows the line of the M1 between the IAF and Ratby.

Noise N3: Aims to reduce the impact of noise by routing south of Coalville, west of Swadlincote, and east of Burton upon Trent.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

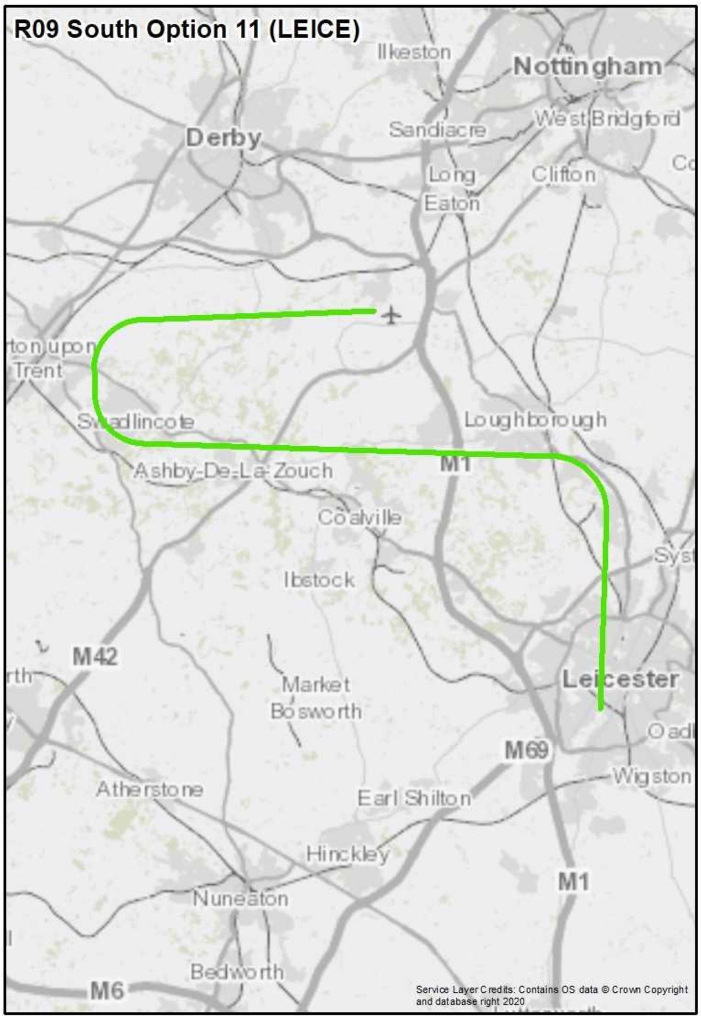
25.11. Runway 09 South, Option 10

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows an identical initial track as Option 9 but routes further west before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester and tracks north following the line of the M1 and overflying the western edge of Leicester. The route turns north west at Ratby and continues to follow the M1 initially but continuing on this heading to track south of Coalville until west of Swadlincote. It then turns north and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.86° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF and the route are positioned close to major urban centres, and areas of higher ambient noise. Follows the line of the M1 between the IAF and Ratby. Noise N3: Aims to reduce the impact of noise by routing south of Coalville, and west of Swadlincote. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



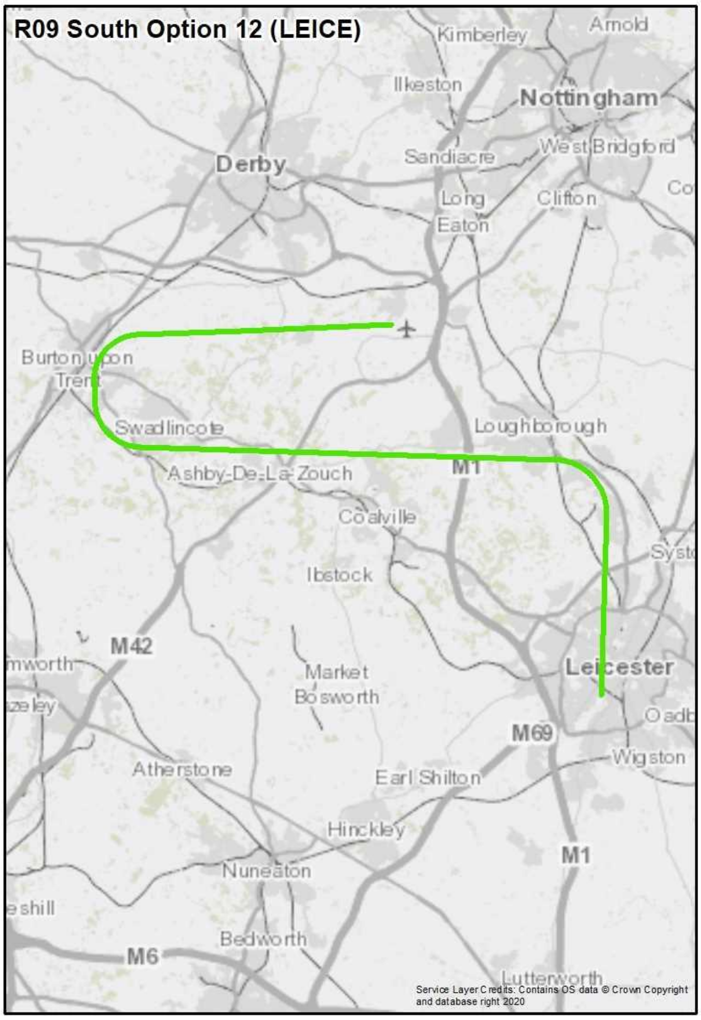
25.12. Runway 09 South, Option 11

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF LEICE, near the King Power Stadium in Leicester from where the route tracks directly north over Leicester to Mountsorrel where the route turns west. It overflies the southern part of Loughborough, passing south of Shepshed and just north of Ashby-de-la-Zouch until south west of Swadlincote. The route turns north just to the west of Swadlincote before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.7° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from LEICE. Noise N2: The IAF is positioned close to railway lines and the major urban centre, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by routing south of Loughborough, north of Coalville and Ashby-de-la-Zouch and between Swadlincote and Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



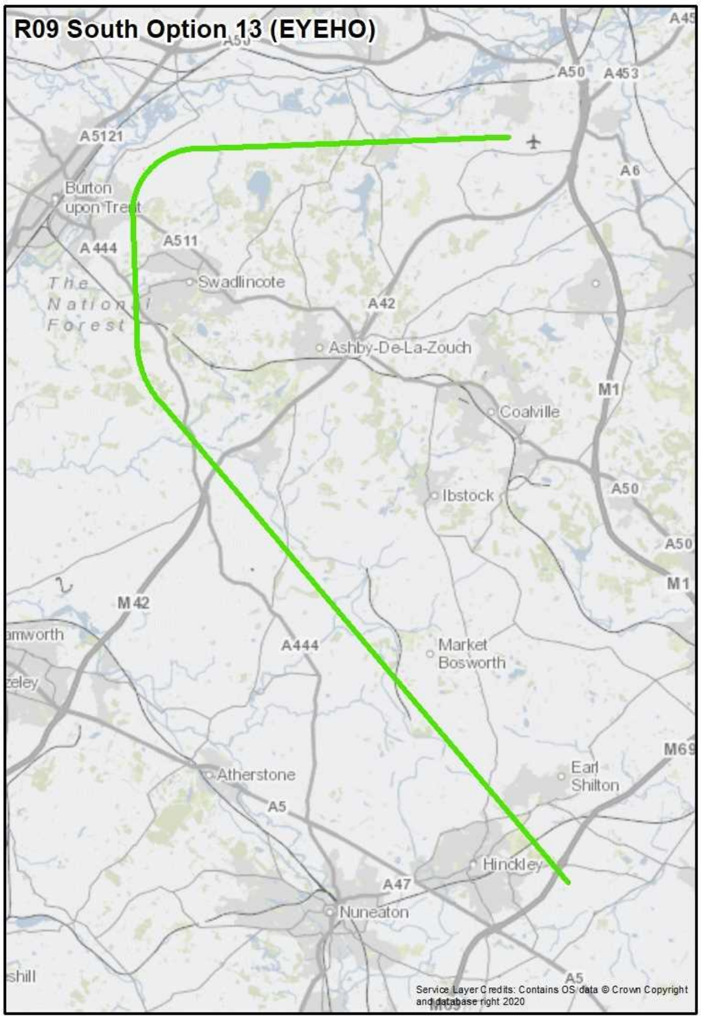
25.13. Runway 09 South, Option 12

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows an identical initial track as Option 11 but routes further west before joining the final approach. The option starts at IAF LEICE, near the King Power Stadium in Leicester from where the route tracks directly north over Leicester to Mountsorrel where the route turns west. It overflies the southern part of Loughborough, passing south of Shepshed and just north of Ashby-de-la-Zouch until west of Swadlincote. It then turns north and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.57° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from LEICE. **Noise N2**: The IAF is positioned close to railway lines and the major urban centre, an area of higher ambient noise. **Noise N3**: Aims to reduce the impact of noise by routing south of Loughborough, north of Coalville and Ashby-de-la-Zouch and west of Swadlincote. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



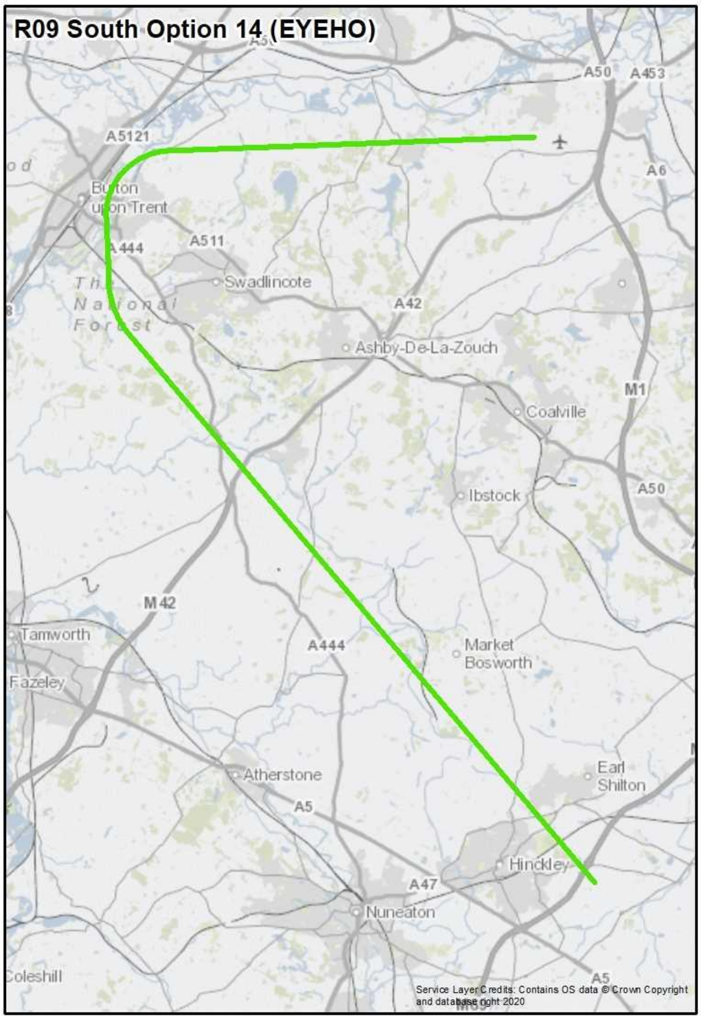
25.14. Runway 09 South, Option 13

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF EYEHO, south east of Hinkley from where the route heads north west passing between Earl Shilton and Hinckley. It continues on this heading until just south of Swadlincote where it turns north and passes between Swadlincote and Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.15° which is close to the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from EYEHO. Noise N2: IAF positioned close to the M69 junction, an area of higher ambient noise. Noise N3: Close to the optimum CDA gradient. Aims to reduce the impact of noise by routing between Swadlincote and Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



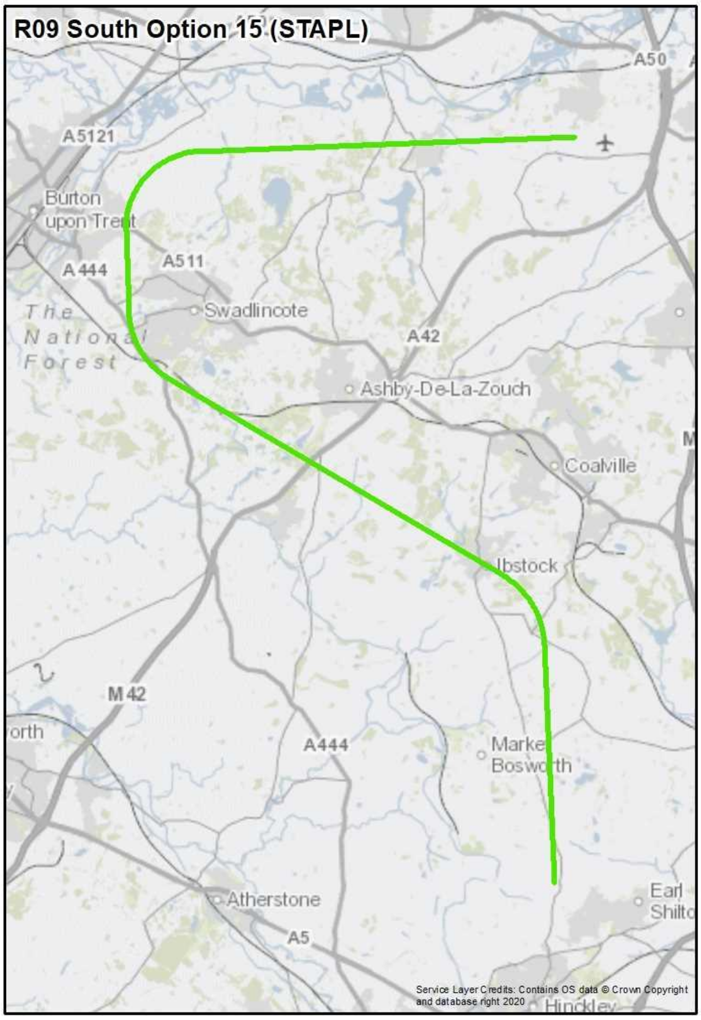
25.15. Runway 09 South, Option 14

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows an identical initial track as Option 13 but routes further west before joining the final approach. The option starts at IAF EYEHO, south east of Hinkley from where the route heads north west passing between Earl Shilton and Hinckley. It continues on this heading until south west of Swadlincote where it turns north and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from EYEHO. Noise N2: IAF positioned close to the M69 junction, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Swadlincote. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

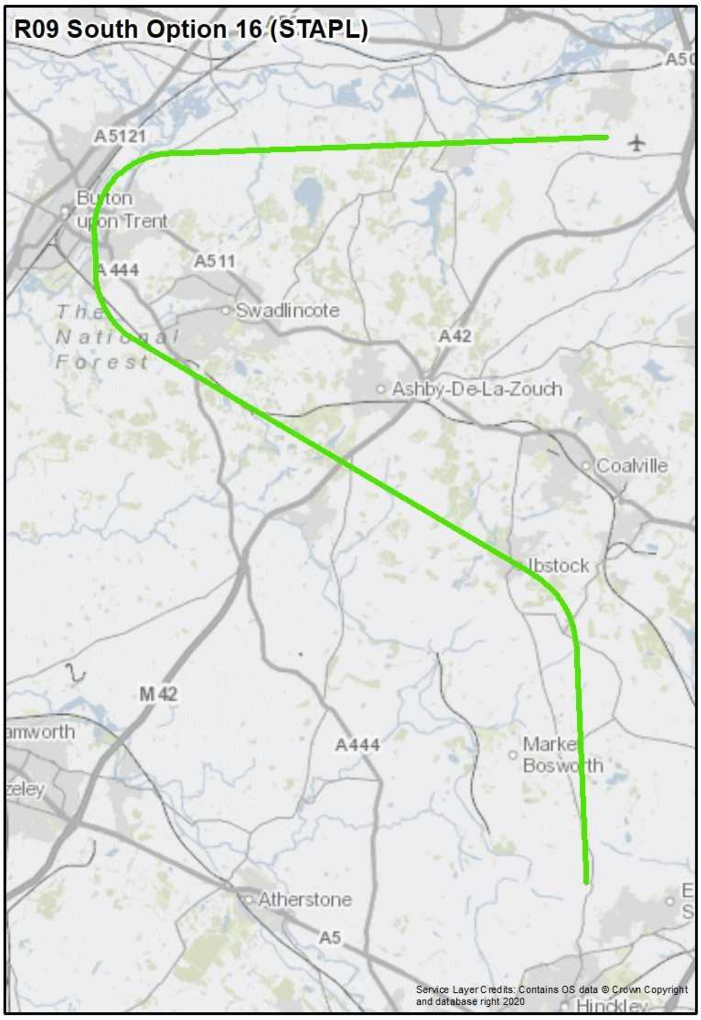


25.16. Runway 09 South, Option 15

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF STAPL at Stapleton north of Hinkley from where it tracks north, turning north west to over fly Ibstock but remaining south of Coalville. It continues on this track to fly south of Ashby-de-la-Zouch until south west of Swadlincote where the route turns north before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.39° which is within the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from STAPL. **Noise N3:** Provides an optimal low noise CDA gradient. Aims to reduce the impact of noise by routing south of Coalville and Ashby-de-la-Zouch and between Swadlincote and Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

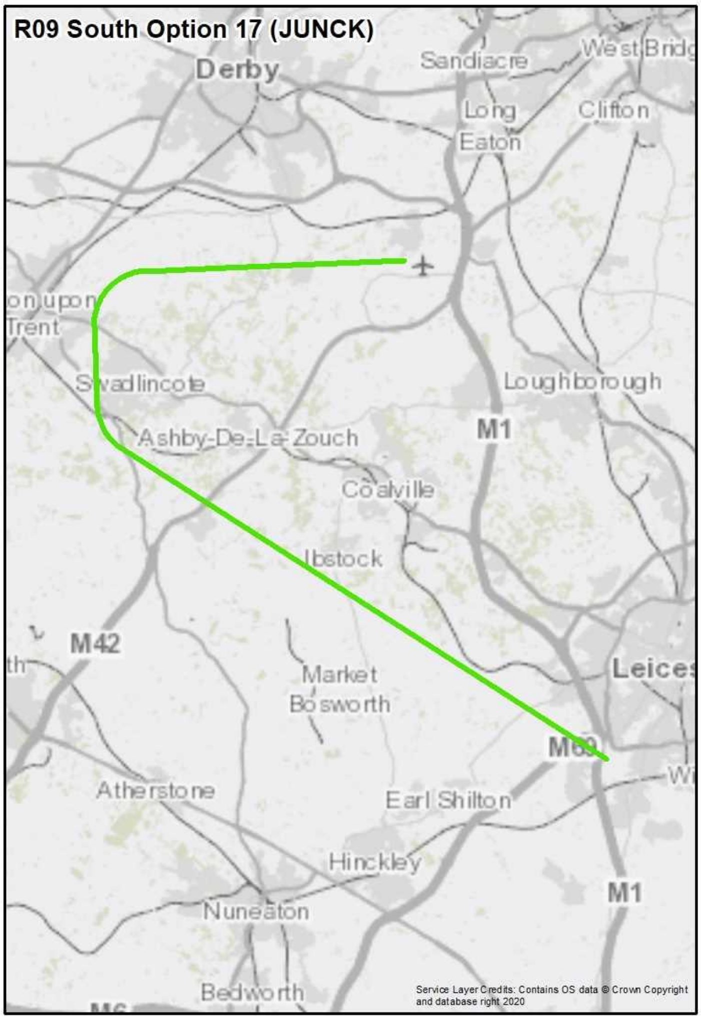


25.17. Runway 09 South, Option 16

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows an identical initial track as Option 15 but routes further west before joining the final approach. The option starts at IAF STAPL at Stapleton north of Hinkley from where it tracks north, turning north west to over fly Ibstock but remaining south of Coalville. It continues on this track to fly south of Ashby-de-la-Zouch until west of Swadlincote where it turns north and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.18° which is close to the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.  	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from STAPL. **Noise N3:** Provides close to an optimal low noise CDA gradient. Aims to reduce the impact of noise by routing south of Coalville and Ashby-de-la-Zouch and west of Swadlincote. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.

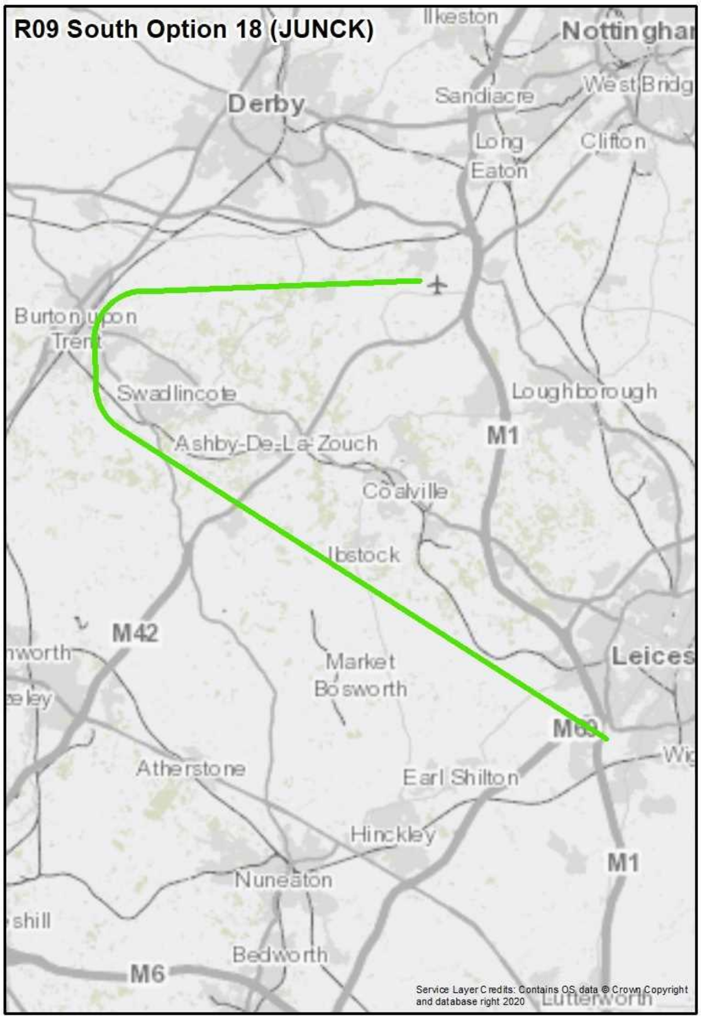
25.18. Runway 09 South, Option 17

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF JUNCK, southwest of Leicester from where the route tracks north west passing south of Ibstock and Ashby-de-la-Zouch until south west of Swadlincote. At this point the route turns north before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 2.08° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: IAF positioned close to the M1 & M69 junction, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by routing south of Coalville and Ashby-de-la-Zouch and between Swadlincote and Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



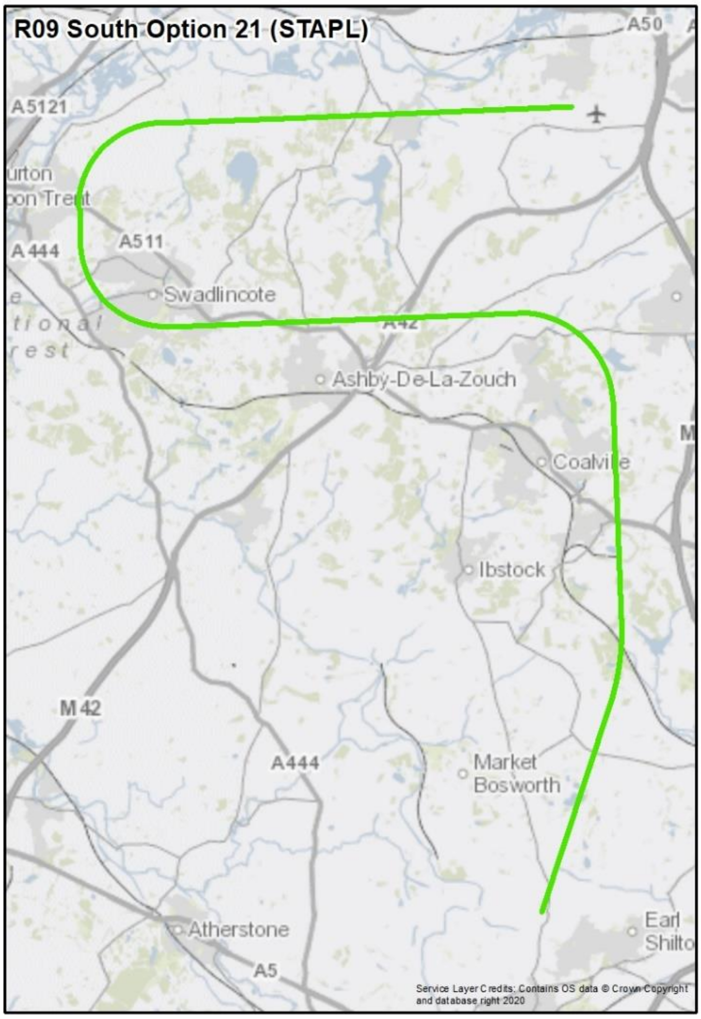
25.19. Runway 09 South, Option 18

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows an identical initial track as Option 17 but routes further west before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester from where the route tracks north west passing south of Ibstock and Ashby-de-la-Zouch until west of Swadlincote. At this point the route turns north and overflies the edge of Burton upon Trent before turning right to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.91° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from JUNCK. **Noise N2:** IAF positioned close to the M1 & M69 junction, an area of higher ambient noise. **Noise N3:** Aims to reduce the impact of noise by routing south of Coalville and Ashby-de-la-Zouch and west of Swadlincote. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



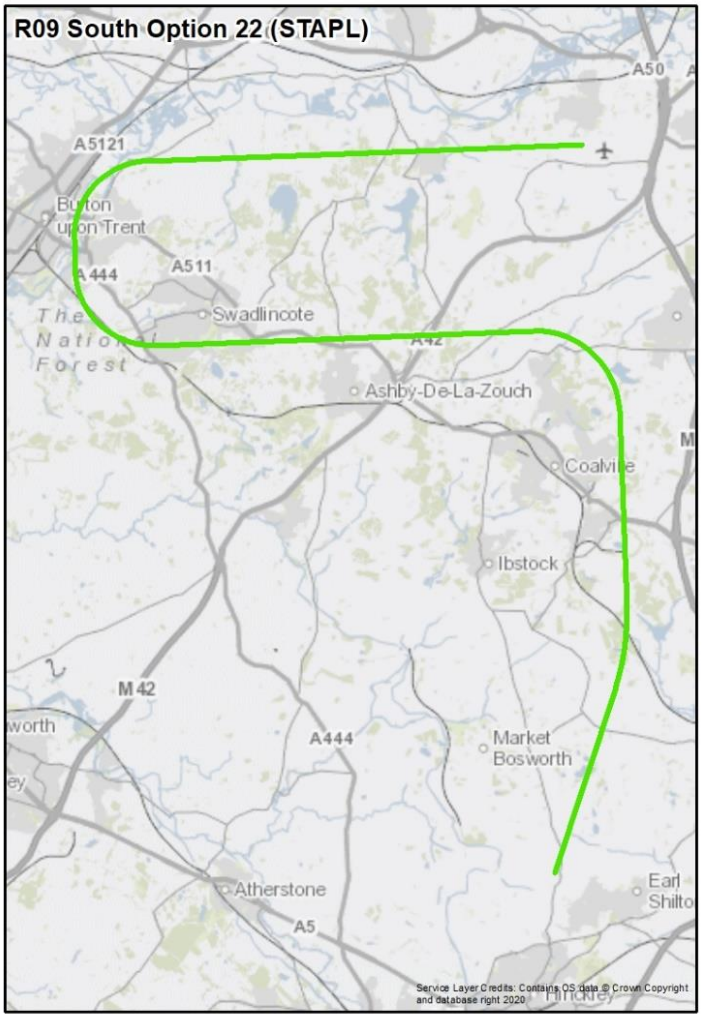
25.20. Runway 09 South, Option 21

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF STAPL at Stapleton north of Hinkley from where the route initially tracks north east until close to Thornton where the route turns north to pass east of Coalville. The route then turns west and passes to the north of Coalville and Ashby-de-la-Zouch and over the southern portion of Swadlincote, before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.95° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from STAPL. **Noise N3:** Aims to reduce the impact of noise by avoiding Coalville, Ashby-de-la-Zouch and Burton upon Trent. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



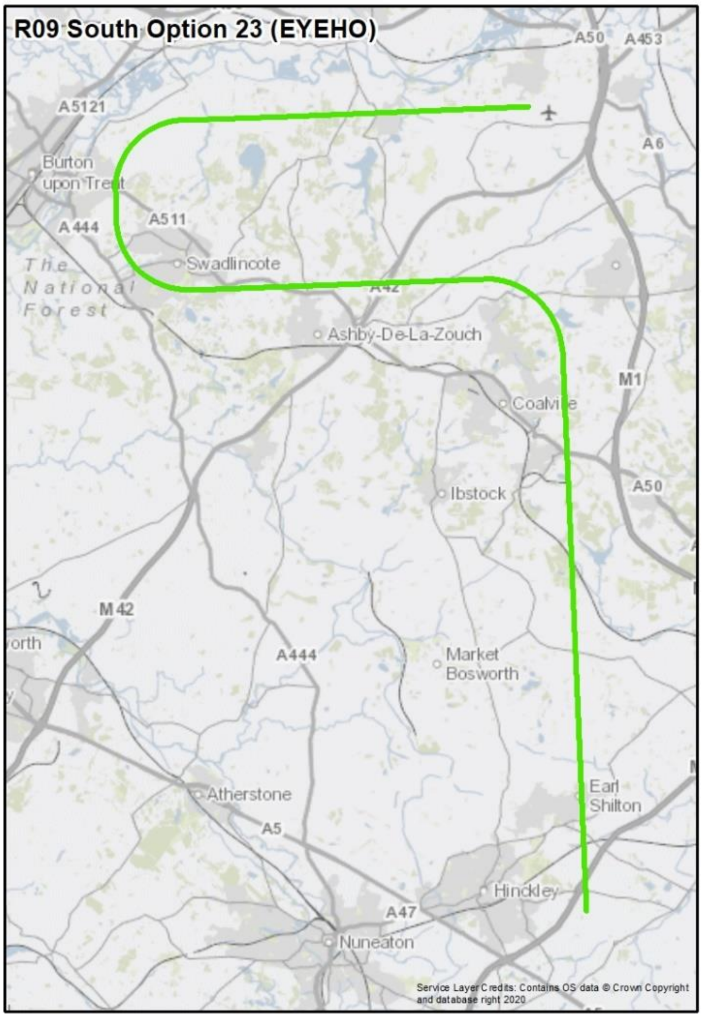
25.21. Runway 09 South, Option 22

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is ‘indirect’ which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a ‘direct’ route. It follows the same route as Option 21 but routes further west before joining the final approach. The option starts at IAF STAPL at Stapleton north of Hinkley from where the route initially tracks north east until close to Thornton where the route turns north to pass east of Coalville. The route then turns west and passes to the north of Coalville and Ashby-de-la-Zouch and over the southern portion of Swadlincote, before turning right over the eastern edge of Burton upon Trent to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.76° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from STAPL. Noise N3: Aims to reduce the impact of noise by avoiding Coalville and Ashby-de-la-Zouch. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



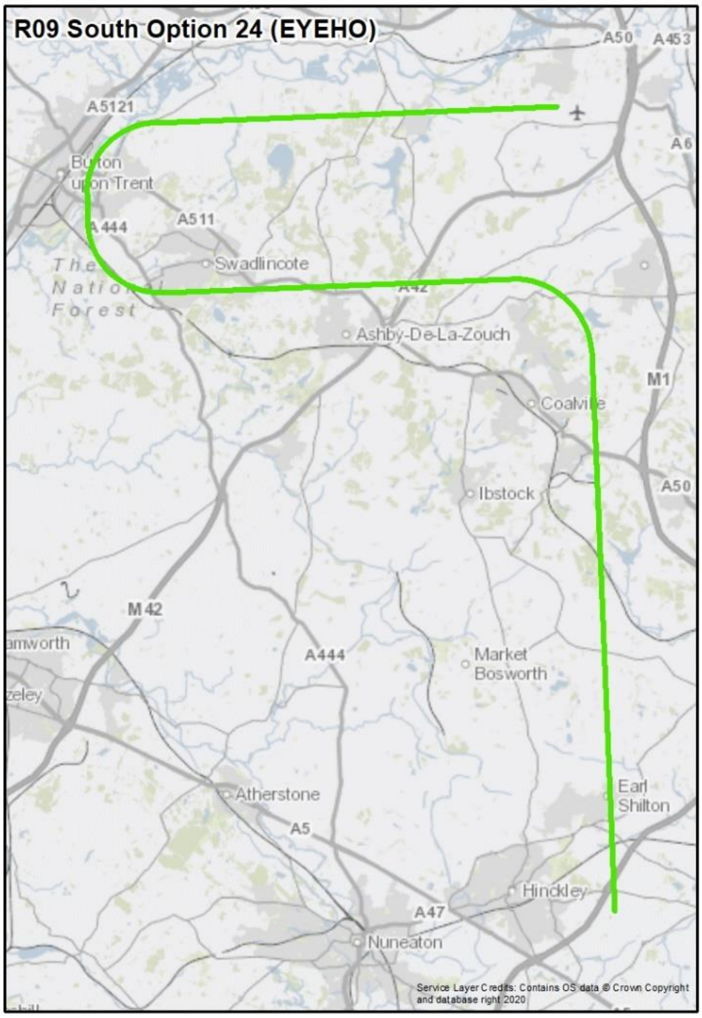
25.22. Runway 09 South, Option 23

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF EYEHO, south east of Hinkley from where the route tracks north to pass east of Coalville. It then turns west and passes to the north of Coalville and Ashby-de-la-Zouch and over the southern portion of Swadlincote, before turning right to join the extended runway centreline east of Burton upon Trent. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.75° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from EYEHO. Noise N2: IAF positioned close to the M69, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Coalville, Ashby-de-la-Zouch and Burton upon Trent. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



25.23. Runway 09 South, Option 24

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF EYEHO, south east of Hinkley from where the route tracks north to pass east of Coalville. It then turns west and passes to the north of Coalville and Ashby-de-la-Zouch and over the southern portion of Swadlincote, before turning right over the eastern edge of Burton upon Trent to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5.1nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 09 approaches. The descent gradient to the FAF is 1.6° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from EYEHO. Noise N2: IAF positioned close to the M69 junction, an area of higher ambient noise. Noise N3: Aims to reduce the impact of noise by avoiding Coalville and Ashby-de-la-Zouch. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



25.24. Runway 09 Transition South: Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A19	S	P	C
Description: This is a route that commences at an IAF located in the vicinity of Syston to the north of Leicester and routed north of Coalville and Ashby-de-la-Zouch to join the final approach for runway 09 at an IF at 3.85nm from the FAF. It was originally created in the comprehensive list of Arrivals as Option 19 but was changed to Viable Poor Fit following analysis on descent gradients. Safety: As detailed at section 19.9f) it is a safety requirement for each IAF to have the ability to provide arrivals procedures to both runway 27 and runway 09. From the position of SYSTO to the north of Leicester this is not possible as the IAF is too close to the FAF for runway 27 and creates a CDA gradient that is above the range for CDAs defined within ICAO guidance. Without the ability to provide viable options to runway 27, any arrivals options from this IAF to runway 09 are therefore also classified as Viable but Poor Fit. To create and operate these in isolation (without reciprocal procedures for runway 27) would create a potentially unsafe scenario within the network in operating the STAR, and during a runway change if RTF communications were lost.			
B20	S	P	C
Description: This is a route that commences at an IAF located in the vicinity of Syston to the north of Leicester and routed north of Coalville and Ashby-de-la-Zouch to join the final approach for runway 09 at an IF at 5.1nm from the FAF. It was originally created in the comprehensive list of Arrivals as Option 20 but was changed to Viable Poor Fit following analysis on descent gradients. Safety: As detailed at section 19.9f) it is a safety requirement for each IAF to have the ability to provide arrivals procedures to both runway 27 and runway 09. From the position of SYSTO to the north of Leicester this is not possible as the IAF is too close to the FAF for runway 27 and creates a CDA gradient that is above the range for CDAs defined within ICAO guidance. Without the ability to provide viable options to runway 27, any arrivals options from this IAF to runway 09 are therefore also classified as Viable but Poor Fit. To create and operate these in isolation (without reciprocal procedures for runway 27) would create a potentially unsafe scenario with within the network in operating the STAR, and during a runway change if RTF communications were lost.			

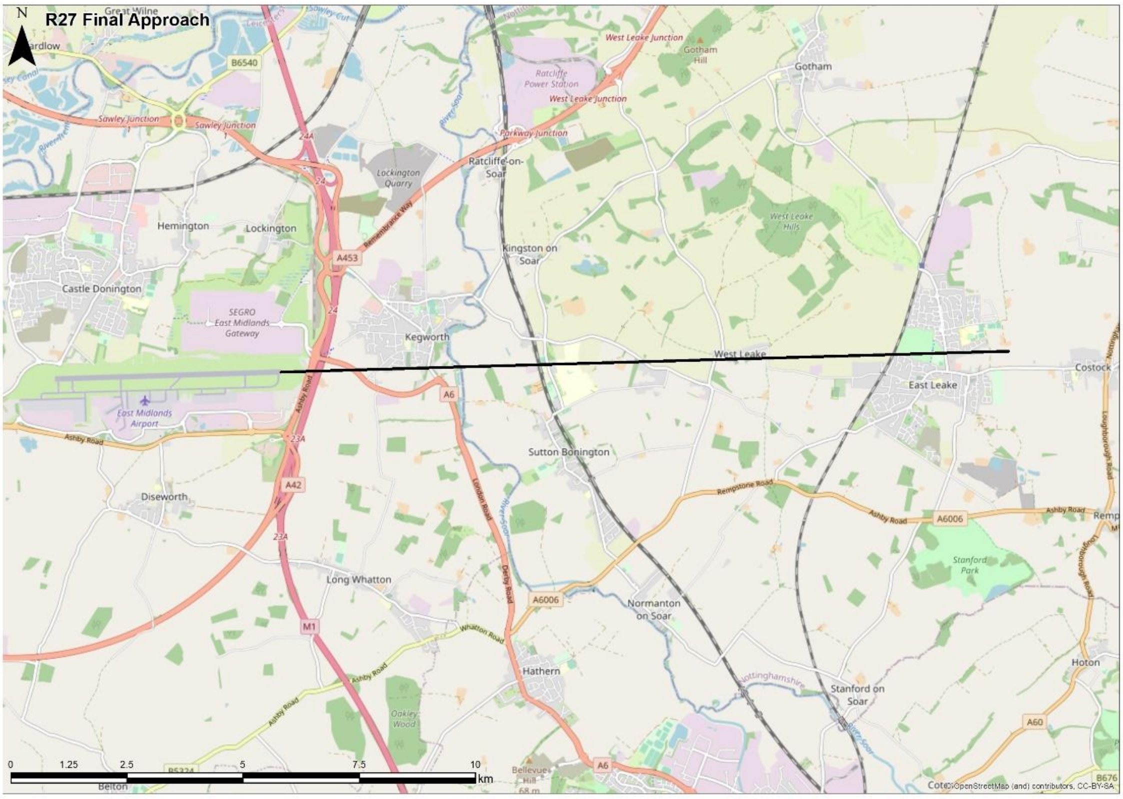
26. Final Approach Runway 27

As described in section 19.6, for each runway direction there is single final approach segment that takes aircraft from the FAF to the runway. This final approach segment allows the aircraft to establish a safe and stable approach to the runway, and for this reason it is created as a single line aligned to the runway centreline.

The final approach for runway 27 commences at the FAF located at 2,000ft and from this point the final approach has a descent gradient of 3°. The approach is aligned with the track of the current published ILS procedure for Runway 27.

The intermediate segment length that precedes this the final approach segment caters for any turns in the transition at the Intermediate Fix (IF) of up to 90°, which provides sufficient distance for turn anticipation and the Minimum Stabilisation Distance (MSD).

A diagram and narrative describing these segments can be found at section 19.6.



27. Runway 27 – Approach Transitions

27.1. Introduction to 27 Approach Design Envelopes

This envelope has been created for traffic routing to the RNP approach for runway 27. It covers the transitions from an IAF at 7,000ft and the design of the final approach.

In current operations for arrivals from the north, ATC radar vector aircraft onto the Final Approach from the ROKUP hold which is located to the west of Belper. Traffic is routed downwind in a south easterly direction to the north and east of the airfield to a base leg to the south east Nottingham. The position of this hold relative to both the airfield and to built up areas results in the majority of these flight routing over central Nottingham.

From the south, ATC radar vector aircraft from the PIGOT hold which is located south east of Leicester, to a base leg north west of Melton Mowbray.

Maps of both these traffic patterns can be seen in the section that describes current operations at section 2.5.

The design options both runway 09 and runway 27 have been created with these operations in mind, and to adhere to the UK CAA Containment Policy for RNAV1 STARs; 'Specified nominal tracks designed to RNAV 1 (RNP 1) standard should not be less than 3Nm from the limits of controlled/advisory airspace'.

Section 19.6 describes the design process which has created a set of transitions starting at the IAFs at 7,000ft. Each option flies an initial descent before making a turn at the IF to connect to the intermediate segment, and thereafter onto the final approach segment. The length of each of these segments is driven by the criteria contained within PANS-OPS 8168 and includes a consideration of the appropriate speeds of aircraft in this phase of flight.

Although these future airspace options have been developed on the principle of minimising ATC vectoring (the process known as systemisation described in section 19.9b), some ATC vectoring will still be required in order to ensure safe separation and to maintain capacity. This is in line with the design principles Safety and Continuity.

27.2. Methodology

As detailed in section 19.3, arrivals to EMA are predominantly from the north and south. To ascertain an area of airspace for an arrival method that could accommodate CDAs to both runways, an arc with a given radius was predicated on the IF of an approach procedure, based on a FAF altitude of 2,000ft. This process was replicated for runway 09, and the two overlapping arcs produce a common area, within which we have placed IAFs which define the start of the arrivals design options.

The options for runway 27 were designed to the current FAF of 2,000ft.

Additionally, the arrivals design options took account of the constraints and considerations in section 19.8 which means that not all the design envelope area can be used as potential airspace to design within.

In particular the area extending from the south east of Nottingham towards Mansfield is not classified as Controlled Airspace (CAS) and no arrivals procedures have been created from

IAF's in this area. This is further detailed in section 21.3 with specific reference to Viable but Poor Fit IAF's A6, B7 and C8.

27.3. Runway 27 Direct and Indirect Routes

The EMA Design Principle Noise N1 states that "Flight paths should, where practical, be spread out to avoid concentration of aircraft activity to share any noise impacts". One method of achieving this is through the provision of noise respite.

As described in section 19.7, both direct and indirect options have been created from each IAF, and this concept is intended to create an opportunity for noise respite.

Table 14 and Table 15 below detail the direct and indirect option numbers from each IAF for runway 27:

RUNWAY 27 NORTH IAF	DIRECT Options				INDIRECT Options	
IAF1	17	18			19	20
IAF2	13	14			21	22
IAF3	23	24			11	12
IAF4	9	10			25	26
IAF5	15	16			27	28
ROKUP	1	2			3	4
DIPSO	5	6	7	8	29	30

Table 14: Runway 27 North IAFs direct and indirect options

RUNWAY 27 SOUTH IAF	DIRECT Options				INDIRECT Options			
STAPL	15	16			19	20		
EYEHO	21	22			13	14		
JUNCK	1	2	7	8	3	4	9	10
LEICE	23	24			5	6	11	12

Table 15: Runway 27 South IAFs direct and indirect options

27.4. Runway 27 Design Envelopes Location Map

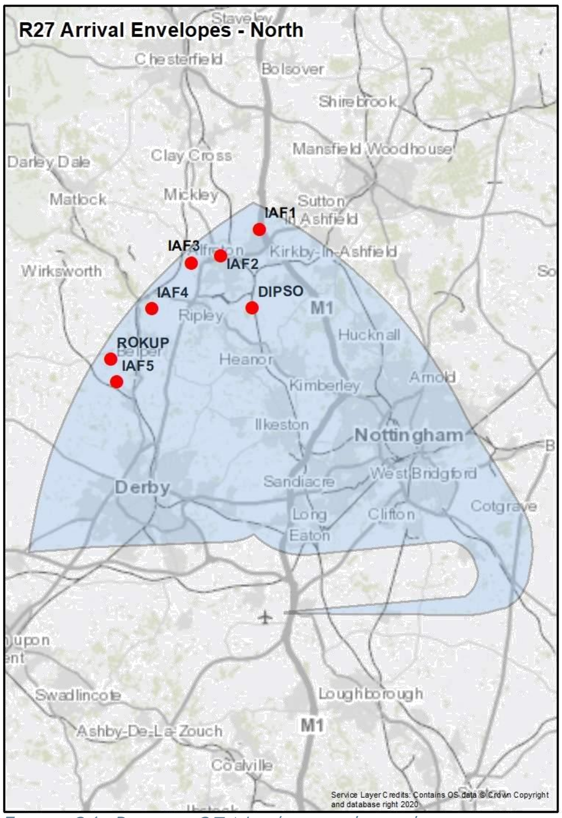


Figure 36: Runway 27 North arrival envelope

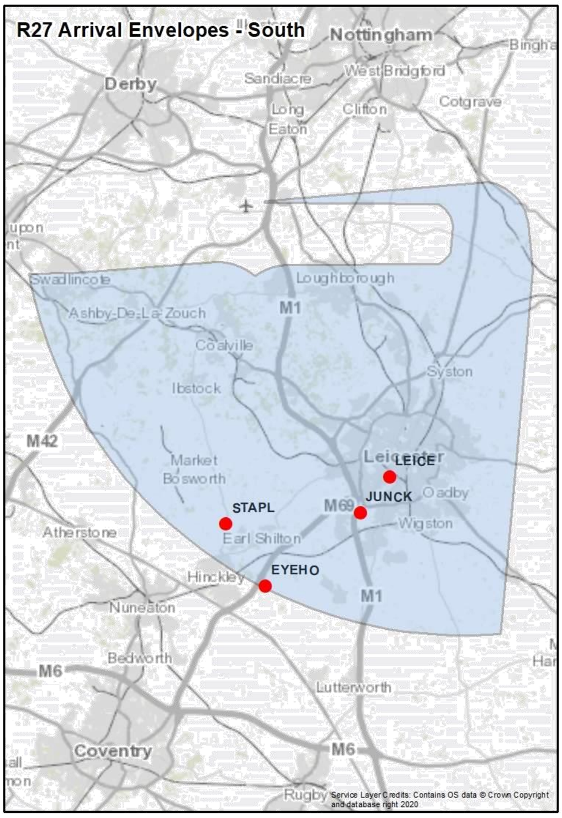


Figure 37: Runway 27 South arrival envelope

28. Runway 27 – North

28.1. Runway 27 North, Options Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.13° The route style is 'direct'. '			U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for non-compliance. These cover options that may be non-compliant with PANS-OPS in relation to: • MSD and the turn onto final approach. • Descent gradients above the PANS-OPS maximum. • Turn radius based on speed, altitude, and descent gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	IAF = **ROKUP** west of Belper The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.93° The route style is 'direct'				

3	IAF = ROKUP west of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.96° The route style is 'indirect'				
4	IAF = ROKUP west of Belper The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.81° The route style is 'indirect'				
5	IAF = DIPSO, east of Ripley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.59° The route style is 'direct'				
6	IAF = DIPSO, east of Ripley The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.33° The route style is 'direct'				
7	IAF = DIPSO, east of Ripley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.57° The route style is 'direct'				
8	IAF = DIPSO, east of Ripley The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.3° The route style is 'direct'				

9	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.17° The route style is 'direct'				
10	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.97° The route style is 'direct'				
11	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.86° The route style is 'indirect'				
12	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.71° The route style is 'indirect'				
13	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.18° The route style is 'direct'				
14	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.99° The route style is 'direct'				

15	IAF = **IAF5** north of Duffield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.19° The route style is 'direct'				
16	IAF = **IAF5** north of Duffield The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.98° The route style is 'direct'				
17	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.29° The route style is 'direct'				
18	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2.08° The route style is 'direct'				
19	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.82° The route style is 'indirect'				
20	IAF = **IAF1**, west of Sutton-in-Ashfield The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.67° The route style is 'indirect'				

21	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.89° The route style is 'indirect'				
22	IAF = **IAF2** near Alfreton The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.72° The route style is 'indirect'				
23	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.19° The route style is 'direct'				
24	IAF = **IAF3** west of Alfreton The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 2° The route style is 'direct'				
25	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.95° The route style is 'indirect'				
26	IAF = **IAF4** north of Belper The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.78° The route style is 'indirect'				

27	IAF = **IAF5** north of Duffield The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.09° The route style is 'indirect'				
28	IAF = **IAF5** north of Duffield The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.89° The route style is 'indirect'				
29	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.1° The route style is 'indirect'				
30	IAF = **DIPSO**, east of Ripley The length of the Intermediate Segment (IF to FAF) is 5nm CDA descent gradient = 1.9° The route style is 'indirect'				

28.2. Runway 27 North, Option 1

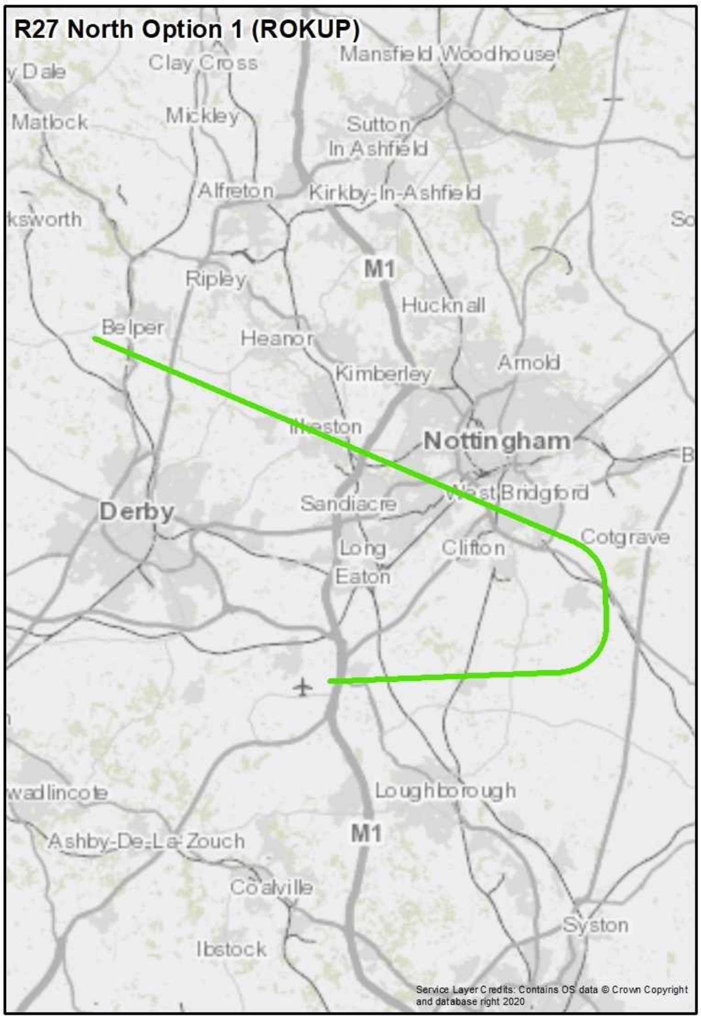
Description

The IAF for this option is ROKUP and the style of the route is 'direct' which means the distance to the final approach has been minimised.

This option starts at IAF ROKUP west of Belper and initially tracks south east over southern Ilkeston and southern Nottingham. It continues on this track until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.13° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from ROKUP.

Noise N2: Routes over southern Nottingham which has a higher level of ambient noise than surrounding rural areas.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

28.3. Runway 27 North, Option 2

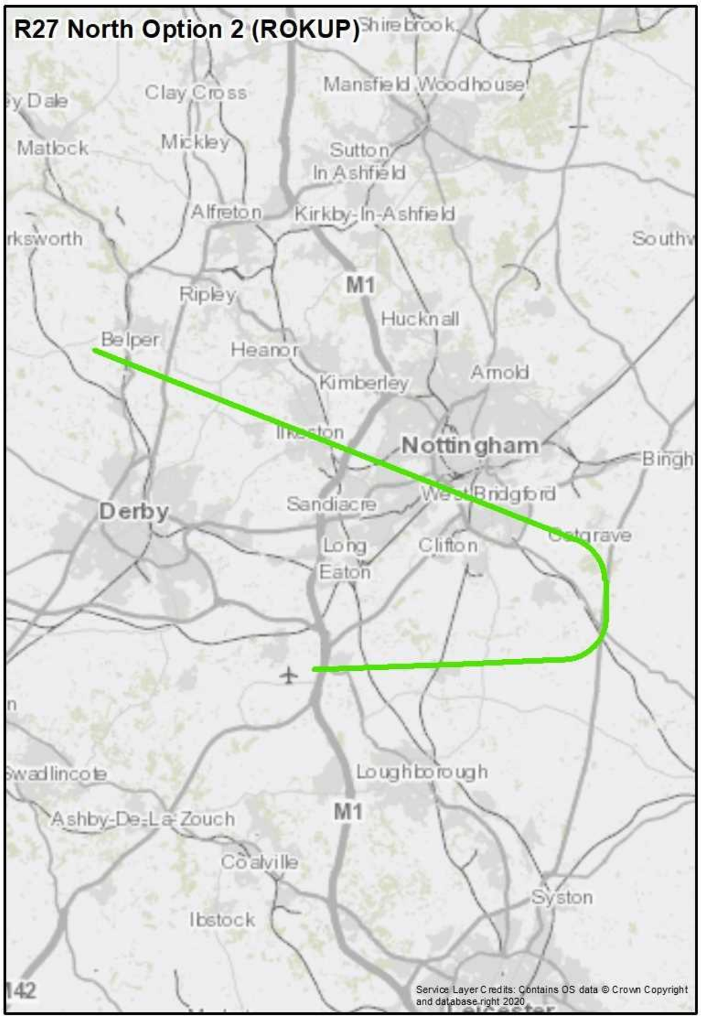
Description

The IAF for this option is ROKUP and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route to Option 1 but routes further east before joining the final approach.

The option starts at IAF ROKUP west of Belper and initially tracks south east over southern Ilkeston and southern Nottingham. It continues on this track until Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 1.93° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

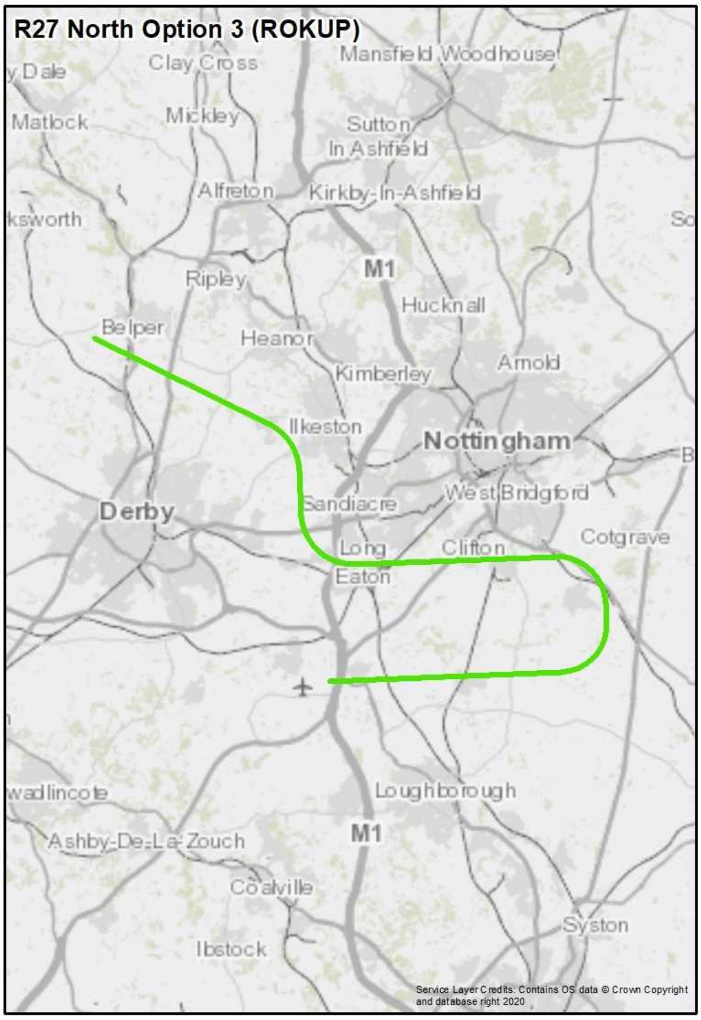
Noise N1: Can provide respite when combined with other options from ROKUP.

Noise N2: Routes over southern Nottingham which has a higher level of ambient noise than surrounding rural areas.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

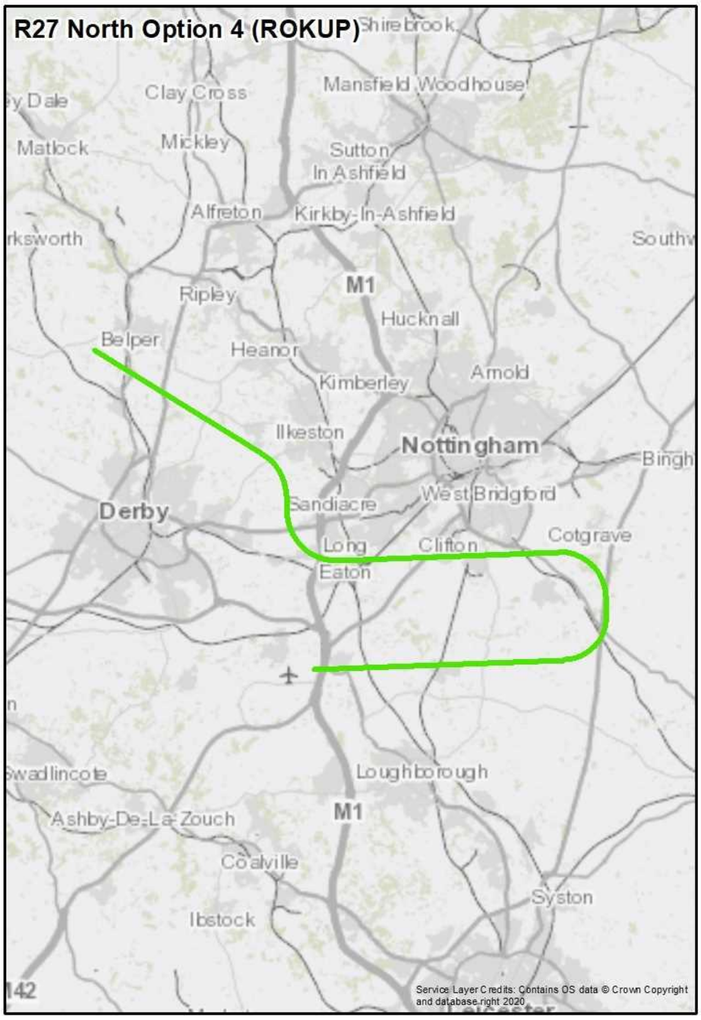
28.4. Runway 27 North, Option 3

Description	Reason for inclusion
The IAF for this option is ROKUP and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF ROKUP west of Belper and initially tracks south east before turning south over West Hallam, just to the west of Ilkeston, then turning east to fly over Long Eaton and Clifton. To the south east of Nottingham, the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.96° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from ROKUP. **Noise N3:** Aims to reduce the impact of noise by routing west and south of Nottingham. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



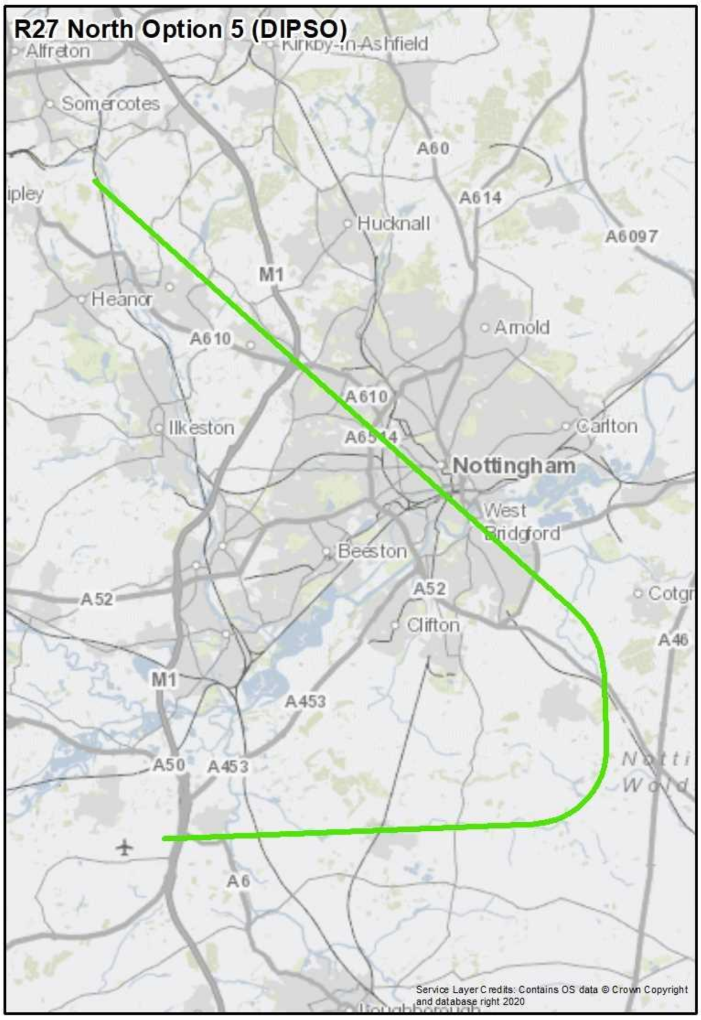
28.5. Runway 27 North, Option 4

Description	Reason for inclusion
The IAF for this option is ROKUP and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows a similar route to Option 3 but routes further east before joining the final approach. The option starts at IAF ROKUP west of Belper and initially tracks south east before turning south over West Hallam, just to the west of Ilkeston, then turning east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.81° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1:** Can provide respite when combined with other options from ROKUP. **Noise N3:** Aims to reduce the impact of noise by routing west and south of Nottingham. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.6. Runway 27 North, Option 5

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF DIPSO, east of Ripley and initially tracks south east over Eastwood, Kimberley, and central Nottingham. It continues on this track until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.59° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from DIPSO. **Noise N2:** Routes over central Nottingham which has a higher level of ambient noise than surrounding rural areas. **Noise N3:** Provides an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.7. Runway 27 North, Option 6

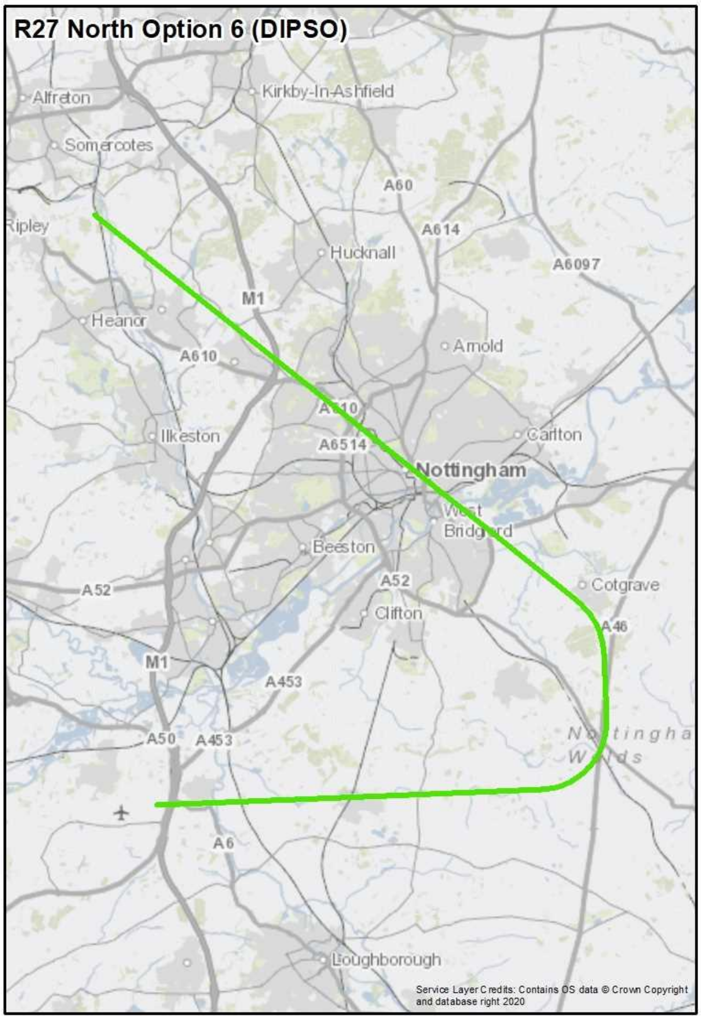
Description

The IAF for this option is DIPSO and the style of the route is ‘direct’ which means the distance to the final approach has been minimised. It follows a similar route to Option 5 but routes further east before joining the final approach.

The option starts at IAF DIPSO, east of Ripley and initially tracks south east over Eastwood, Kimberley, and central Nottingham. It continues on this track until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.33° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from DIPSO.

Noise N2: Routes over central Nottingham which has a higher level of ambient noise than surrounding rural areas.

Noise N3: Provides an optimal low noise CDA gradient.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

28.8. Runway 27 North, Option 7

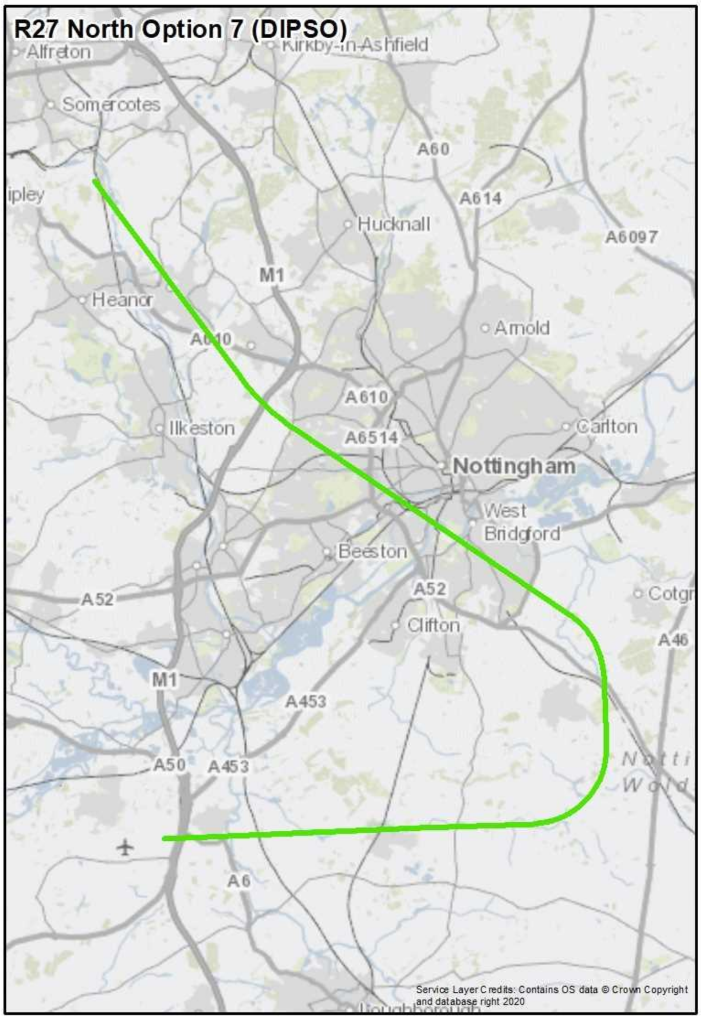
Description

The IAF for this option is DIPSO and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar track to Option 5 but routes slightly further south west over Nottingham.

The option starts at IAF DIPSO east of Ripley and initially tracks south east passing just south of Kimberley. Just west of Nottingham it makes a slight left turn and continues over central Nottingham until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.57° which is within the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from DIPSO.

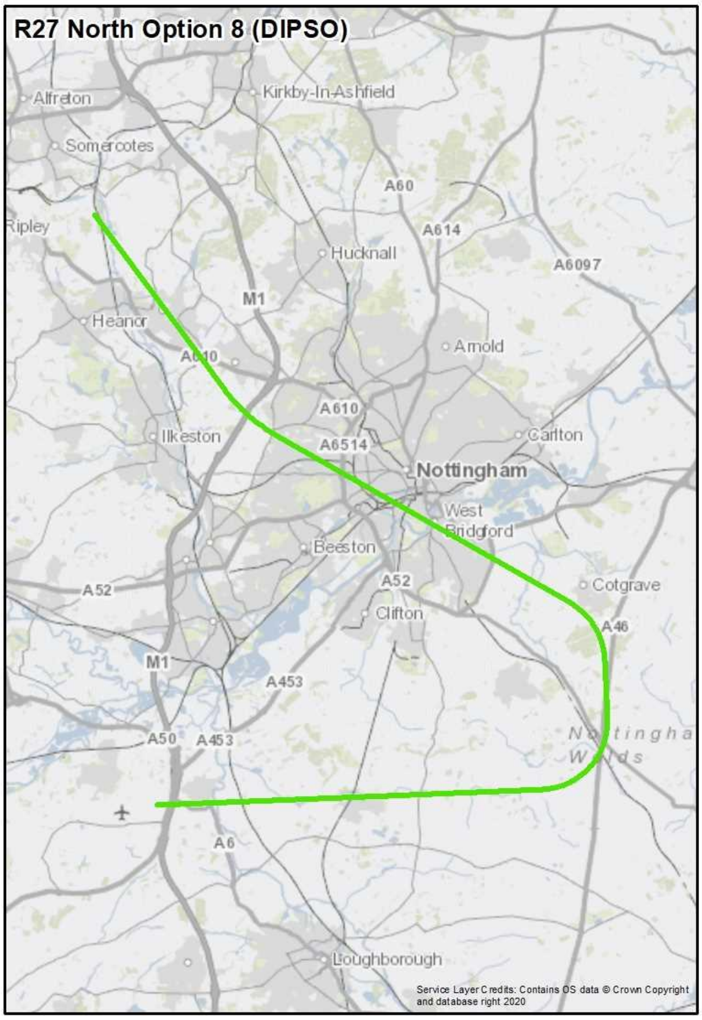
Noise N2: Routes over central Nottingham which has a higher level of ambient noise than surrounding rural areas.

Noise N3: Provides an optimal low noise CDA gradient.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

28.9. Runway 27 North, Option 8

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route to Option 7 but routes further east before joining the final approach. The option starts at IAF DIPSO east of Ripley and initially tracks south east passing just south of Kimberley. Just west of Nottingham it makes a slight left turn and continues over central Nottingham until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.3° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from DIPSO. **Noise N2:** Routes over central Nottingham which has a higher level of ambient noise than surrounding rural areas. **Noise N3:** Provides an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.10. Runway 27 North, Option 9

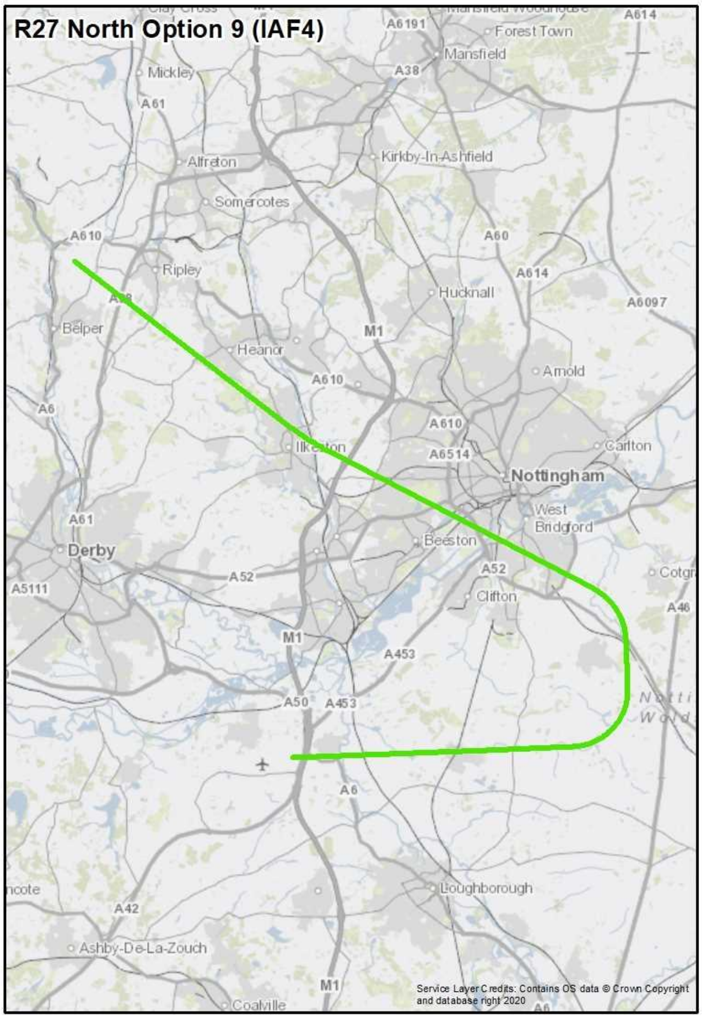
Description

The IAF for this option is IAF4 and the style of the route is 'direct' which means the distance to the final approach has been minimised.

This option starts at IAF4 north of Belper from where it tracks south east passing between Belper and Ripley, turning slightly left over Ilkeston to over fly south west Nottingham. Once south east of Nottingham at a point south of Gamston the route turns south and routes east of Keyworth before turning left to join the extended runway centreline.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.17° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from IAF4.

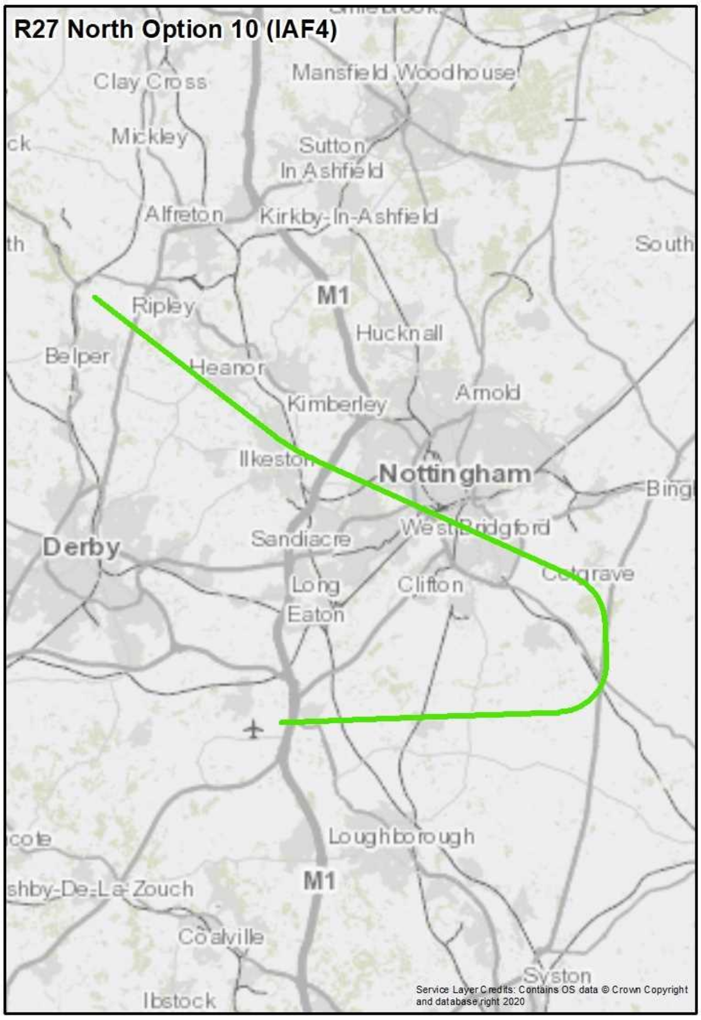
Noise N2: Routes over south west Nottingham which has a higher level of ambient noise than surrounding rural areas.

Noise N3: Provides a CDA gradient that is close to the optimal for low noise purposes.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

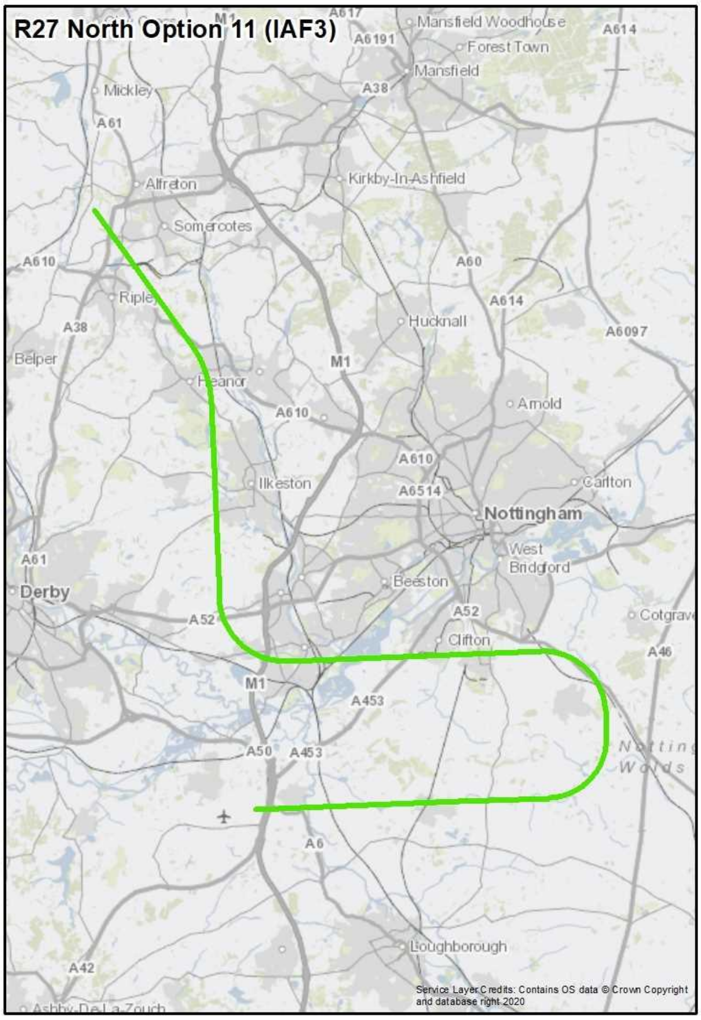
28.11. Runway 27 North, Option 10

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route to Option 9 but routes further east before joining the final approach. This option starts at IAF4 north of Belper from where it tracks south east passing between Belper and Ripley, turning slightly left over Ilkeston to over fly south west Nottingham. It continues on this track until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.97° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from IAF4. Noise N2: Routes over south west Nottingham which has a higher level of ambient noise than surrounding rural areas. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



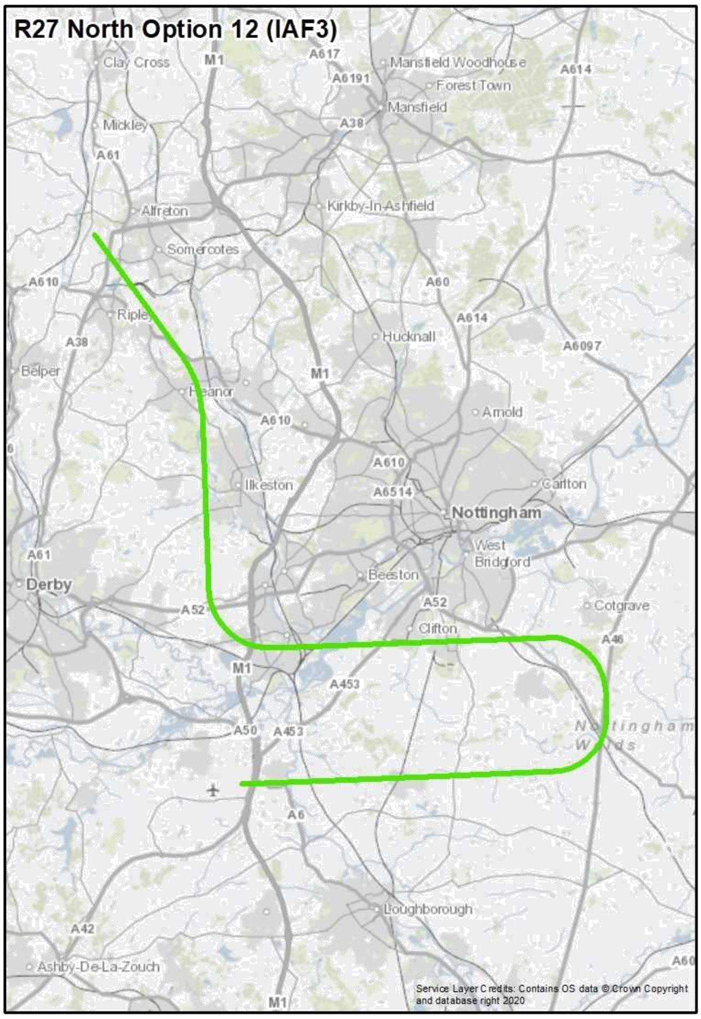
28.12. Runway 27 North, Option 11

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF3 west of Alfreton from where it tracks south east turning south between Heanor and Eastwood and routing west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. To the south east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.86° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF3. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.13. Runway 27 North, Option 12

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 11 but routes further east before joining the final approach. The option starts at IAF3 west of Alfreton from where it tracks south east turning south between Heanor and Eastwood and routing west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.71° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF3. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.14. Runway 27 North, Option 13

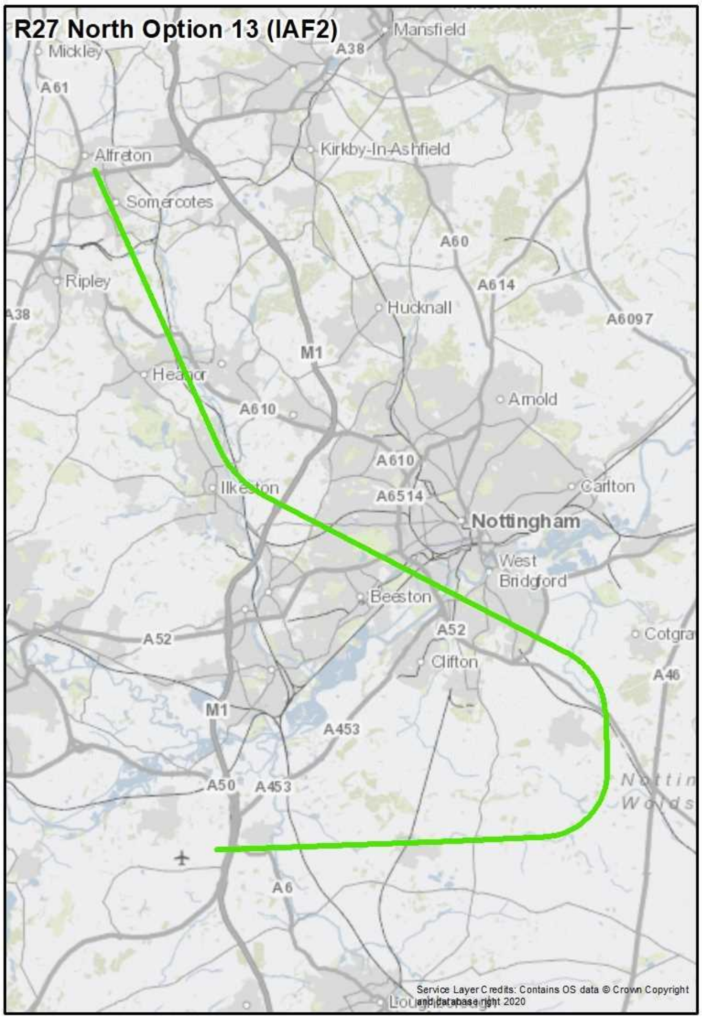
Description

The IAF for this option is IAF2 and the style of the route is 'direct' which means the distance to the final approach has been minimised.

The option starts at IAF2 near Alfreton and tracks south east between Heanor and Eastwood and overflies the eastern side of Ilkeston where it turns slightly left. It then passes over south west Nottingham and continues on this track until south east of Nottingham to a point south of Gamston. At this point the route turns south and routes east of Keyworth before turning left to join the extended runway centreline.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.18° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from IAF2.

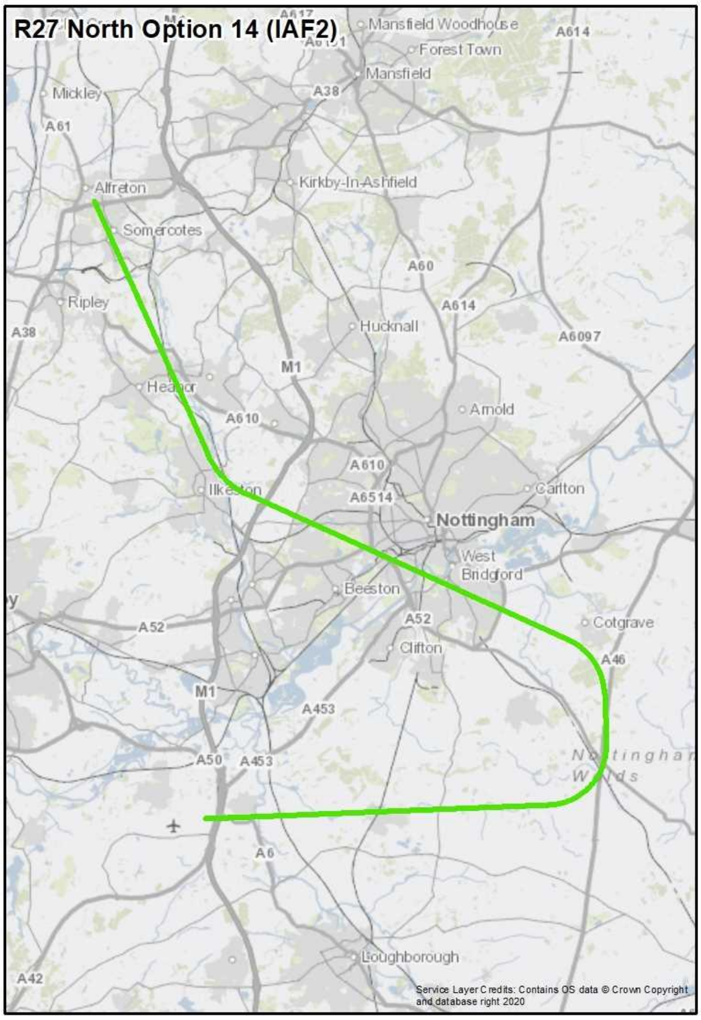
Noise N2: Routes over south west Nottingham which has a higher level of ambient noise than surrounding rural areas.

Noise N3: Provides a CDA gradient close to the optimal for low noise purposes.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

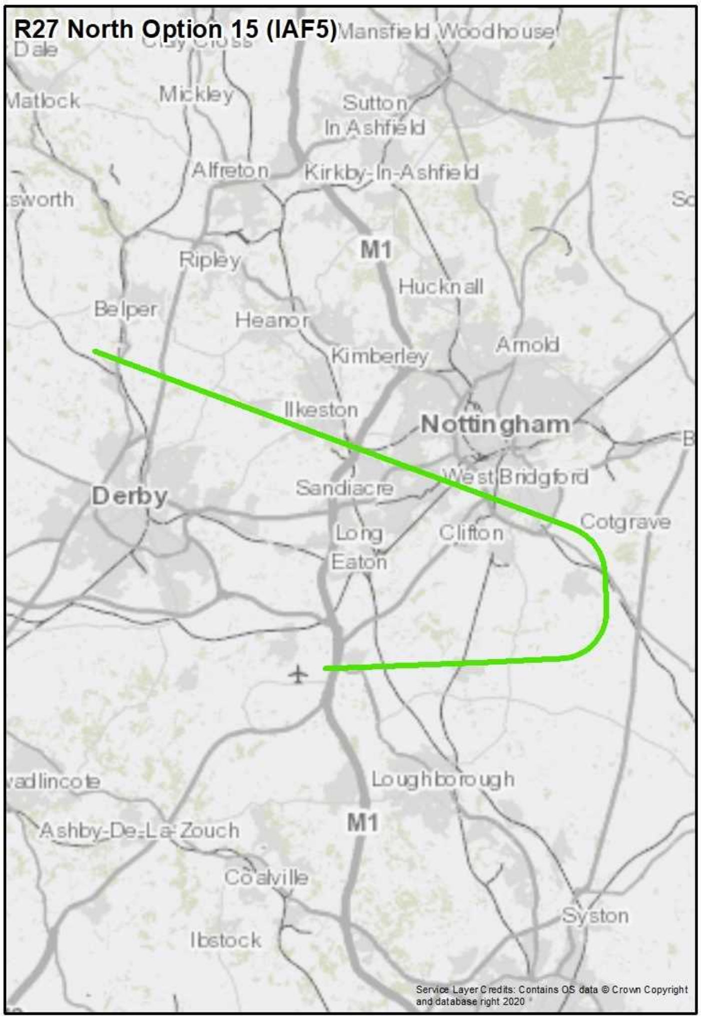
28.15. Runway 27 North, Option 14

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route as Option 13 but routes further east before joining the final approach. The option starts at IAF2 near Alfreton and tracks south east between Heanor and Eastwood and overflies the eastern side of Ilkeston where it turns slightly left. It then passes over south west Nottingham and continues on this track until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth, briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.99° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF2. **Noise N2:** Routes over south west Nottingham which has a higher level of ambient noise than surrounding rural areas. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



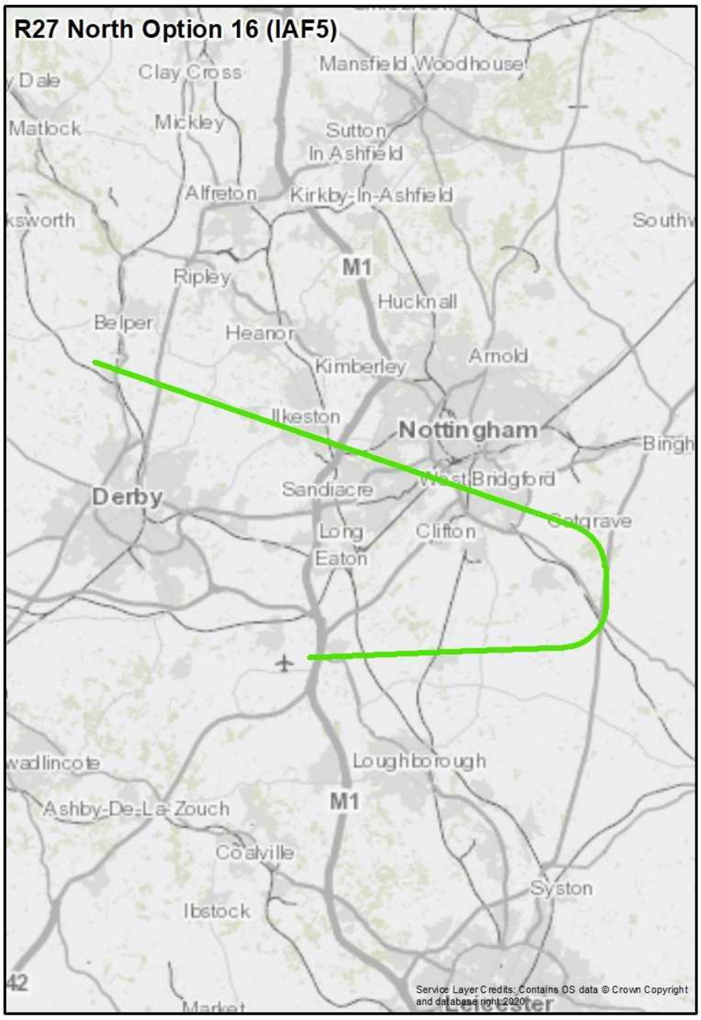
28.16. Runway 27 North, Option 15

Description	Reason for inclusion
The IAF for this option is IAF5 and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF5 north of Duffield and initially tracks south east passing south of Ilkeston and routing over south west Nottingham. It continues on this track until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.19° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF5. **Noise N2:** Routes over south west Nottingham which has a higher level of ambient noise than surrounding rural areas. **Noise N3:** Provides a CDA gradient close to the optimal for low noise purposes. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.17. Runway 27 North, Option 16

Description	Reason for inclusion
The IAF for this option is IAF5 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route as Option 15 but routes further east before joining the final approach. This option starts at IAF5 north of Duffield and initially tracks south east passing south of Ilkeston and routing over south west Nottingham. It continues on this track until Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.98° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from IAF5. **Noise N2:** Routes over south west Nottingham which has a higher level of ambient noise than surrounding rural areas. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.18. Runway 27 North, Option 17

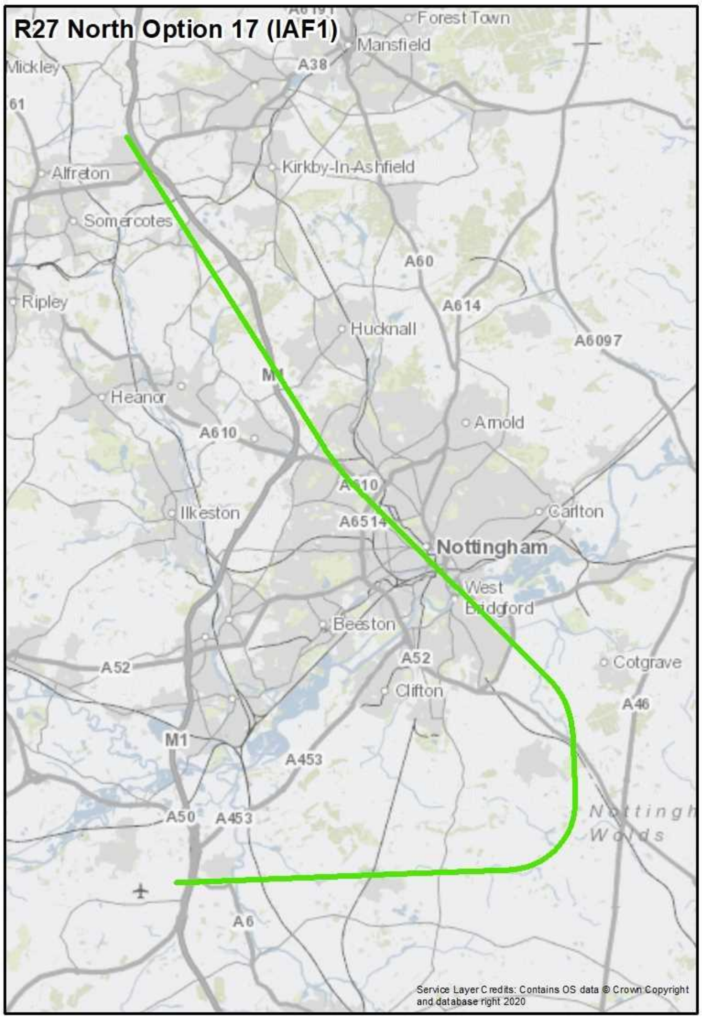
Description

The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised.

The option starts at IAF1 west of Sutton-in-Ashfield and tracks south east following the line of the M1 motorway, passing between Hucknall and Kimberley. It then makes a slight left turn passing over central Nottingham and continues on this track until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.3° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from IAF1.

Noise N2: Follows the line of the M1 and routes over central Nottingham both of which have a higher level of ambient noise than surrounding rural areas.

Noise N3: Provides an optimal low noise CDA gradient.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

28.19. Runway 27 North, Option 18

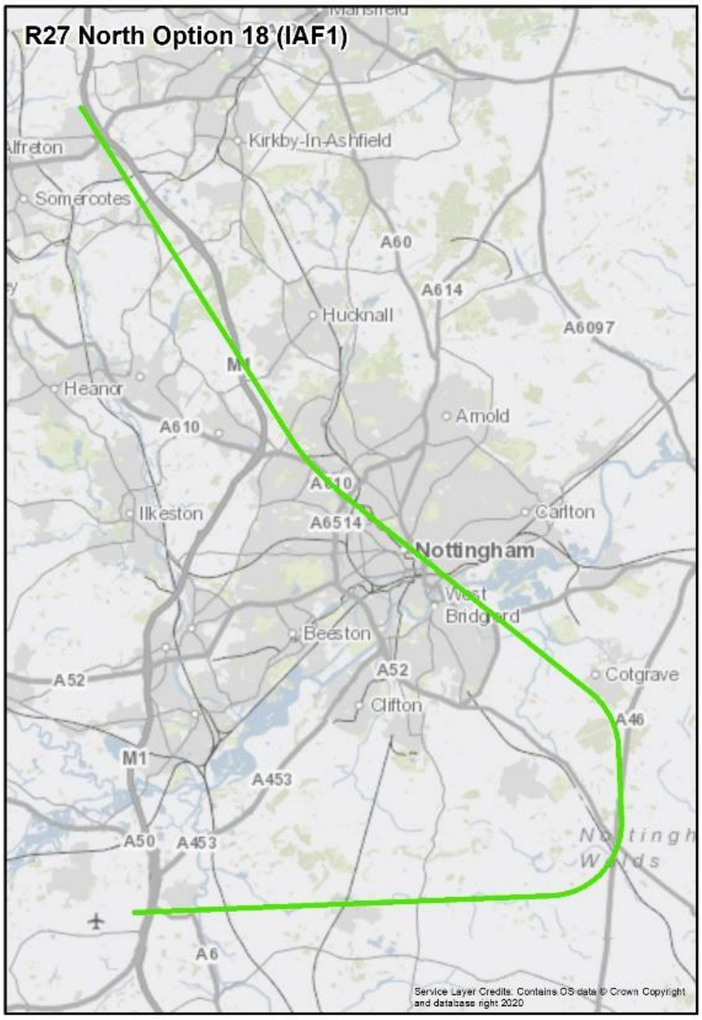
Description

The IAF for this option is IAF1 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route as Option 17 but routes further east before joining the final approach.

The option starts at IAF1 west of Sutton-in-Ashfield and tracks south east following the line of the M1 motorway, passing between Hucknall and Kimberley. It then makes a slight left turn passing over central Nottingham and continues on this track until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.08° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

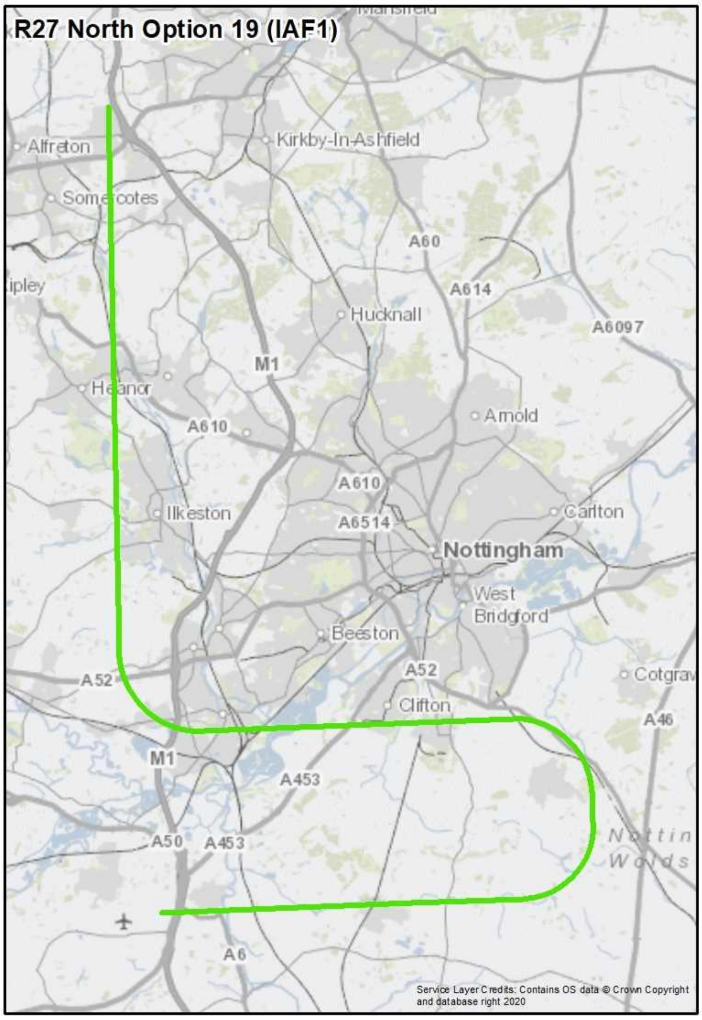
Noise N1: Can provide respite when combined with other options from IAF1.

Noise N2: Follows the line of the M1 and routes over central Nottingham both of which have a higher level of ambient noise than surrounding rural areas.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

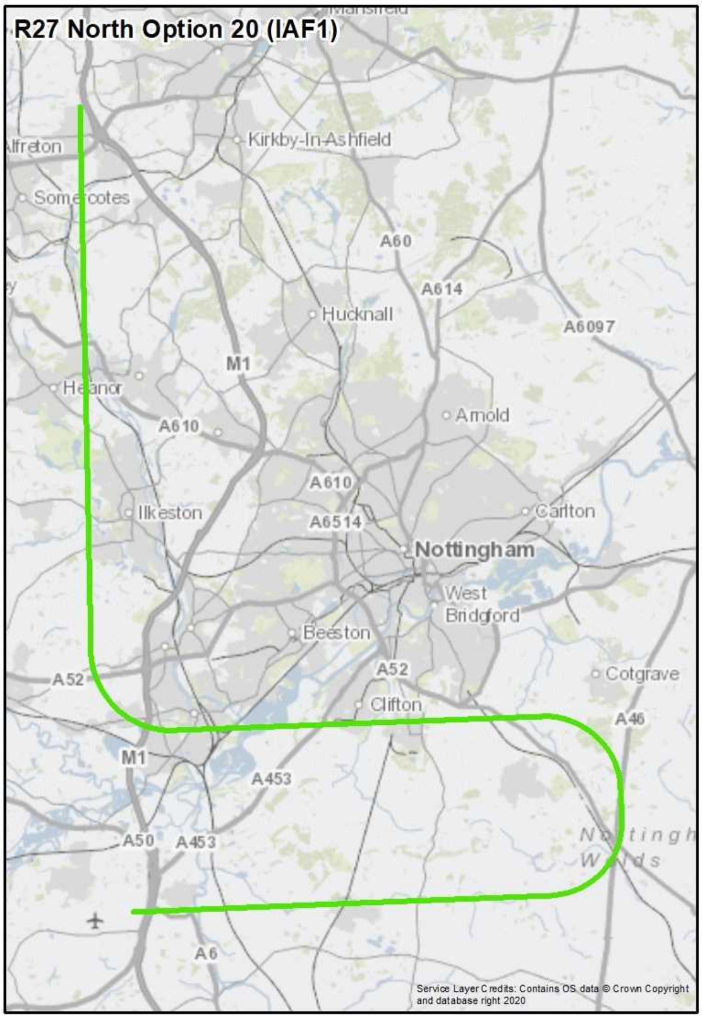
28.20. Runway 27 North, Option 19

Description	Reason for inclusion
The IAF for this option is IAF1 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF1 west of Sutton-in-Ashfield and tracks south passing over Heanor and routing west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. To the south east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.82° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF1. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



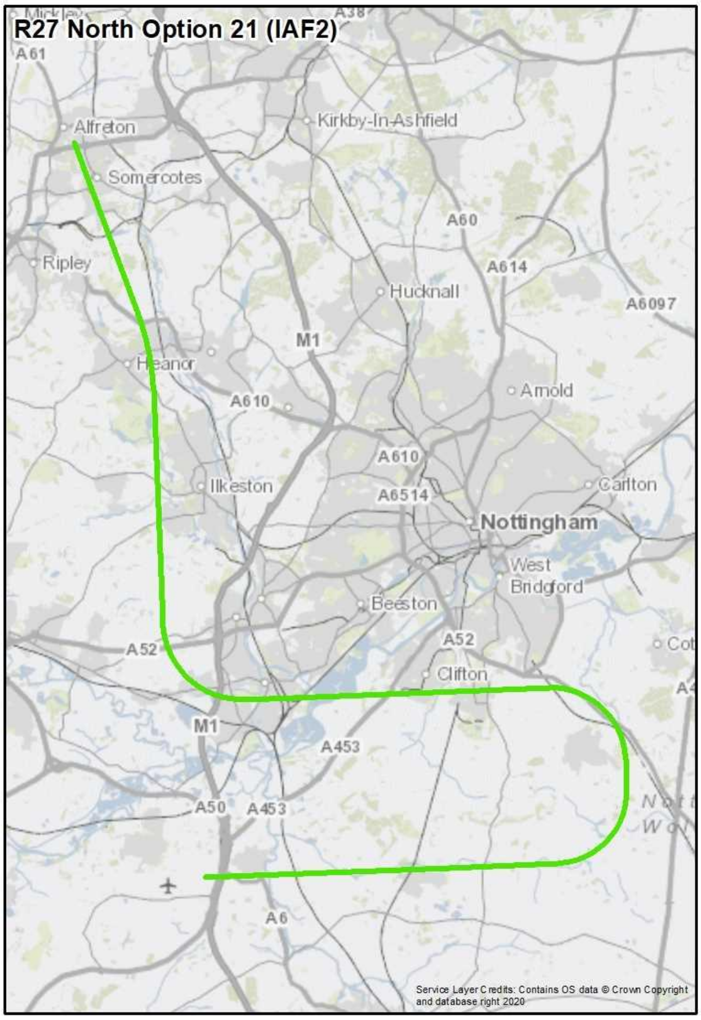
28.21. Runway 27 North, Option 20

Description	Reason for inclusion
The IAF for this option is IAF1 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 19 but routes further east before joining the final approach. The option starts at IAF1 west of Sutton-in-Ashfield and tracks south passing over Heanor and routing west of Ilkeston and Nottingham and then turns east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.67° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from IAF1. **Noise N3:** Aims to reduce the impact of noise by routing west and south of Nottingham. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



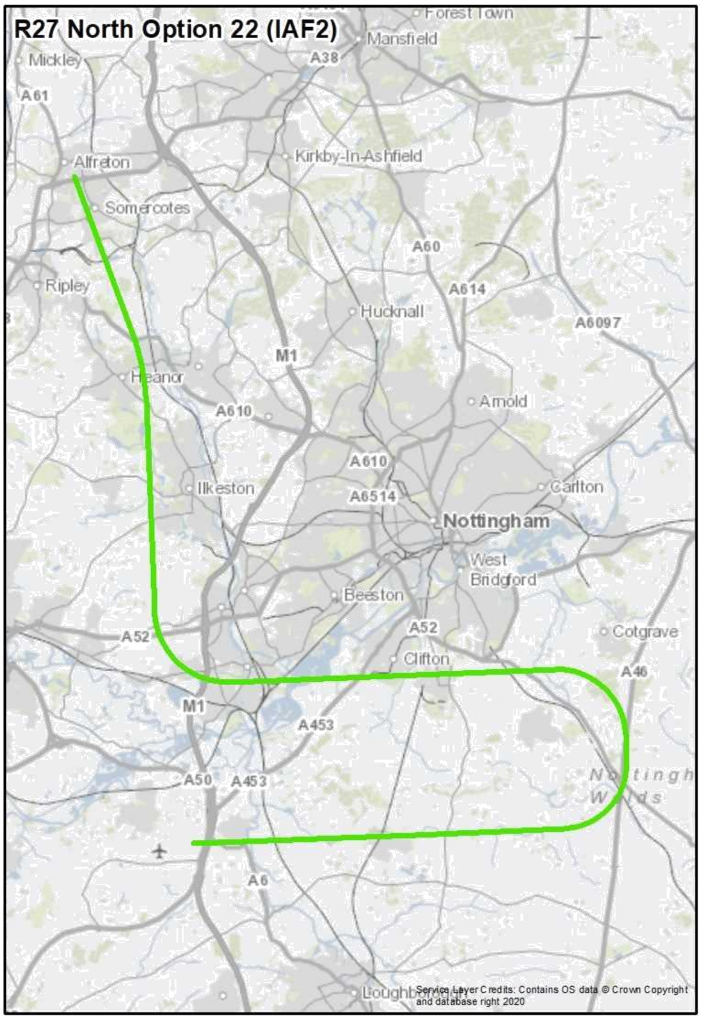
28.22. Runway 27 North, Option 21

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF2 near Alfreton from where it tracks south east turning south between Heanor and Eastwood and routing west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. To the south east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.89° which is within the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF2. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



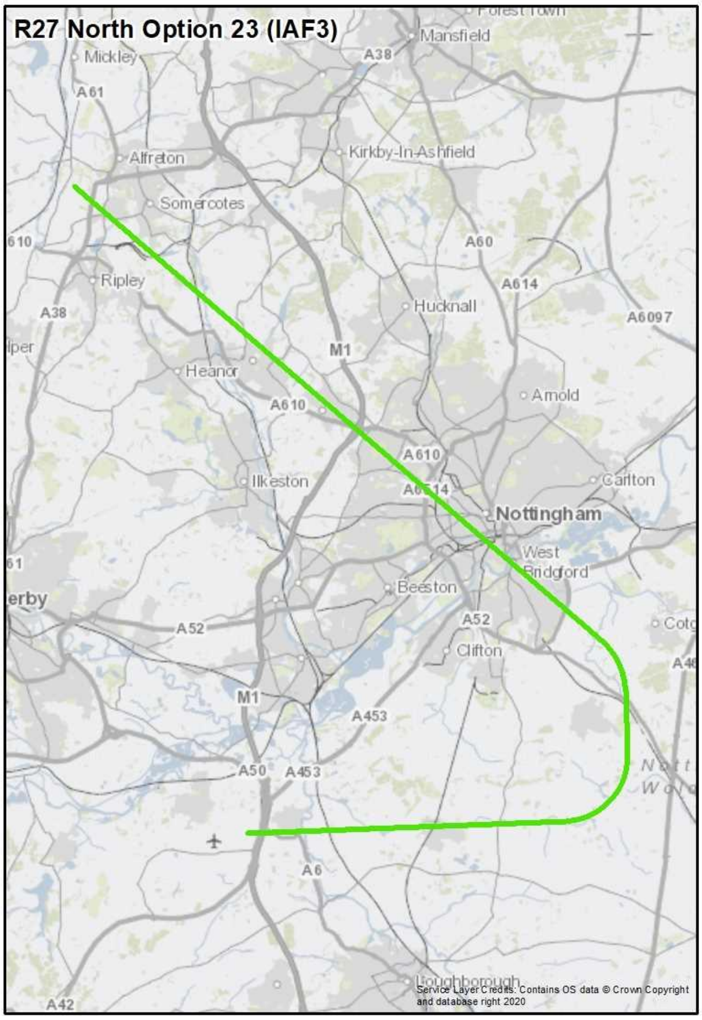
28.23. Runway 27 North, Option 22

Description	Reason for inclusion
The IAF for this option is IAF2 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 21 but routes further east before joining the final approach. The option starts at IAF2 near Alfreton from where it tracks south east turning south between Heanor and Eastwood and routing west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.72° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF2. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.24. Runway 27 North, Option 23

Description	Reason for inclusion
The IAF for this option is IAF3 and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF3 west of Alfreton and initially tracks south east over Eastwood, Kimberley, and central Nottingham. It continues on this track until south of Gamston where the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.19° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. Noise N1: Can provide respite when combined with other options from IAF3. Noise N2: Routes over central Nottingham which has a higher level of ambient noise than surrounding rural areas. Noise N3: Provides a CDA gradient close to the optimal for low noise purposes. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.25. Runway 27 North, Option 24

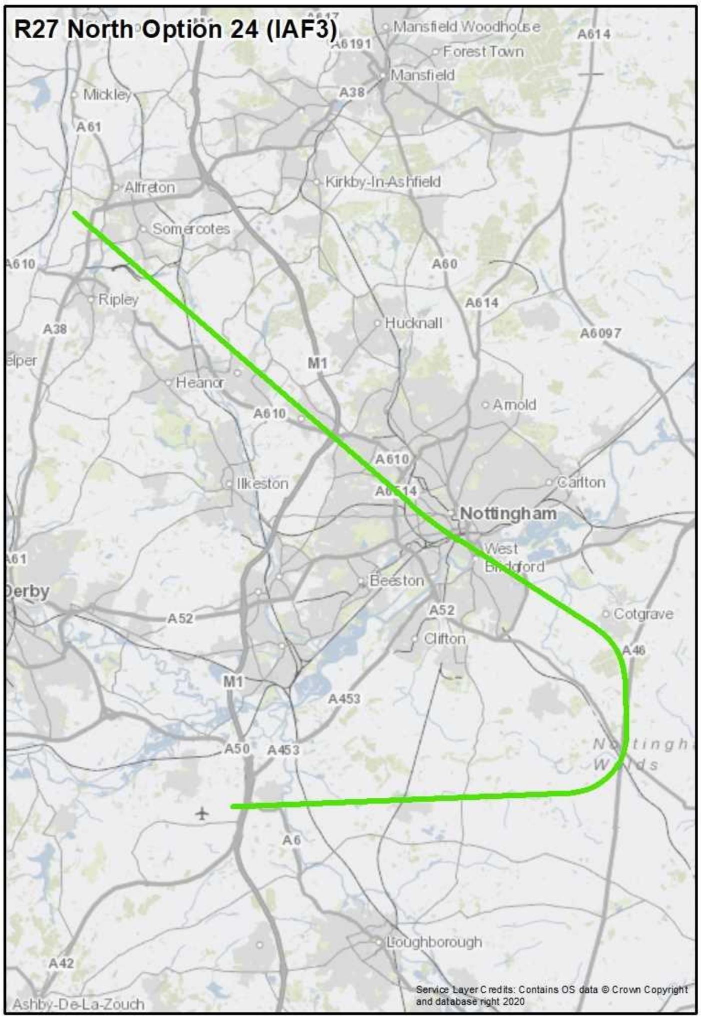
Description

The IAF for this option is IAF3 and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows the same route as Option 23 but routes further east before joining the final approach.

The option starts at IAF3 west of Alfreton and initially tracks south east over Eastwood, Kimberley, and central Nottingham. It continues on this track until overhead Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

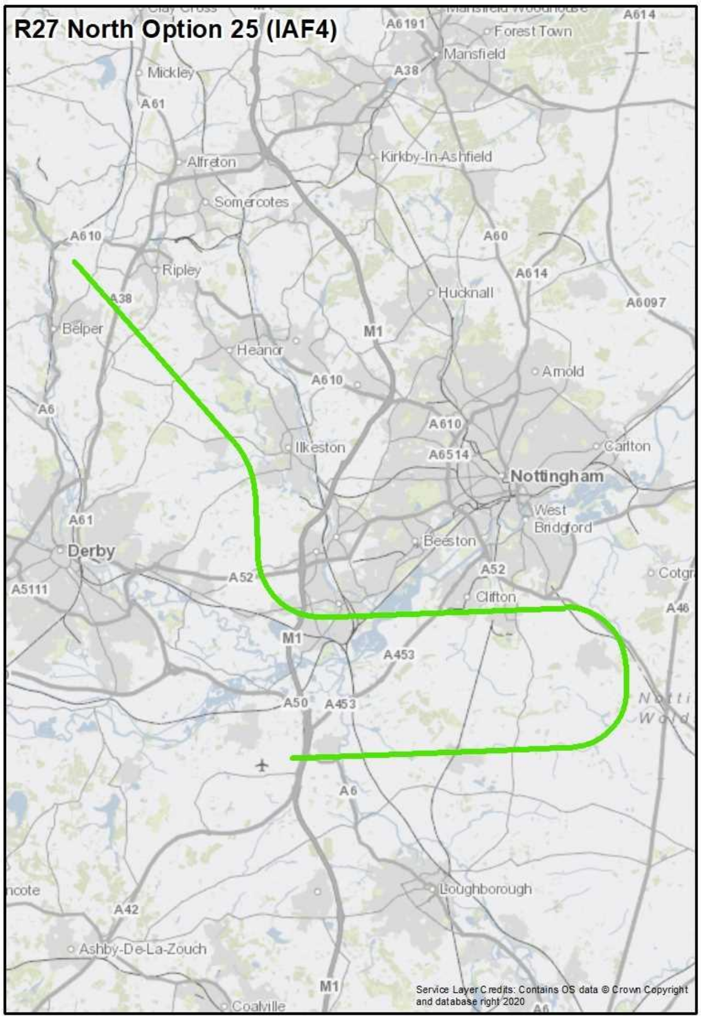
Noise N1: Can provide respite when combined with other options from IAF3.

Noise N2: Routes over central Nottingham which has a higher level of ambient noise than surrounding rural areas.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

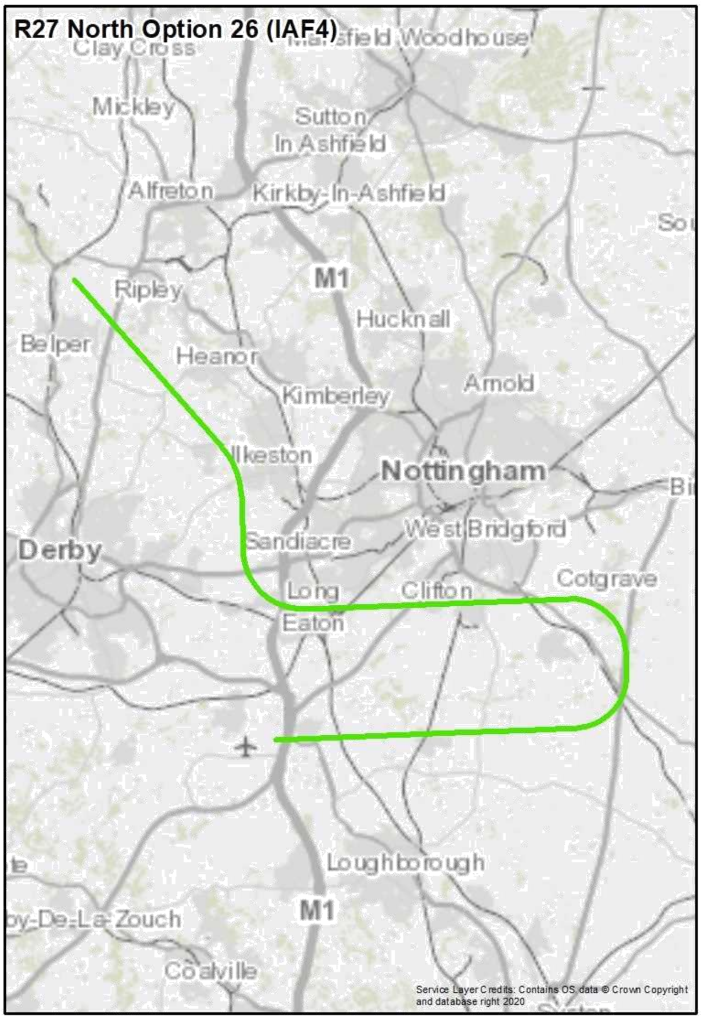
28.26. Runway 27 North, Option 25

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF4 north of Belper and tracks south east between Belper and Ripley before turning south just west of Ilkeston and routing to the west of Nottingham. It then turns east to fly over Long Eaton and Clifton. To the south east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.95° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from IAF4. **Noise N3:** Aims to reduce the impact of noise by routing west and south of Nottingham. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



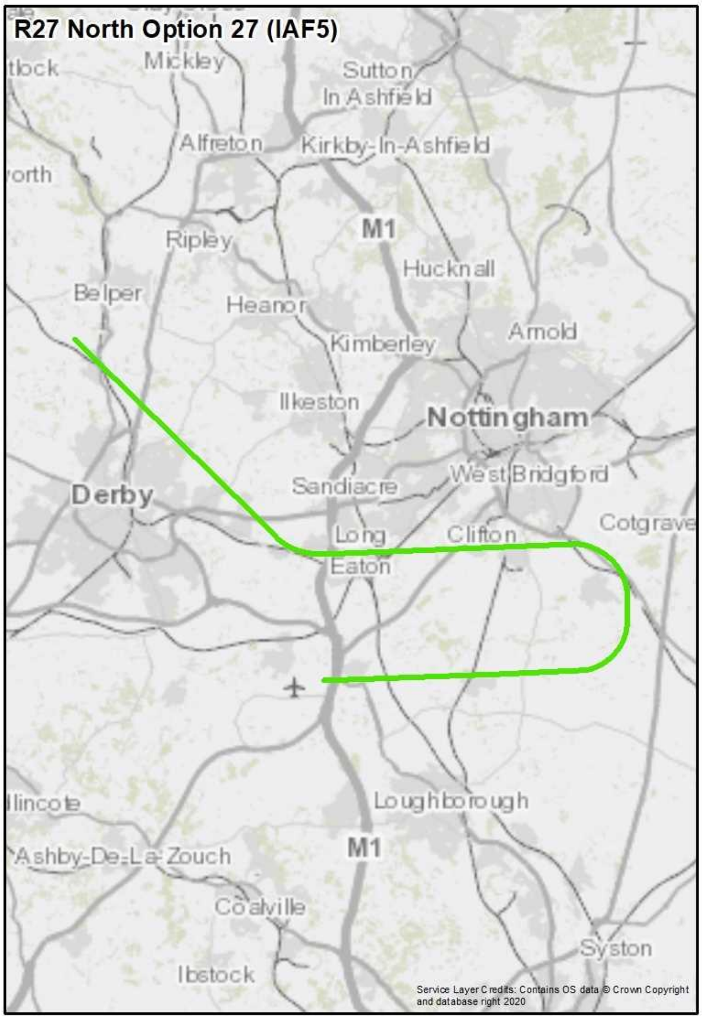
28.27. Runway 27 North, Option 26

Description	Reason for inclusion
The IAF for this option is IAF4 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 25 but routes further east before joining the final approach. The option starts at IAF4 north of Belper and tracks south east between Belper and Ripley before turning south just west of Ilkeston and routing to the west of Nottingham. It then turns east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.78° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF4. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.28. Runway 27 North, Option 27

Description	Reason for inclusion
The IAF for this option is IAF5 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF5 north of Duffield and initially tracks south east, just north of Derby. Close to Draycott the route turns left to head east passing over Long Eaton and Ruddington, and to the south east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.09° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from IAF5. Noise N3: Aims to reduce the impact of noise by routing north of Derby, and west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.29. Runway 27 North, Option 28

Description

The IAF for this option is IAF5 and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 27 but routes further east before joining the final approach.

This option starts at IAF5 north of Duffield and initially tracks south east, just north of Derby. Close to Draycott the route turns left to head east passing over Long Eaton and Ruddington. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

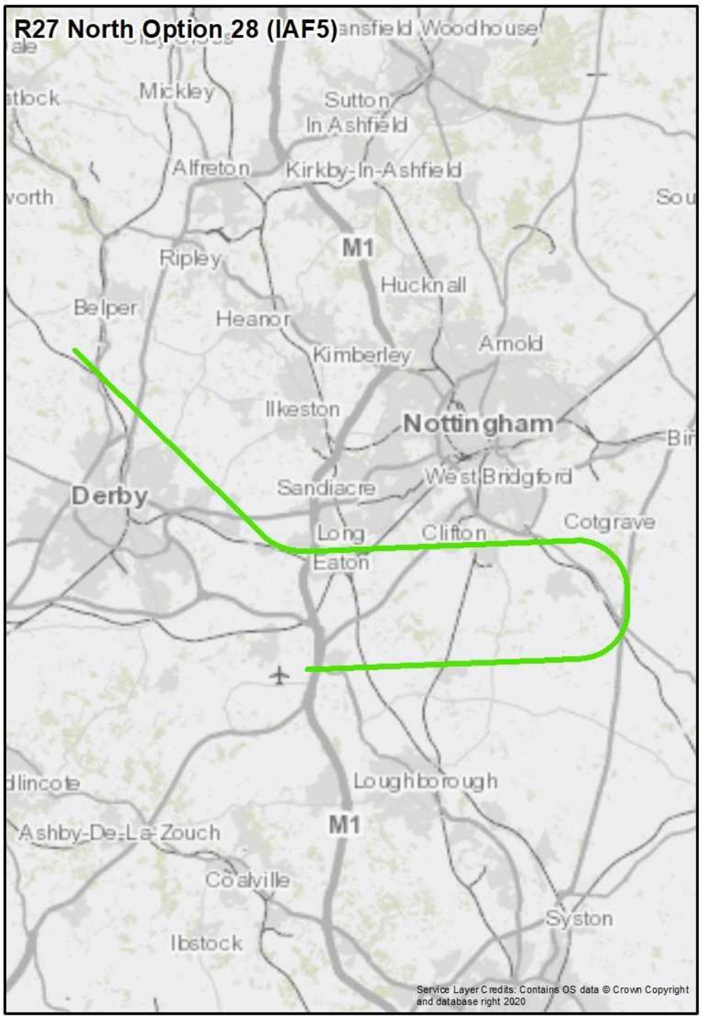
The descent gradient to the FAF is 1.89° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.

Reason for inclusion

Noise N1: Can provide respite when combined with other options from IAF5.

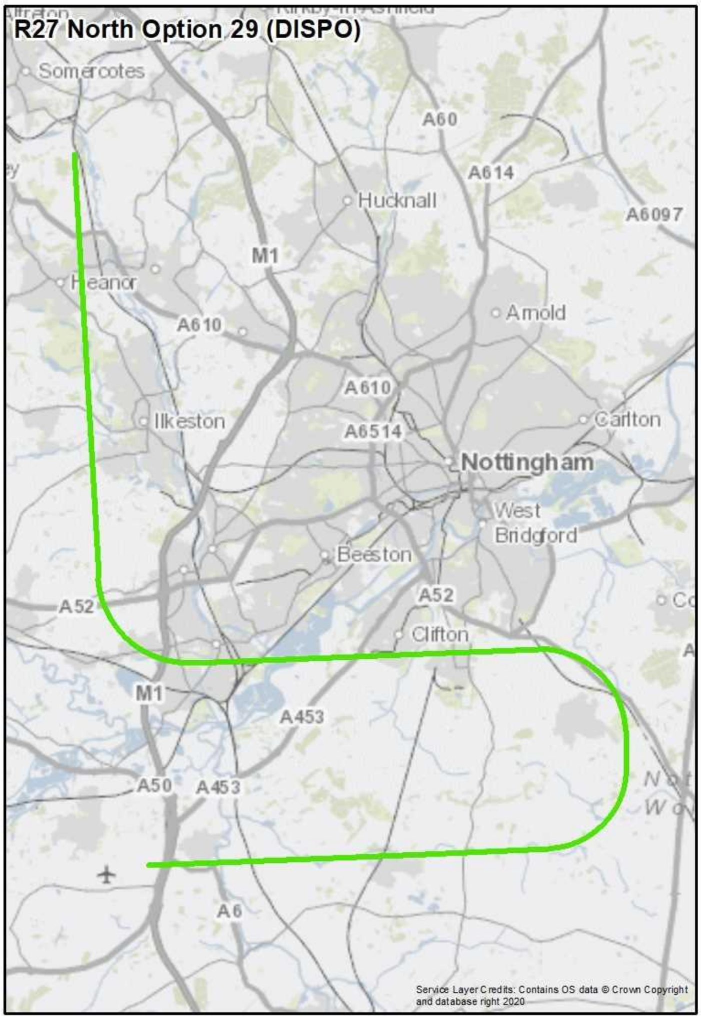
Noise N3: Aims to reduce the impact of noise by routing north of Derby, and west and south of Nottingham.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



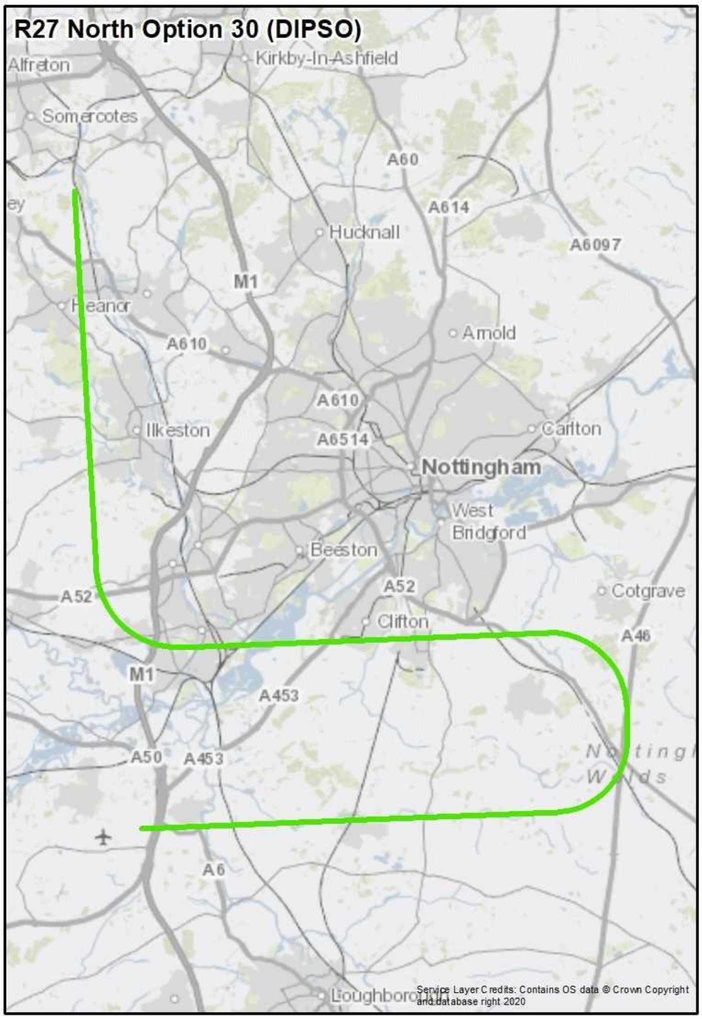
28.30. Runway 27 North, Option 29

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF DIPSO, east of Ripley and tracks south between Heanor and Eastwood and west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. To the south east of Nottingham the route turns south and routes east of Keyworth before turning left to join the extended runway centreline. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.1° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from DIPSO. Noise N3: Provides a CDA gradient close to the optimal for low noise purposes. Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



28.31. Runway 27 North, Option 30

Description	Reason for inclusion
The IAF for this option is DIPSO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF DIPSO, east of Ripley and tracks south between Heanor and Eastwood and west of Ilkeston and Nottingham. It then turns east to fly over Long Eaton and Clifton. It continues on this track until south west of Cotgrave to the south east of Nottingham where the route turns south and routes east of Keyworth briefly following the line of the A46, before turning left to join the extended runway centreline. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (5nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.9° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from DIPSO. Noise N3: Aims to reduce the impact of noise by routing west and south of Nottingham. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



29. Runway 27 – South

29.1. Runway 27 South, Options Summary Table

Viable and Good Fit		Viable but Poor Fit		Unviable	
1	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.77° The route style is 'direct'	A17	IAF **SYSTO** Originally Option 17 from an IAF located in the vicinity of Syston to the north of Leicester. A direct route north to an IF at 3.85nm. Option fails to align to: • Programme	U	Unviable options for this envelope are those that would not comply with PANS-OPS 8168 design criteria or did not have a supporting safety justification for non-compliance. These cover options that may be non-compliant with PANS-OPS in relation to: • MSD and the turn onto final approach. • Descent gradients above the PANS-OPS maximum. • Turn radius based on speed, altitude, and descent gradient. These options have not been designed and are not described further within this comprehensive list of design options.
2	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 2.77° The route style is 'direct'	B18	IAF **SYSTO** Originally Option 18 from an IAF located in the vicinity of Syston to the north of Leicester. A direct route north to an IF at 3.85nm. Option fails to align to: • Programme		

3	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.86° The route style is 'indirect'				
4	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.53° The route style is 'indirect'				
5	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.78° The route style is 'indirect'				
6	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 2.29° The route style is 'indirect'				
7	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.78° The route style is 'direct'				
8	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 2.33° The route style is 'direct'				

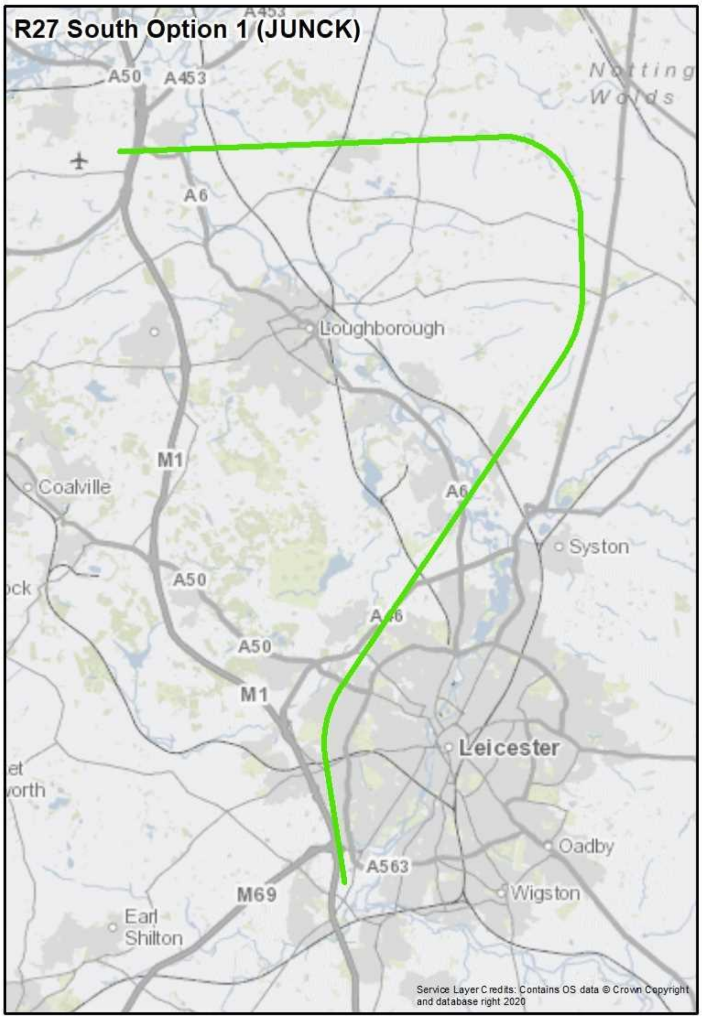
9	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.25° The route style is 'indirect'				
10	IAF = **JUNCK**, southwest of Leicester The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.83° The route style is 'indirect'				
11	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.25° The route style is 'indirect'				
12	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.84° The route style is 'indirect'				
13	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.72° The route style is 'indirect'				
14	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.57° The route style is 'indirect'				

15	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.32° The route style is 'direct'				
16	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.91° The route style is 'direct'				
19	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 1.68° The route style is 'indirect'				
20	IAF = **STAPL** at Stapleton north of Hinkley The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.51° The route style is 'indirect'				
21	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 2.13° The route style is 'direct'				

22	IAF = **EYEHO**, south east of Hinkley The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 1.79° The route style is 'direct'				
23	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 3.85nm CDA descent gradient = 3.22° The route style is 'direct'				
24	IAF = **LEICE**, near the King Power Stadium The length of the Intermediate Segment (IF to FAF) is 6.3nm CDA descent gradient = 2.61° The route style is 'direct'				

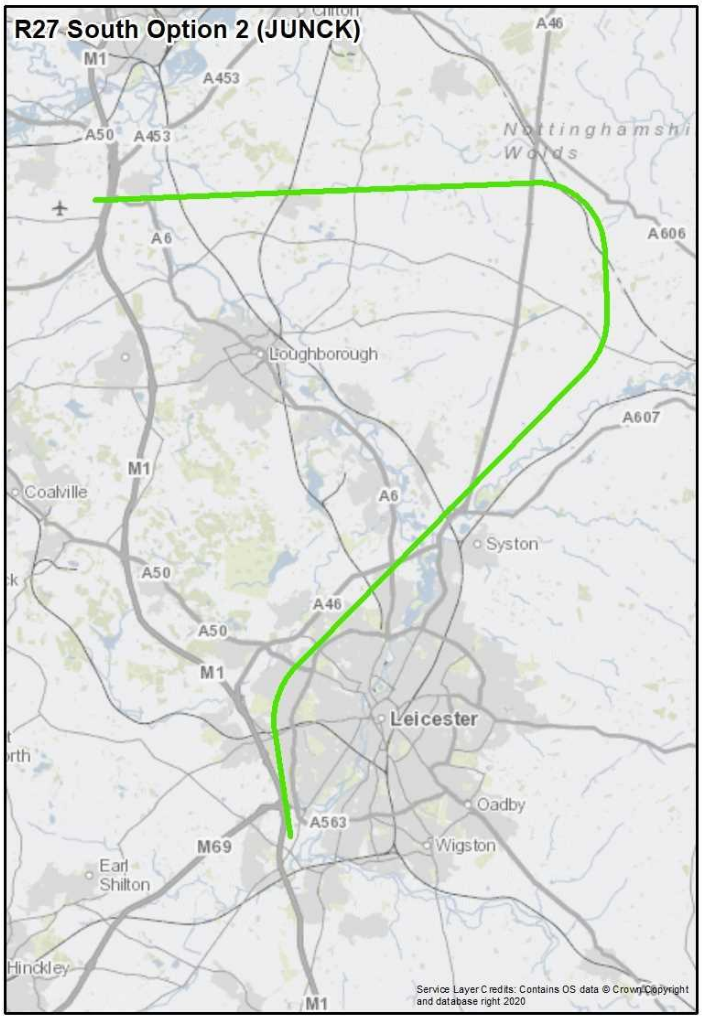
29.2. Runway 27 South, Option 1

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. The option starts at IAF JUNCK, southwest of Leicester and initially tracks north following the M1 motorway over west Leicester before turning right to head north east over north west Leicester, Rothley and Sileby. It turns left to head north and parallel the A46 just north of Seagrave to the east of Loughborough, before turning left to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.77° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from JUNCK. **Noise N2**: Both the IAF and initial route are close to the M1 & M69, an area of higher ambient noise. **Noise N3:** Close to an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



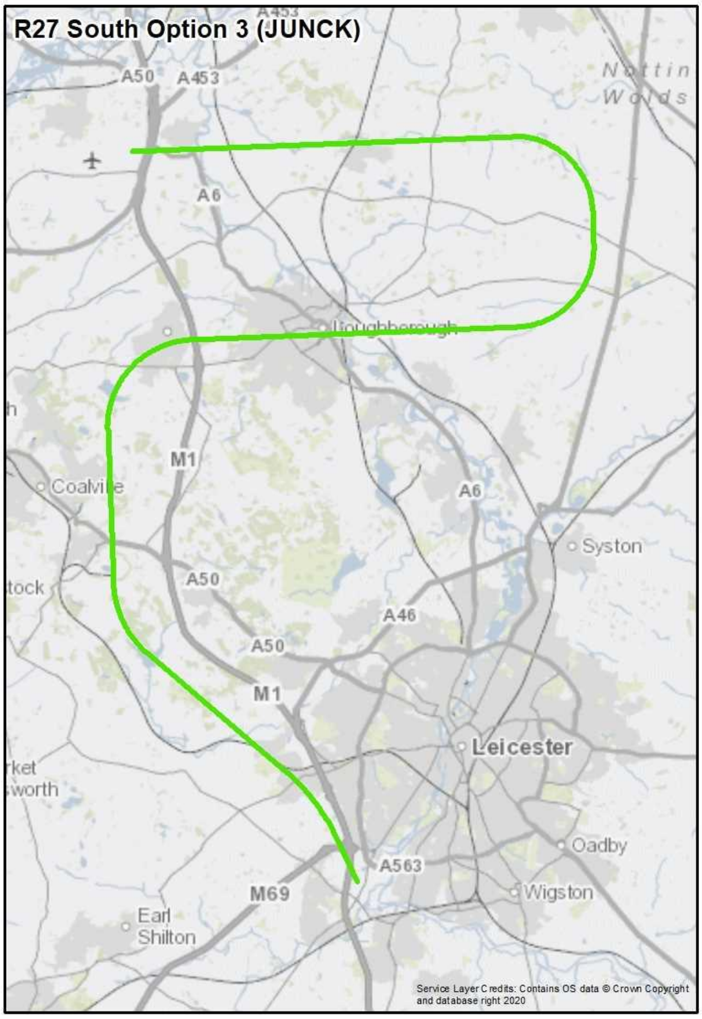
29.3. Runway 27 South, Option 2

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows a similar route to Option 1 but routes further east before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester and initially tracks north following the M1 motorway over west Leicester before turning right to head north east over north west Leicester, and north west of Syston. To the west of Melton Mowbray the route turns north before turning left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.23° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions **Noise N1**: Can provide respite when combined with other options from JUNCK. **Noise N2**: Both the IAF and initial route are close to the M1 & M69, an area of higher ambient noise. **Noise N3:** Close to an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



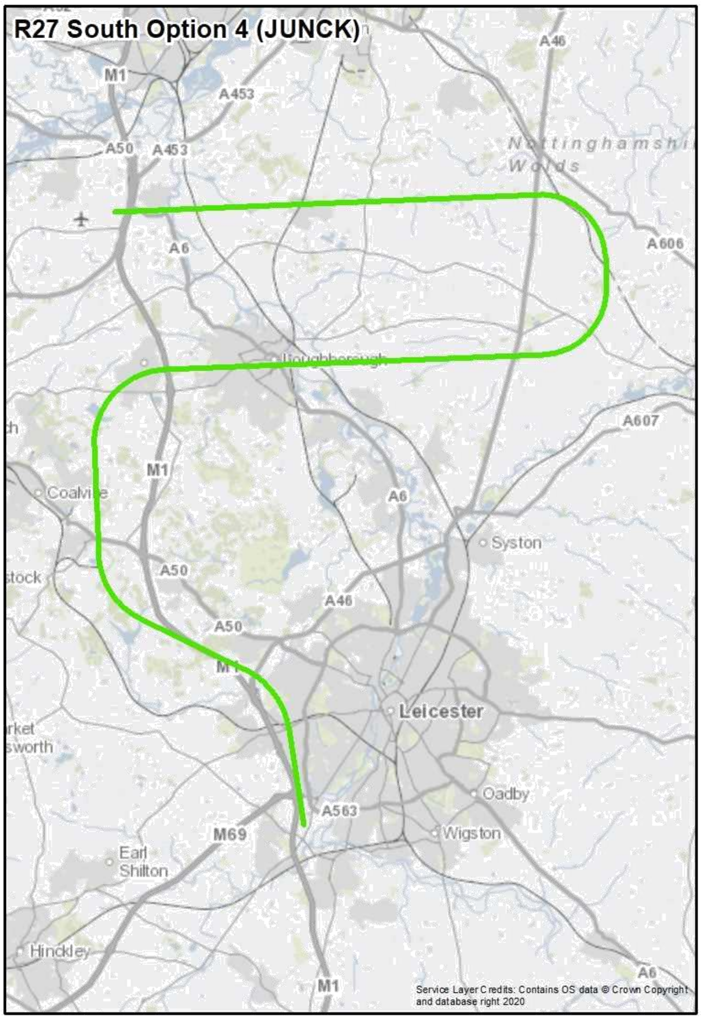
29.4. Runway 27 South, Option 3

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF JUNCK, southwest of Leicester and initially follows the line of the M1 before turning north to pass the eastern edge of Coalville. To the south west of Shepshed the route turns east passing over Shepshed and central Loughborough and it continues on this track until just north of Seagrave to the east of Loughborough, where it turns left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.86° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: The initial route follows the line of the M1, and the route also overflies central Loughborough, all areas of higher ambient noise. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



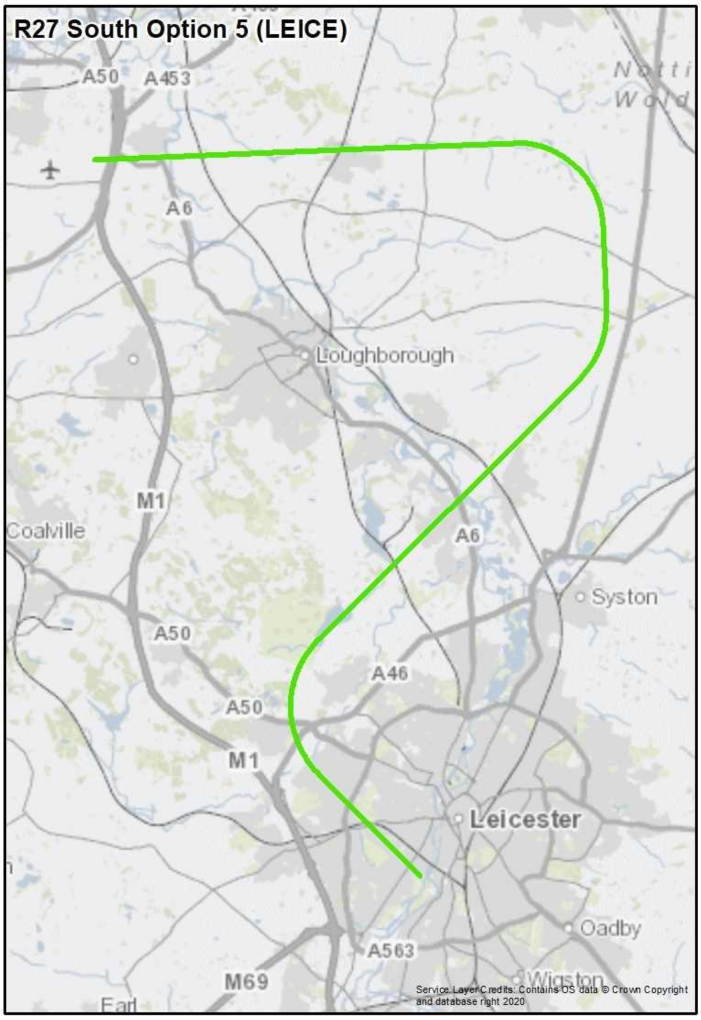
29.5. Runway 27 South, Option 4

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows a similar profile to Option 3 but routes further east before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester and initially follows the line of the M1 over Leicester Forest East services before turning north to pass the eastern edge of Coalville. To the south west of Shepshed the route turns east passing over Shepshed and central Loughborough and it continues on this track until west of Melton Mowbray where it turns left and then left again to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.53° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from JUNCK. **Noise N2**: The initial route follows the line of the M1, and the route also overflies central Loughborough, all areas of higher ambient noise. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



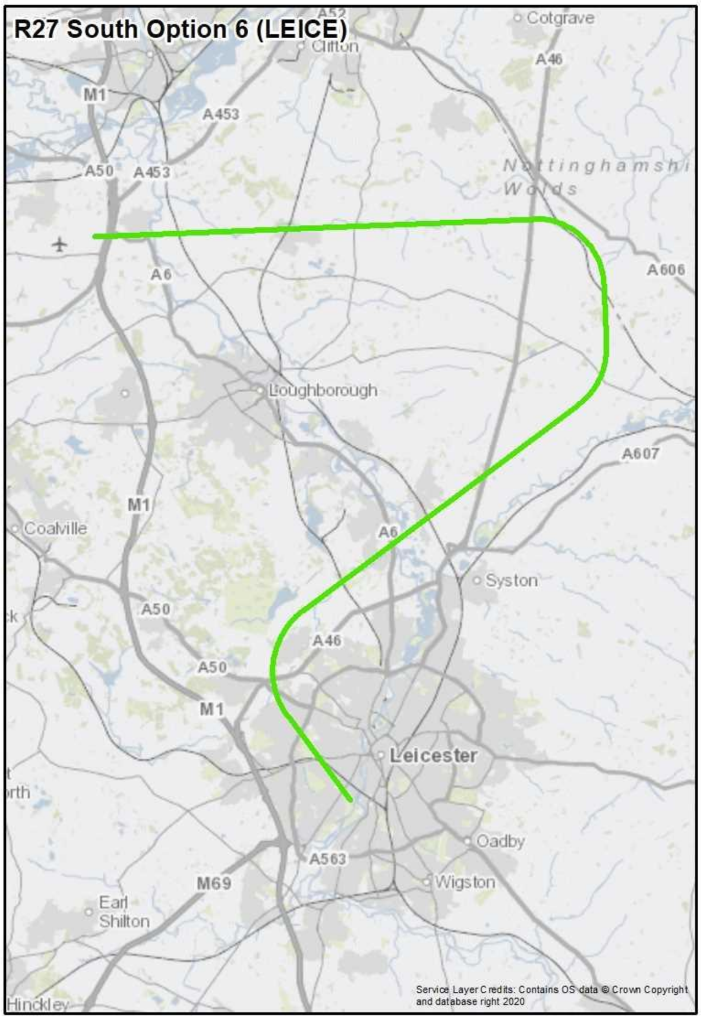
29.6. Runway 27 South, Option 5

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. This option starts at IAF LEICE, near the King Power Stadium from where it initially tracks north west to pass just east of Groby where it turns to a north east heading passing over Mountsorrel. It continues on this track until just north of Seagrave to the east of Loughborough, where it turns left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.78° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from LEICE. **Noise N2**: The IAF is positioned close to railway lines and the major urban centre, an area of higher ambient noise. **Noise N3:** Close to an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



29.7. Runway 27 South, Option 6

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows a similar profile to Option 5 but routes further east before joining the final approach. This option starts at IAF LEICE, near the King Power Stadium and initially tracks north west to pass over Anstey where it turns right to a north east heading and follows a line just north of the Leicester western bypass. It continues on this heading, passing between Syston and Mountsorrel and to the west of Melton Mowbray the route turns north before turning left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.29° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from LEICE. Noise N2: The IAF is positioned close railway lines and major urban centre, an area of higher ambient noise. The route also follows the line of the Leicester western bypass. Noise N3: Optimal low noise CDA gradient. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



29.8. Runway 27 South, Option 7

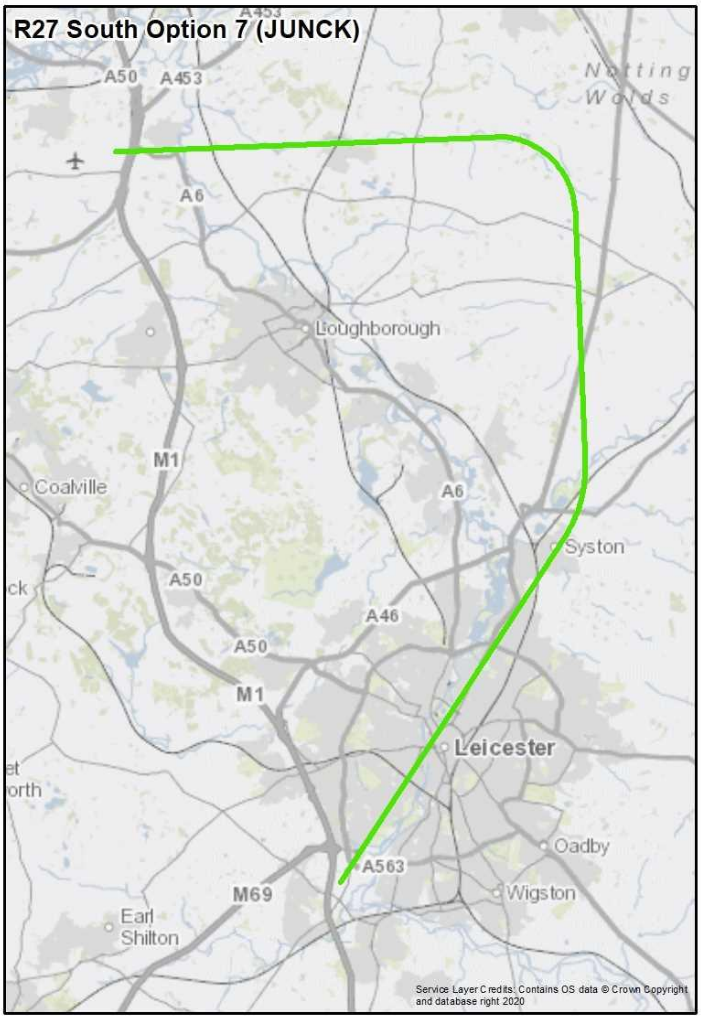
Description

The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised.

The option starts at IAF JUNCK, southwest of Leicester and initially tracks north east over central Leicester and Syston. Just north of Syston the route turns north and continues on this heading over the A46 before turning left to join the extended runway centreline north east of the Wymeswold solar farm.

This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 2.78° which is close to the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Emissions: The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions.

Noise N1: Can provide respite when combined with other options from JUNCK.

Noise N2: The IAF is positioned close to the M1 & M69 junction, an area of higher ambient noise.

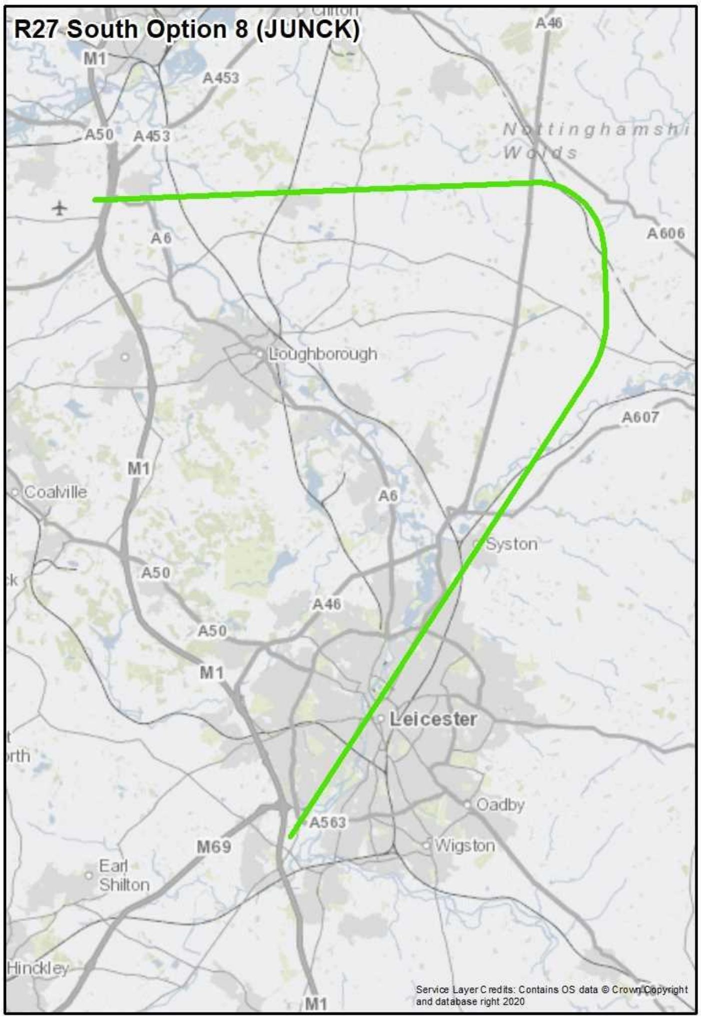
The route also overflies central Leicester.

Noise N3: Close to an optimal low noise CDA gradient.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

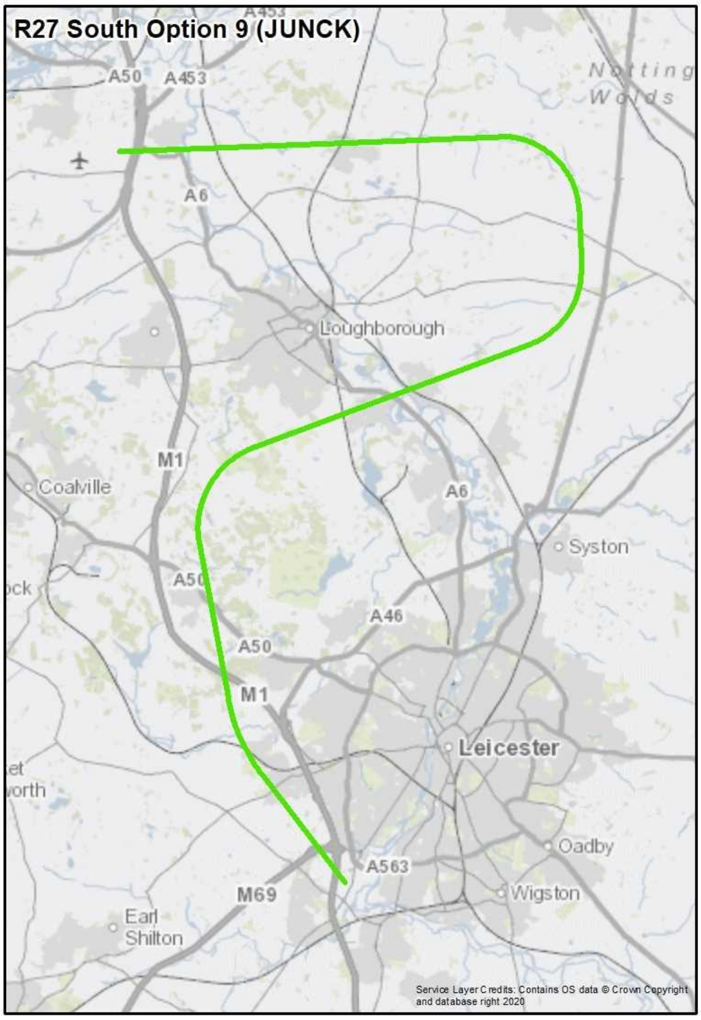
29.9. Runway 27 South, Option 8

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows the same route as Option 7 but routes further east before joining the final approach. The option starts at IAF JUNCK, southwest of Leicester and initially tracks north east over central Leicester and Syston. It continues on this heading until a point to the west of Melton Mowbray where the route turns north before turning left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.33° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from JUNCK. **Noise N2**: The IAF is positioned close to the M1 & M69 junction, an area of higher ambient noise. The route also overflies central Leicester. **Noise N3:** Provides an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



29.10. Runway 27 South, Option 9

Description	Reason for inclusion
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF JUNCK, southwest of Leicester and follows the line of the M1 north, turning slightly right to the west of Ratby to remain east of Coalville. To the north east of the M1 Junction 22 the route turns north east, passing south of Loughborough and over Barrow upon Soar and continues on this track until just north of Seagrave to the east of Loughborough. Here it turns left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.25° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from JUNCK. Noise N2: The IAF is positioned close to the M1 & M69 junction, an area of higher ambient noise. Initially follows the line of the M1 motorway until east of Coalville. Noise N3: Close to an optimal low noise CDA gradient. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



29.11. Runway 27 South, Option 10

Description

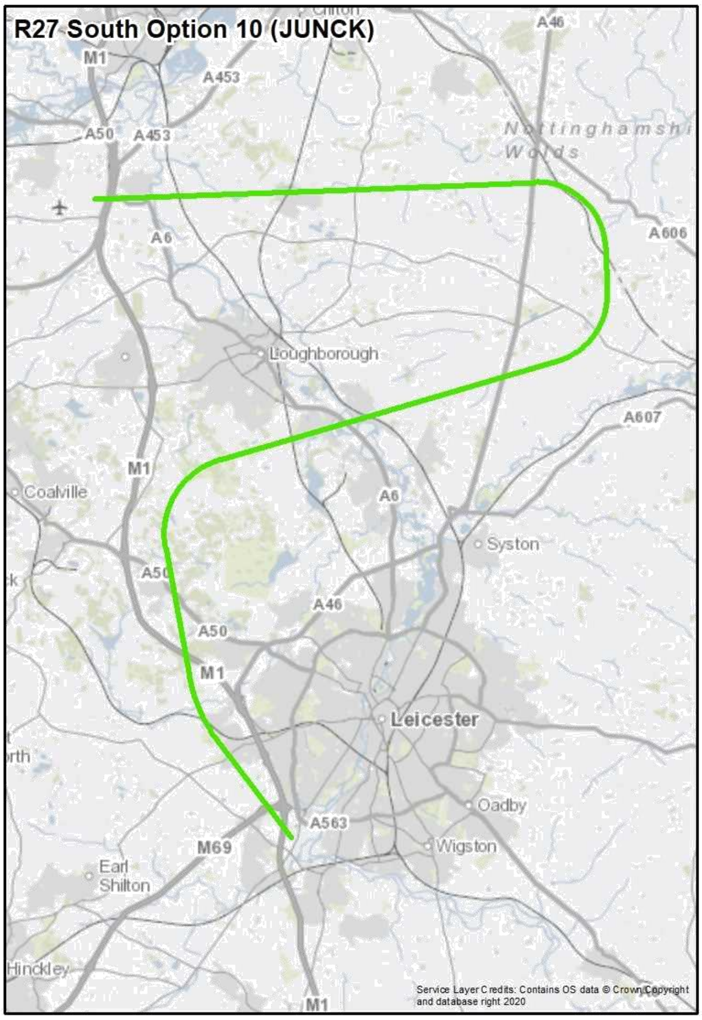
The IAF for this option is JUNCK and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 9 initially but routes further east before joining the final approach.

The option starts at IAF JUNCK, southwest of Leicester and follows the line of the M1 north, turning slightly right to the west of Ratby to remain east of Coalville. To the north east of the M1 Junction 22 the route turns north east, passing south of Loughborough and over Barrow upon Soar. It continues on this heading until a point to the west of Melton Mowbray where the route turns north before turning left to join the extended runway centreline close to Upper Broughton.

This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace.

The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches.

The descent gradient to the FAF is 1.83° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.



Reason for inclusion

Noise N1: Can provide respite when combined with other options from JUNCK.

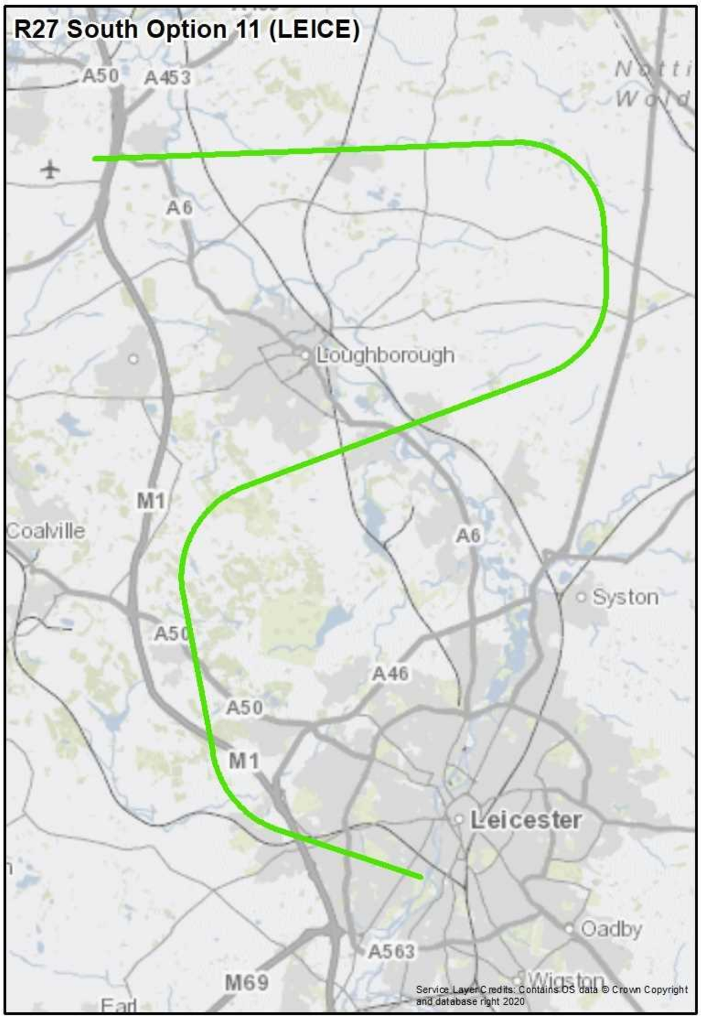
Noise N2: The IAF is positioned close to the M1 & M69 junction, an area of higher ambient noise.

Initially follows the line of the M1 motorway until east of Coalville.

Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.

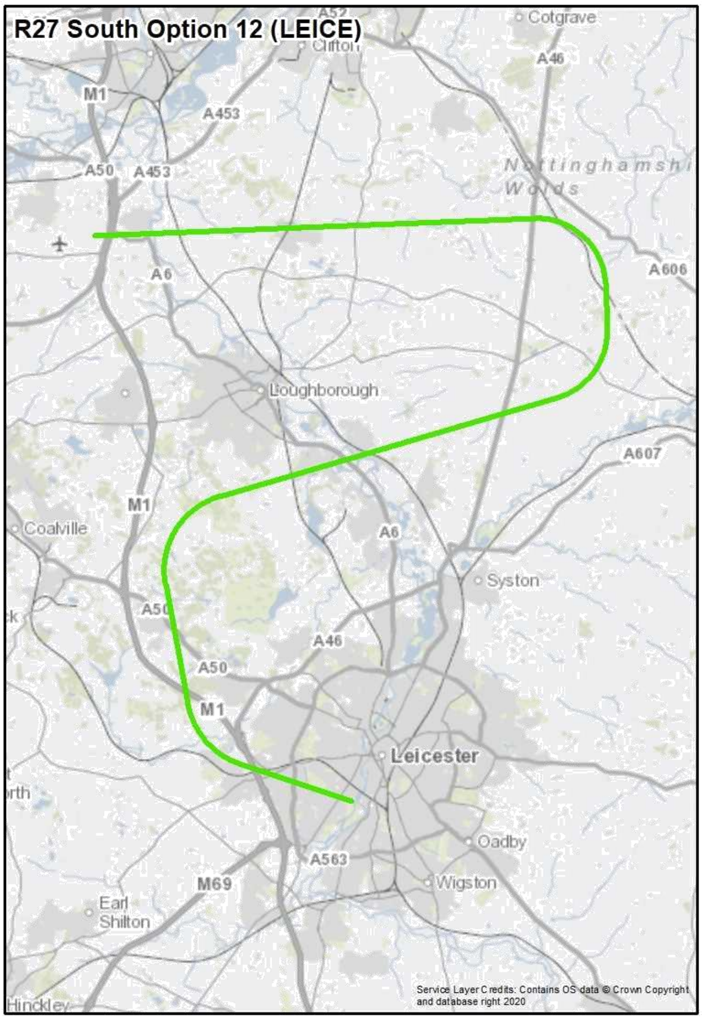
29.12. Runway 27 South, Option 11

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF LEICE, near the King Power Stadium and initially heads north west before turning slightly right to head north to remain east of Coalville. To the north east of the M1 Junction 22 the route turns north east, passing south of Loughborough and over Barrow upon Soar and continues on this track until just north of Seagrave to the east of Loughborough. Here it turns left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.25° which is close to the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from LEICE. Noise N2: The IAF is positioned close railway lines and major urban centre, an area of higher ambient noise. Initially follows the line of the M1 motorway until east of Coalville. Noise N3: Close to an optimal low noise CDA gradient. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



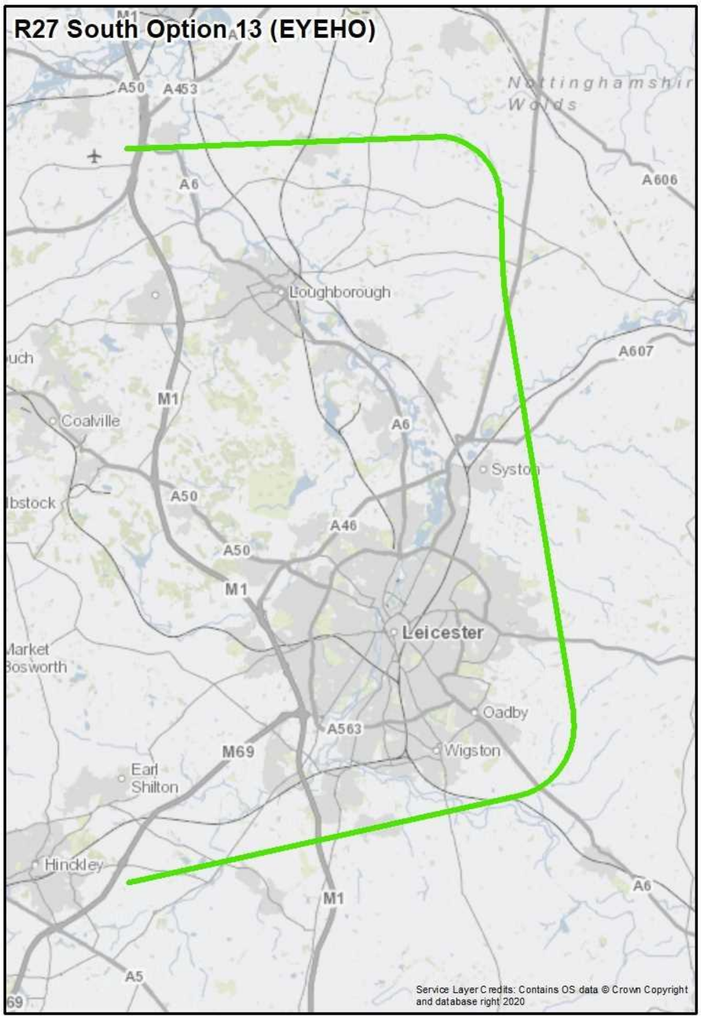
29.13. Runway 27 South, Option 12

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 11 initially but routes further east before joining the final approach. The option starts at IAF LEICE, near the King Power Stadium and initially heads north west before turning slightly right to head north to remain east of Coalville. To the north east of the M1 Junction 22 the route turns north east, passing south of Loughborough and over Barrow upon Soar. It continues on this heading until a point to the west of Melton Mowbray where the route turns north before turning left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.84° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from LEICE. Noise N2: IAF positioned close railway lines and major urban centre, an area of higher ambient noise. Initially follows the line of the M1 motorway until east of Coalville. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



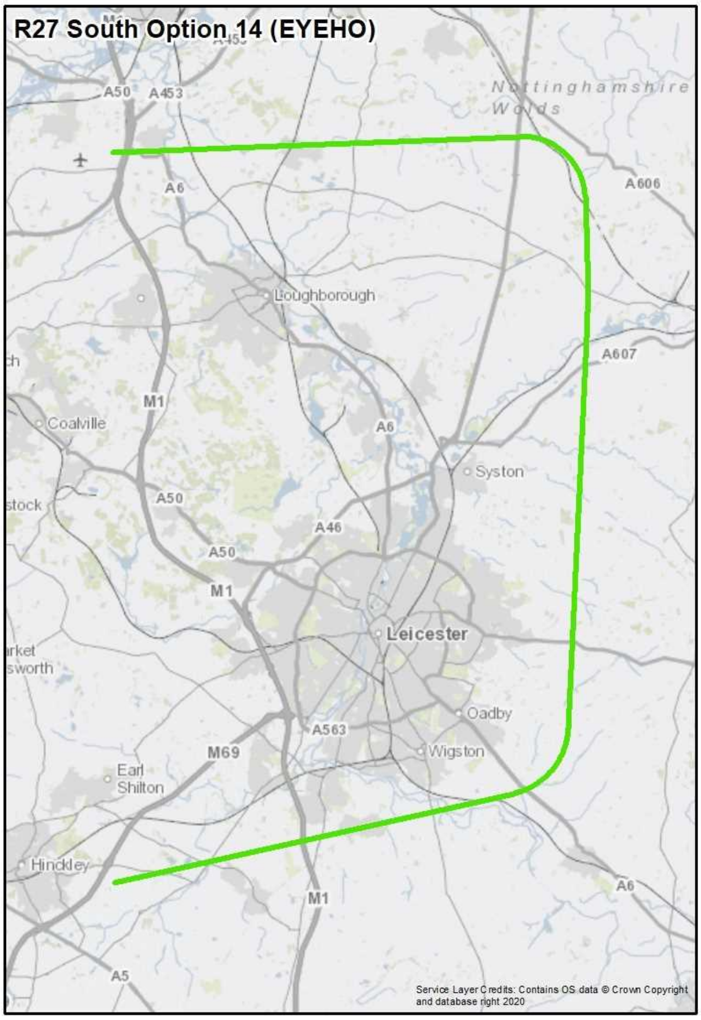
29.14. Runway 27 South, Option 13

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. This option starts at IAF EYEHO, south east of Hinkley from where it routes east to remain south of Leicester. At a point south of Leicester Airport it turns left to head north to by-pass Leicester and Syston to the east. It continues on this heading over the A46 before turning left to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.72° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from EYEHO. **Noise N3:** Aims to reduce the impact of noise by routing south and east of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



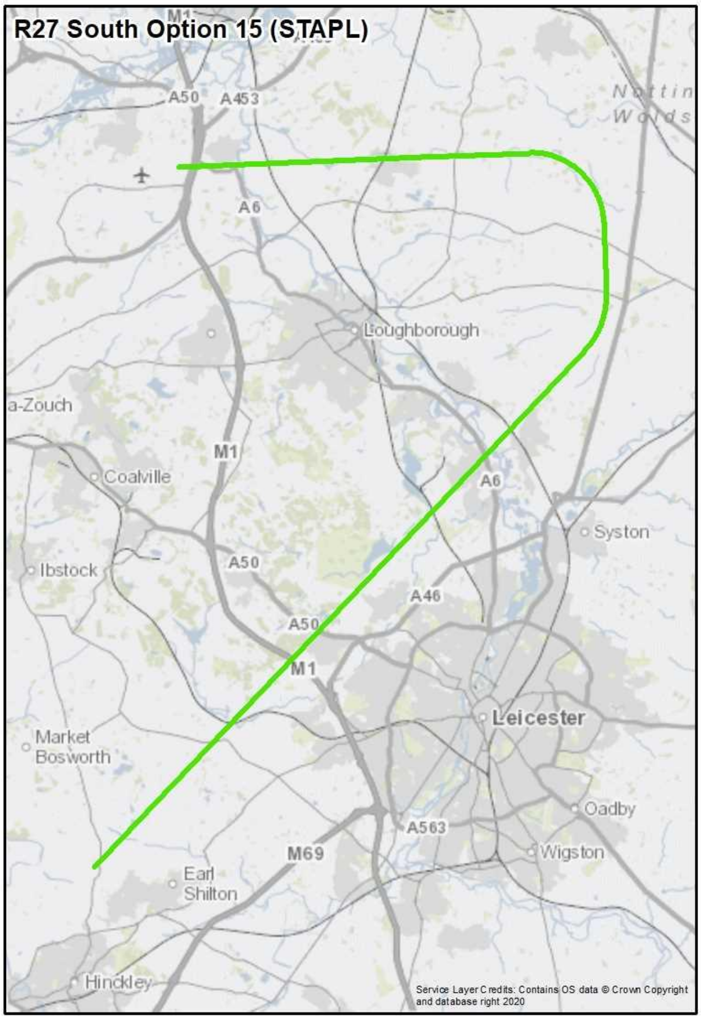
29.15. Runway 27 South, Option 14

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 13 initially but routes further east after the turn north at Leicester Airport. This option starts at IAF EYEHO, south east of Hinkley from where it routes east to remain south of Leicester. At a point south of Leicester Airport it turns left to head north to by-pass Leicester and Syston to the east and passing close to Gaddesby and Hoby before turning left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.57° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Noise N1**: Can provide respite when combined with other options from EYEHO. **Noise N3:** Aims to reduce the impact of noise by routing south and east of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



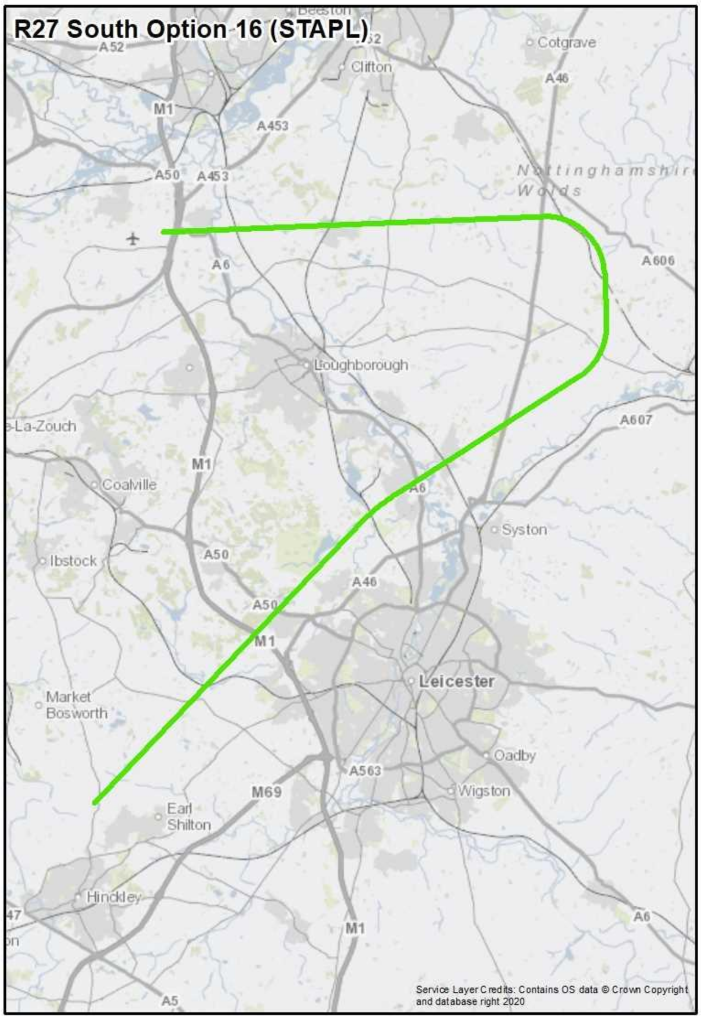
29.16. Runway 27 South, Option 15

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF STAPL at Stapleton north of Hinkley from where the route tracks north east passing over the M1 at Groby and remaining north of Leicester and south of Loughborough. It continues on this track until just north of Seagrave to the east of Loughborough where it turns left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.32° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from STAPL. **Noise N3:** Aims to reduce the impact of noise by routing north of Leicester and south of Loughborough. Provides an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



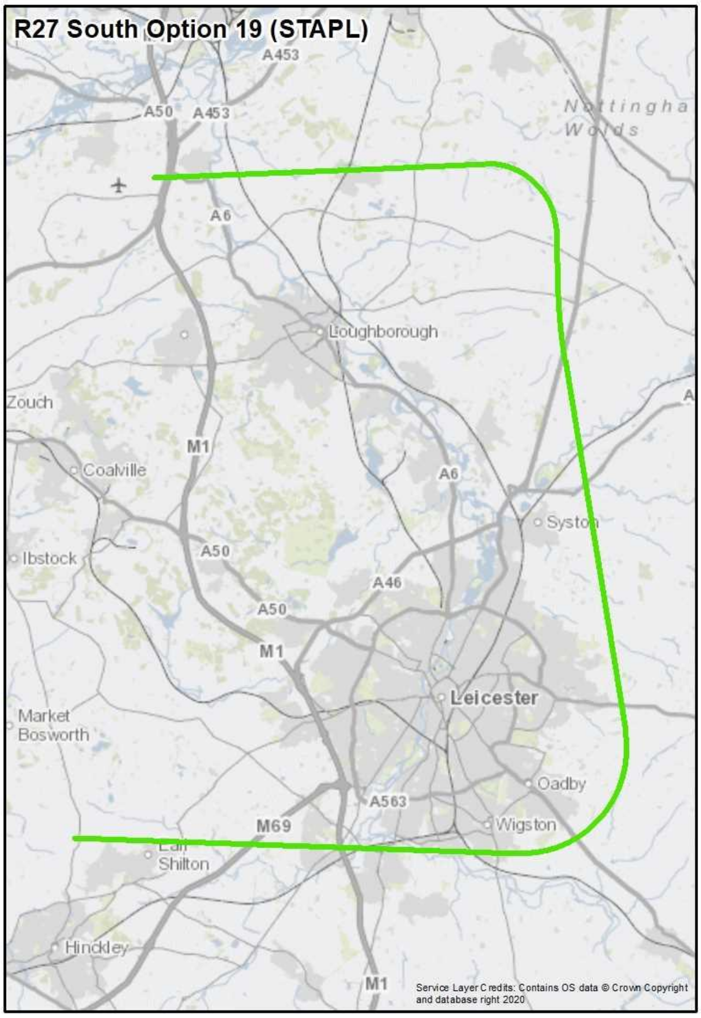
29.17. Runway 27 South, Option 16

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows the same route as Option 15 initially but routes further east after Mountsorrel before joining the final approach. The option starts at IAF STAPL at Stapleton north of Hinkley from where the route tracks north east passing over the M1 at Groby and remaining north of Leicester and south of Loughborough. It continues on this heading until Mountsorrel where it makes a slight right turn and heads to a point to the west of Melton Mowbray where the route turns north. It turns left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.91° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from STAPL. **Noise N3:** Aims to reduce the impact of noise by routing north of Leicester and south of Loughborough. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



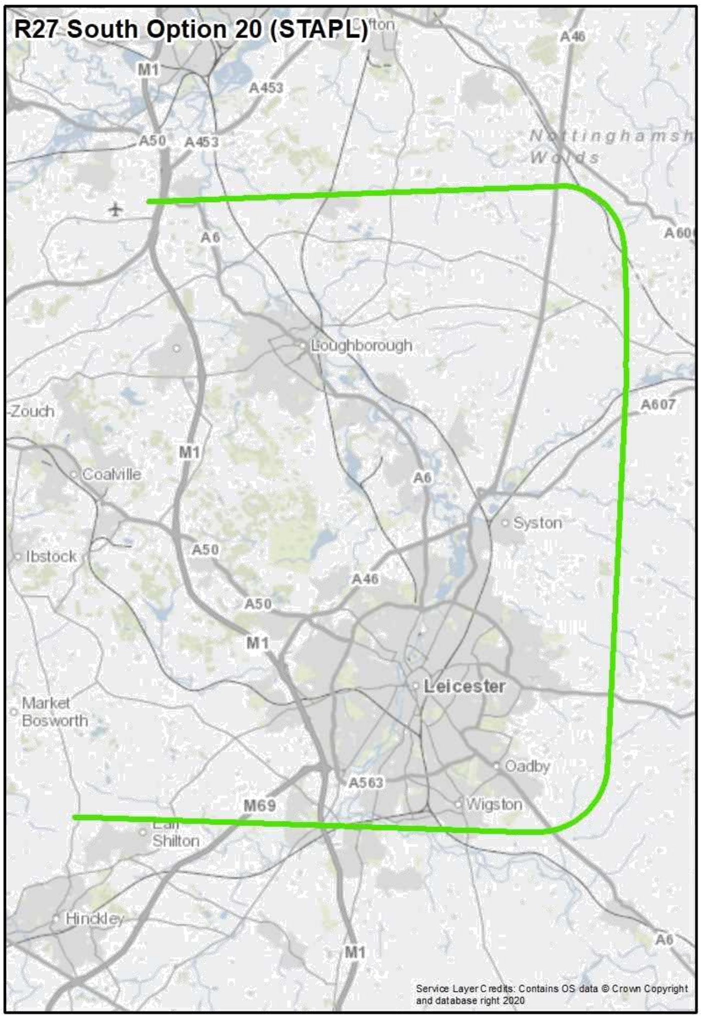
29.18. Runway 27 South, Option 19

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. The option starts at IAF STAPL at Stapleton north of Hinkley from where it routes east to pass over the southern edge of Leicester. At a point south of Leicester Airport it turns left to head north to by-pass Leicester and Syston to the east. It continues on this heading over the A46 before turning left to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.68° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from STAPL. Noise N3: Aims to reduce the impact of noise by routing south and east of central Leicester. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



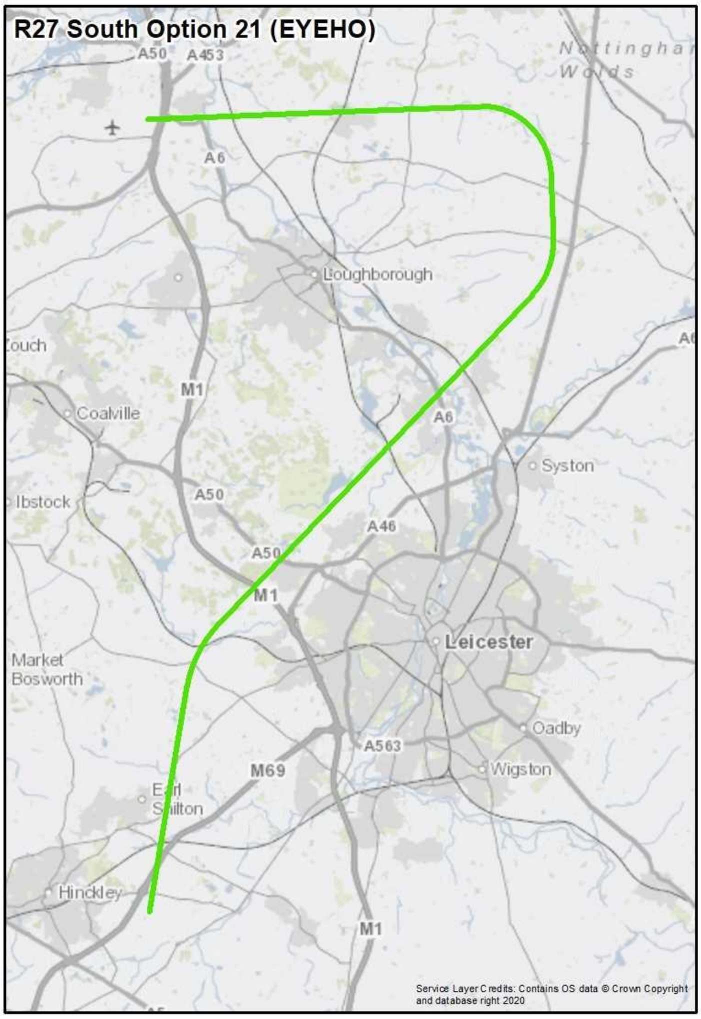
29.19. Runway 27 South, Option 20

Description	Reason for inclusion
The IAF for this option is STAPL and the style of the route is 'indirect' which means the distance to the final approach has not been minimised but has been designed to provide an alternative respite option to a 'direct' route. It follows the same route as Option 19 initially but routes further east after the turn north at Leicester Airport. The option starts at IAF STAPL at Stapleton north of Hinkley from where it routes east to pass over the southern edge of Leicester. At a point south of Leicester Airport it turns left to head north to by-pass Leicester and Syston to the east and passing close to Gaddesby and Hoby before turning left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.51° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	Noise N1: Can provide respite when combined with other options from STAPL. Noise N3: Aims to reduce the impact of noise by routing south and east of central Leicester. Technology: RNAV is the lowest PBN specification and therefore usable by all aircraft.



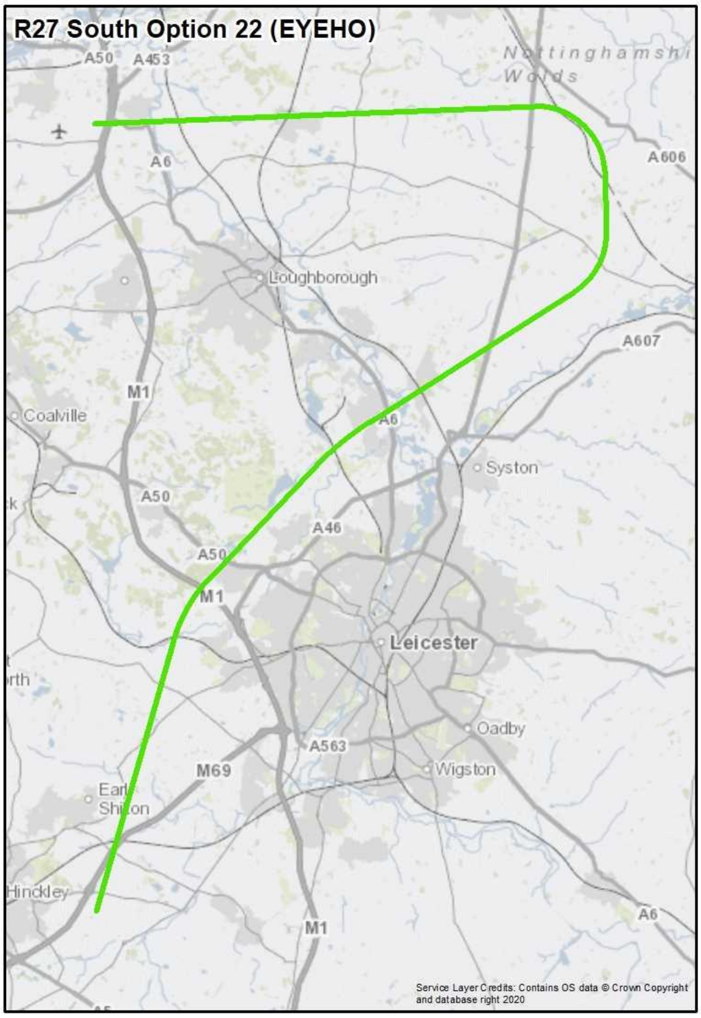
29.20. Runway 27 South, Option 21

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF EYEHO, south east of Hinkley from where it heads north initially until Desford where the route turns right to head north east passing over the M1 at Groby and remaining north of Leicester and south of Loughborough. It continues on this track until just north of Seagrave to the east of Loughborough where it turns left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.13° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from EYEHO. **Noise N3:** Aims to reduce the impact of noise by routing north of Leicester and south of Loughborough. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



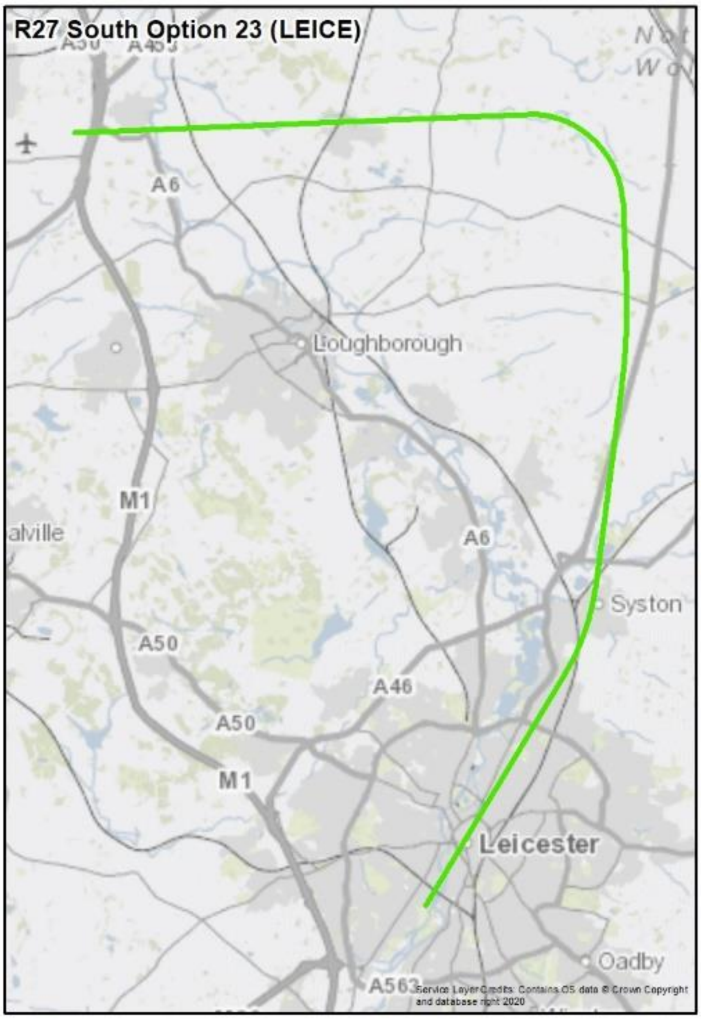
29.21. Runway 27 South, Option 22

Description	Reason for inclusion
The IAF for this option is EYEHO and the style of the route is 'direct' which means the distance to the final approach has been minimised. It follows the same route as Option 21 initially but routes further east before joining the final approach. This option starts at IAF EYEHO, south east of Hinkley from where it heads north initially until east of Desford where the route turns right to head north east passing over the M1 at Groby and remaining north of Leicester and south of Loughborough. It continues on this heading until Mountsorrel where it makes a slight right turn and heads to a point to the west of Melton Mowbray where the route turns north. It turns left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 1.79° which is below the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1:** Can provide respite when combined with other options from EYEHO. **Noise N3:** Aims to reduce the impact of noise by routing north of Leicester and south of Loughborough. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



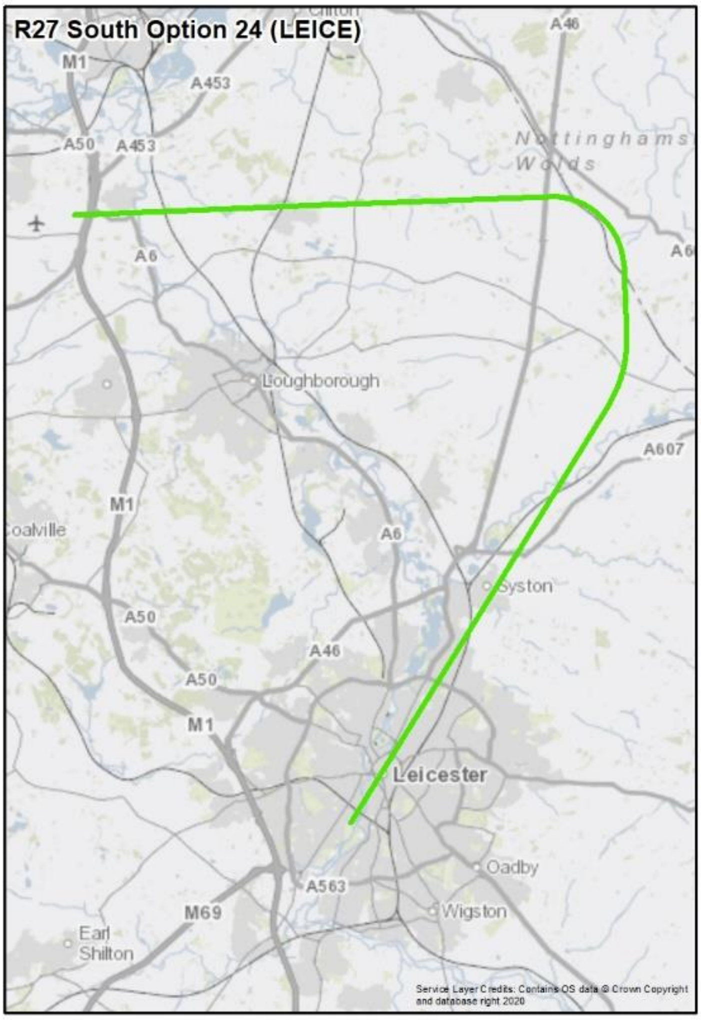
29.22. Runway 27 South, Option 23

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF LEICE, near the King Power Stadium from where the route heads north east over central Leicester. At Syston the route turns slightly left to head north and continues on this track until just north of Seagrave to the east of Loughborough where it turns slightly left and then left again to join the extended runway centreline north east of the Wymeswold solar farm. This RNAV 1 route connects the IAF to the IF which is placed as close as possible to the FAF (3.85nm) when PANS-OPS criteria and MSD for a 90° turn is taken into consideration. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 3.22° which is above the optimum range for low noise approaches but is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from LEICE. **Noise N2**: The IAF is positioned close railway lines and major urban centre, an area of higher ambient noise. The route also overflies the central area of Leicester. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



29.23. Runway 27 South, Option 24

Description	Reason for inclusion
The IAF for this option is LEICE and the style of the route is 'direct' which means the distance to the final approach has been minimised. This option starts at IAF LEICE, near the King Power Stadium from where the route heads north east over central Leicester. It continues on this track until a point to the west of Melton Mowbray where the route turns north. It turns left to join the extended runway centreline close to Upper Broughton. This RNAV 1 arrival connects the IAF to the IF which is placed as far as possible from the FAF (6.3nm) whilst keeping the route within existing controlled airspace. The FAF is at 2,000ft, which is the platform altitude for the existing FAF for runway 27 approaches. The descent gradient to the FAF is 2.61° which is within the optimum range for low noise approaches and is within the acceptable range for CDAs defined within ICAO guidance.	**Emissions:** The direct routing and track miles from 7,000ft to the FAF is intended to minimise fuel burn and emissions. **Noise N1**: Can provide respite when combined with other options from LEICE. **Noise N2**: The IAF is positioned close railway lines and major urban centre, an area of higher ambient noise. The route also overflies the central area of Leicester. **Noise N3:** Provides an optimal low noise CDA gradient. **Technology:** RNAV is the lowest PBN specification and therefore usable by all aircraft.



29.24. Runway 27 Transition South: Viable but Poor Fit Options

Option	Safety	Programme	Continuity
A17	S	P	C
Description: This is a route that commences at an IAF located in the vicinity of Syston to the north of Leicester. From Syston the route heads north to join the extended runway centreline north east of the Wymeswold solar farm. It was originally created in the comprehensive list of Arrivals as Option 17 but was changed to Viable Poor Fit following analysis on descent gradients. <u>Programme</u>: This option fails to align with the environmental ends of the AMS. *Noise*: The IAF is located on the boundary of the area within which a CDA could be achieved to both runway ends. Further investigation showed that the IAF is too close to the FAF for runway 27 and created a CDA gradient of 5.02°. This is significantly above the optimum range for low noise approaches and above the ideal range for CDAs defined within ICAO guidance. A CDA is lower in noise impact than a non-CDA, hence this option would not align with the ANG to minimise noise impacts below 7,000ft.			
B18	S	P	C
Description: This is a route that commences at an IAF located in the vicinity of Syston to the north of Leicester. From Syston the route heads north east to join the extended runway centreline close to Upper Broughton. It was originally created in the comprehensive list of Arrivals as Option 18 but was changed to Viable Poor Fit following analysis on descent gradients. <u>Programme</u>: This option fails to align with the environmental ends of the AMS. Noise: The IAF is located at the boundary of the area within which a CDA could be achieved to both runway ends. Further investigation showed that the IAF is too close to the FAF for runway 27 and created a CDA gradient of 3.7°. This is significantly above the optimum range for low noise approaches and above the ideal range for CDAs defined within ICAO guidance. A CDA is lower in noise impact than a non-CDA, hence this option would not align with the ANG to minimise noise impacts below 7,000ft.			

30. Glossary

ACOG	Airspace Change Organisation Group formed in 2019 as a fully independent organisation within NATS under the direction of the UK Government Department for Transport and Civil Aviation Authority, who are the co-sponsors of the AMS.
ACP	Airspace Change Proposal.
ADWR	Airspace Development Workshop Record - the output from bilateral discussions with NERL to record and inform their comprehensive list of options for the network that interfaces with EMA traffic.
Agl	Above ground level.
AIAA	Area of Intense Aerial Activity – Airspace within which aircraft, singly or in combination with others, regularly participate in unusual manoeuvres, not constrained by a formal route network.
AIP	The UK Aeronautical Information Publication - a document published by the UK CAA which contains information essential to air navigation. (www.aurora.nats.co.uk/htmlAIP/Publications/2022-07-14-AIRAC/html/index-en-GB.html).
Altitude Based Priorities	The ANG sets out a framework of 'Altitude Based Priorities', to be taken into account when considering the potential environmental impact of airspace changes.
AMS	Airspace Modernisation Strategy (CAP1711) - this is the Government's strategy and plan for the use of UK airspace, including the modernisation of airspace (www.caa.co.uk/cap1711). The original AMS was published in December 2018 and a refreshed version in January 2023. All references to the AMS are to this January 2023 version.
AMSL	Above mean sea level.
ANCON	The UK civil Aircraft Noise Contour Model. A computer model developed and maintained by the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority which calculates contours of aircraft noise exposure levels around airports.
ANG	Air Navigation Guidance 2017 - Guidance to the CAA (from DfT) on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management. (www.gov.uk/government/publications/uk-air-navigation-guidance-2017).
ANSP	Air Navigation Service Provider - an organisation which operates the technical system, infrastructure, procedures, and rules of an air navigation service system, which includes air traffic control.
AONB	Area of Outstanding Natural Beauty - an area of countryside which has been designated for conservation because of its significant landscape value, recognising its national importance.
AQMA	Air Quality Management Area - designated by a local authority and subject to a Local Air Quality Management Plan.
ATC	Air Traffic Control - service from an air navigation service provider providing guidance to aircraft through Controlled Airspace.
ATCC	Air Traffic Control Centre. There are two air traffic control centres in the UK both operated by NERL. The London ATCC deals with aircraft operating to the south of EMA and the Scottish ATCC deals with flights to the north of EMA.

ATCO	Air Traffic Control Officer – air traffic controllers who monitor the flow of aircraft into and out of the airport airspace by providing instructions and information to pilots, so that they fly safely and efficiently. ATCOs manage flights at both airports and within the en-route (upper) airspace network.
ATM	Air Transport Movement - an aircraft operation for commercial purposes, as opposed to a flight for recreational or personal reasons.
ATS	Air Traffic Services.
ATZ	Aerodrome Traffic Zone – An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic.
BKY	Abbreviation for the Barkway DVOR navigation beacon and routes that use that as a navigation point.
BHX	The three letter IATA code for Birmingham Airport.
Biodiversity	The variability among living things from all ecosystems (including terrestrial, marine, and aquatic amongst others) and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems.
CAA	Civil Aviation Authority - the aviation industry's regulator.
CAP	Civil Aviation Publication - a document published by the UK CAA which can provide information, guidance or policy depending on the subject covered. The list of all CAPs is published on the CAA website (www.caa.co.uk/our-work/publications).
CAP1385	The CAA's PBN enhanced route spacing guidance (www.caa.co.uk/cap1385).
CAP1498	The CAA's Definition of Overflight - this defines overflight as it relates to airspace regulation and provides an overflight metric which may be used to quantitatively compare different airspace options (www.caa.co.uk/cap1498).
CAP1616	The CAA's airspace change guidance document - it sets out the regulatory process which all airspace change proposals must follow (www.caa.co.uk/cap1616).
CAP1616a	A technical annex to CAP1616 - guidance on the regulatory process for changing airspace design including community engagement requirements. This annex outlines relevant methodologies for use in environmental assessments relating to airspace change (www.caa.co.uk/cap1616a).
CAP1711	Airspace Modernisation Strategy - this is the Government's strategy and plan for the use of UK airspace, including the modernisation of airspace (www.caa.co.uk/cap1711).
CAP1781	The CAA's DVOR/DME/NDB Rationalisation - guidance for the use of RNAV Substitution (www.caa.co.uk/cap1781).
CAP1926	General Requirements and Guidance Material for the use of RNAV Substitution (www.caa.co.uk/cap1926) and which supports airlines in the implementation of RNAV substitution under CAP1781
CAP1991	Procedure for the CAA to review the classification of airspace (www.caa.co.uk/cap1991).
CAP2091	CAA Policy on Minimum Standards for Noise Modelling -document defines categories of noise modelling sophistication and sets out requirements of the minimum category which different stakeholder or sponsor groups should use when providing noise calculations to the CAA. (www.caa.co.uk/cap2091).
CAP2156A	Airspace change Masterplan - CAA acceptance criteria: the criteria against which the CAA will make the decision whether to accept the airspace change Masterplan into the Airspace Modernisation Strategy (www.caa.co.uk/cap2156A).

CAP2302	A Low Noise Arrival CAP2302 - a report that makes recommendations to implement low noise arrivals (www.caa.co.uk/cap2303).
CAP493	Manual of Air Traffic Services - contains procedures, instructions and information which are intended to form the basis of air traffic services within the United Kingdom (www.caa.co.uk/cap493).
CAP725	The CAA's airspace change process guidance document that preceded CAP1616 (www.caa.co.uk/cap725).
CAP760	CAA's Guidance on the Conduct of Hazard Identification, Risk Assessment, and the Production of Safety Cases (www.caa.co.uk/cap760).
CAP778	The CAA's Policy and Guidance for the Design and Operation of Departure Procedures in UK Airspace (www.caa.co.uk/cap778).
CAA Controlled Airspace Containment Policy Statement	The CAA Controlled Airspace Containment Policy Statement (January 2014 superseded in August 2022) sets out the minimum criteria applicable to containment of instrument flight procedures for airports already within Controlled Airspace (CAS). Annex B provides the design criteria that have been applied to the arrival and departure routes in this ACP. (https://publicapps.caa.co.uk/docs/33/Policy%20for%20the%20Design%20of%20Controlled%20Airspace%20Structures%20110822.pdf).
CAS	Controlled Airspace is airspace within which air traffic services are provided. There are different classifications which define the air traffic control service provided and the requirements of aircraft flying within it. All commercial (passenger) flights fly within Controlled Airspace.
CATI & CATIIIB (approaches)	Categories of precision approach and landing (including Instrument Landing System (ILS) and Autoland) operations are defined according to the applicable Decision Altitude/Height and Runway Visual Range/visibility. A category I (CATI) approach requires a higher decision height and better visibility than a category IIIB (CATIIIB) approach. The technical apparatus for CATIIIB approaches allow an airport to maintain operations in very poor visibility.
CCO	Continuous Climb Operations - allows departing aircraft to climb continuously, which reduces the level of noise heard on the ground, reduces fuel burn and emissions.
CDA	Continuous Descent Approach - allows arriving aircraft to descend continuously which reduces the level of noise heard on the ground, reducing fuel burn and emissions.
CF	Course to Fix - a path that terminates at a fix with a specified course at that fix.
Change sponsor	An organisation that proposes, or sponsors, a change to the airspace design in accordance with the CAA's airspace change process.
CHASE	The northerly of the two holds used for arrivals at Birmingham Airport.
Class G airspace	Class G airspace is also referred to as uncontrolled airspace and is airspace where an ATC service is not deemed necessary or cannot be provided for practical reasons. This means there are no restrictions on which aircraft can enter it, what equipment the aircraft must carry, or the routes taken by the aircraft.
Comprehensive list	The full list of design options that are viable designs as required by Stage 2 of the CAP1616 process and which are detailed in the Design Options Report.
CONOPS	Concept of Operations - a document that outlines how we want the airspace system to work in the future and the standards that we will use.
CO_2	Carbon dioxide, one of the gases produced when burning aviation fuel.

COVID-19	Coronavirus disease 19 is a contagious disease caused by a virus that was identified in 2019 and which resulted in a pandemic in the year 2020.
CP	Country Park - areas of land designated and protected by local authorities to provide access to the countryside.
Cumulative Impact	Where an environmental topic/receptor is affected by impacts from more than one source/project at the same time and the impacts act together.
CTA	Control Area - the controlled airspace that exists in the vicinity of an airport.
dB	Decibels - a unit used to measure noise levels.
DEFRA	Department for the Environment, Food and Rural Affairs (UK Government).
DER	Departure End of Runway - a term that, when used in PANS-OPS 8168, determines the start point for the design of a departure procedure.
Design envelopes	Broad areas where it is possible to design routes and which are the areas where we have created design options for arriving and departing aircraft.
Design option	An output from the route design process that responds to the design principles and the Statement of Need (SoN). Design options are a requirement of the CAP1616 process. During the engagement carried out at Stage 2, design options were also referred to as route options.
Design principles	The principles encompassing the safety, environmental and operational criteria, and the strategic policy objectives that the change sponsor seeks to achieve in developing the airspace change proposal. They are an opportunity to combine local context with technical considerations and are therefore drawn up through discussion with affected stakeholders. The design principles at East Midlands Airport were established during Stage 1 of the CAP1616 process.
DF Coding	Direct to Fix coding - type of waypoint used in the design of PBN procedures.
DfT	Department for Transport.
DME	Distance Measuring Equipment - a ground-based beacon that allows aircraft to measure their precise distance from its location, often used to define a turn point.
DOE	Design Options Evolution - shows the evolution of the design options through Stages 2A and 2B of the CAP1616 process. Included as Appendix A to the Stage 2 Summary Document.
DOR	Design Options Report - this responds to the requirements of CAP1616 to develop a comprehensive list of options that address the SoN and that align with the design principles. It details the design process and the output of that process in the form of design options for both departures and arrivals.
DPE	Design Principle Evaluation - the document that undertakes an evaluation of the Viable and Good Fit options described in this report against the design principles.
DTY	Abbreviation for the Daventry DVOR navigation beacon and routes that use that as a navigation point.
DVOR	Doppler VHF Omni-directional Range - ground-based radio navigation beacon used by pilots to assist in aircraft navigation.
EASA	European Union Aviation Safety Agency.
Education (facilities)	For our analysis we have used the 'Ordnance Survey Address Base' count of educations facilities, details of which they receive from the local government contributing authority. These include all educational services including College, Further Education, Higher Education, Children's Nursery / Crèche, Preparatory / First / Primary / Infant / Junior / Middle School, Non

	State Primary / Preparatory School, Secondary / High School, Non State Secondary School, University, Special Needs Establishment and Other Educational Establishments.
EU	The European Union - an economic and political union of 27 countries.
EMA	The three letter IATA code for East Midlands Airport.
ERCD	The Environmental Research and Consultancy Department of the Civil Aviation Authority.
FAF	Final Approach Fix - The point at which the aircraft starts its final approach to land.
FASI-N	Future Airspace Strategy Implementation – North: The programme of airspace changes across the northern part of the UK, including East Midlands Airport, that is implementing the Governments Airspace Modernisation Strategy.
FASI-S	Future Airspace Strategy Implementation – South: The programme of airspace changes across the southern part of the UK including London that is implementing the Governments Airspace Modernisation Strategy. Whilst the East Midlands Airport ACP will de deployed as part of FASI-N programme, the route structures to and from EMA to the south result in the need to align with the network being developed as part of FASI-S.
FIR	Flight Information Region - airspace delegated to a country by ICAO. In the UK there are two FIRs, London and Scottish.
FL	FL means 'Flight Level' and uses the standard international pressure (1013.2 hPa) to express altitude in hundreds of feet. For example, FL90 equates to 9,000ft calculated according to the 'constant' pressure altitude, rather than local pressure (QNH).
Flat segment	A defined period of level flight as required by a PANS-OPS PBN Approach procedure.
Flight path	The routes taken by aircraft within airspace.
Flight Level	A means to separate aircraft (above the transition altitude) by using a standard pressure setting for all aircraft.
FMS	Flight Management System - a specialised computer system that automates a wide variety of in-flight tasks, and which encompasses a data base to allow SID and arrivals routes to be pre-programmed and flown.
FOA	Full Options Appraisal - the options appraisal carried out at Stage 3 of the CAP1616 process.
Focus group	Group of representative stakeholders brought together to discuss proposals and offer feedback.
Ft	Feet.
GA	General Aviation - defined by ICAO as 'all civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire'.
GANP	The ICAO Global Air Navigation Plan provides a global strategy to modernise the air traffic management system. The GANP provides the foundation for the delivery of the UK AMS (CAP1711). (https://www.icao.int/airnavigation/documents/ganp-2016-mobile.pdf).
GBAS	Ground Based Augmentation System - augments the existing GPS by providing corrections to aircraft in the vicinity of an airport to improve the accuracy of, and provide integrity for, the aircraft's GPS navigational position.
GDPR	The General Data Protection Regulations.
GIS	Geographic Information System.
GNSS	Global Navigation Satellite System - a term used to describe a system that uses satellites for position fixing.

GPS	Global Positioning System - a satellite-based radio navigation system owned by the United States government and operated by the United States Space Force.
HAZID Workshop	Hazard Identification workshop – the first part of the safety assurance process which identifies the safety requirements and potential interactions that may have a safety impact. It is held with air traffic control experts as well as airline representatives operating from East Midlands Airport.
IAF	Initial Approach Fix - the start of the approach phase of flight. For the East Midlands arrival design options, the IAF is at 7,000ft.
IF	Intermediate Fix – a defined point on an arrival procedure, where the aircraft speed and configuration are adjusted, shortly before the aircraft starts the final approach.
IATA	The International Air Transport Association - a trade association that supports aviation with global standards for airline safety, security, efficiency and sustainability.
ICAO	International Civil Aviation Organisation - an agency of the United Nations
IFP	Instrument Flight Procedure.
ILS	Instrument Landing System - a radio navigation system that provides vertical and horizontal guidance to arriving aircraft to help them land safely, especially in bad weather.
Instrument Approach Procedures (IAPs)	A series of predetermined manoeuvres for the orderly transfer of an aircraft operating under instrument flight rules from the beginning of the initial approach to a landing, or to a point from which a landing may be made visually.
Intermediate segment	The element of the approach between the IF and FAF where the descent gradient is either minimised or where a portion of level flight is designed into the procedure to assist with aircraft stabilisation.
IOA	Initial Options Appraisal - the document that is the first iteration of the three option appraisals required by CAP1616 - the design options appraised within the IOA are the outputs from the DPE.
KIAS	Knots of indicated airspeed - the number shown on the airspeed indicator.
km	Kilometres.
KTS	Knots – nautical miles per hour.
LAeq	Equivalent continuous sound level, or Leq/LAeq, is the average sound level for a specific location, over a given period.
LBA	The three letter IATA code for Leeds Bradford Airport.
LDA	Localiser Directional Aid - an assisted approach not aligned with the landing runway, used in places where terrain or other factors prevent the localiser antenna from being aligned with the runway that it serves.
LOAEL	Lowest Observed Adverse Effect Level - below this level, there is no detectable effect on health and quality of life due to the noise.
LNAV	Lateral Navigation - a term for lateral (left/right) navigation used within Performance Based Navigation.
LPL	The three letter IATA code for Liverpool John Lennon Airport.
LTMA	London Terminal Manoeuvring Area – the designated area of Controlled Airspace that deals with air traffic in the London area.
m	Metres.
MAGIC map	Interactive map managed by DEFRA containing authoritative geographic information about the natural and built environment from across Government.

MAP	Missed Approach Procedure - on occasion, inbound aircraft are unable to land successfully on their first approach and perform an action known as a 'Go-Around'. The Missed Approach Procedure outlines a mechanism to route the aircraft, without conflict with departing or arriving aircraft, and re-establish it on to the arrivals path for another approach.
MAN	The three letter IATA code for Manchester Airport.
Masterplan	The strategic plan for the coordinated national programme of airspace change, created by the ACOG under the direction of the CAA and DfT. The criteria the CAA will apply to accept the Masterplan are contained in CAP2156a (www.caa.co.uk/cap2156A).
Medical (facilities)	For our analysis we have used the 'Ordnance Survey Address Base' count of 'Medical', details of which they receive from the local government contributing authority. These include Dentist, General Practice Surgery / Clinic, Health Centre, Health Care Services, Hospital, Hospice, Medical / Testing / Research Laboratory, Professional Medical Service, Assessment / Development Services. Not all of these are 'noise sensitive' receptors and in Stage 3 those which are not 'noise sensitive' will be removed from future analysis.
Mean track	For noise modelling purposes, an average track over the ground, derived from radar data samples.
Modal average path	The path over the ground most commonly flown, derived from radar data samples.
MSD	Minimum Stabilisation Distance - a design criteria within PANS-OPS 8168 that ensures aircraft stability when flying a procedure.
MTMA	Manchester Terminal Manoeuvring Area - the designated area of Controlled Airspace that deals with traffic to the north of East Midlands Airport.
NATS	The air navigation service provider for the UK, formerly National Air Traffic Services. NATS 'En Route' manage the traffic in the upper airspace.
NDB	Non-Directional Beacon - a ground based radio beacon that emits a signal in every direction, used as an instrument approach aid for some airport procedures, including contingency procedures at EMA.
NERL	NATS En Route Ltd - the part of NATS that delivers en route air traffic control.
nm	Nautical miles.
NNR	National Nature Reserves - designated under the National Parks and Access to the Countryside Act 1949 and the Wildlife and Countryside Act 1981 to protect important habitats, species or geology.
Noise abatement	Activity to reduce the emission of noise from a given source (aircraft operations).
Noise-sensitive receptors	Specific locations or developments identified as likely to be adversely affected by noise from or due to aircraft operations. Individual locations will have varying degrees of sensitivity (measured noise exposure levels) depending upon their use. These provide a useful reference to the design principles N1, N2 and N3 where the number of people affected by noise, noise effects and noise sensitive areas are referenced.
NP	National Park - designated areas under the National Parks and Access to the Countryside Act 1949 to protect landscapes because of their special qualities.
NPR	Noise Preferential Route – initial flight path corridor around the SID that departing aircraft are required to remain within until they reach a minimum height of 5,000ft. Each NPR at EMA is 2.4km wide (1.2m either side of the SID).
NWMTA	North Wales Military Training Area: A designated area of airspace used extensively by the RAF for military training flights and which restricts use by civil air traffic.

Overflight	According to CAP1498, the definition of overflight is 'an aircraft in flight passing an observer at an elevation angle (approximately the angle between the horizon and the aircraft) that is greater than an agreed threshold, and at an altitude below 7,000ft.'
PANS-OPS	An ICAO document that stands for Procedures for Air Navigation Services Document 8168 that outlines the rules and criteria for designing aircraft flying procedures - commonly shortened to PANS-OPS.
PBN	Performance Based Navigation - a range of specifications that requires aircraft to navigate to specific accuracy standards, mainly by using satellite-based navigation systems. It is designed to improve track-keeping accuracy for departing and arriving aircraft. The transition to PBN is a UK and international policy requirement and a foundation of the AMS and this ACP.
PBN IR	The PBN IR introduces the gradual implementation of PBN flight procedures to support safer, greener, and more efficient aircraft operations. The regulation is binding in its entirety and directly applicable in all EU Member States.
Peak District	The Peak District - an upland area in England at the southern end of the Pennines. Mostly in Derbyshire, it extends into Cheshire, Greater Manchester, Staffordshire, West Yorkshire and South Yorkshire.
PDG	Procedure Design Gradient.
PIGOT	The southerly of the two existing holding stacks used for arriving aircraft at EMA. It is situated south east of Leicester.
Places of Worship	For our analysis we have used the 'Ordnance Survey Address Base' count of 'Places of Worship', details of which they receive from the local government contributing authority. These include any Abbey, Baptistry, Cathedral, Church, Chapel, Citadel, Gurdwara, Kingdom Hall, Methodist, Mosque, Minster, Stupa, Succah, Synagogue, Tabernacle or Temple.
Planned Property Developments	Property developments with a reasonable prospect of being developed based on Local Plan allocations and Local Authority five-year Housing Land Supply Assessment data. During engagement we have used the term 'Future Housing Sites' to represent the broader phrase of planned property development as we are not aware of other future noise sensitive developments that would sit within this category. Data was collated by CBRE and supplied to East Midlands Airport in December 2022.
Point Merge	Is based on a specific precision-area navigation (P-RNAV) route structure, consisting of a point (the merge point) and pre-defined legs (the sequencing legs) equidistant from this point. The sequencing is achieved with a 'direct-to' instruction to the merge point at the appropriate time.
Q&A	Question and Answer - a list of questions (and their answers) that help the reader understand the subject material.
RAG	Red, amber, green - a means of assessing a project's status using the traffic light colours.
RF	Radius to Fix (RF) is a constant radius PBN turn around a defined turn centre which produces a highly accurate track over the ground.
RNAV1	Area Navigation 1 is one of the specifications within PBN. Aircraft must maintain specific navigational accuracy within the flight. The '1' suffix refers to the accuracy requirement in the procedure, in this case aircraft must fly within +/-1 nautical mile of the centreline of the designed route.
RNP APCH	Required Navigation Performance Approach - a type of RNP procedure used in the descent phase of flight.

RNP-AR	Required Navigation Performance-Authorisation Required – a specialist type of PBN arrivals procedure, which requires suitably equipped aircraft, and crews to be trained in its use.
RNP1	Required Navigation Performance - one of the specifications under PBN. Aircraft must maintain specific navigation accuracy, and in RNP are aided by on-board performance monitoring and alerting. It provides slightly more predictable track-keeping when compared to RNAV1. The '1' suffix refers to the accuracy requirement in the procedure, in this case aircraft must fly within +/-1 nautical mile of the centreline of the designed route.
RNP1+RF	Required Navigation Performance with Radius to Fix turns.
ROKUP	The northerly of the two existing holding stacks used for arriving aircraft at EMA. It is situated close to Belper.
Route option	A term used in engagement to describe the design options that have been created in this step of the Airspace Change Process.
SAC	Special Area of Conservation - Designated under the Conservation of Habitats and Species Regulations 2017 as making a significant contribution to the conserving of the habitats of protected species.
Safety Case	A written demonstration of evidence and due diligence provided by a corporation to demonstrate the ability to operate safely and effectively control hazards.
SARG	Safety and Airspace Regulation Group which drives UK Civil Aviation Authority (CAA) safety standards including overseeing aircraft, airlines and air traffic controllers. They are also responsible for the planning and regulation of UK airspace.
Secretary of State	The title typically held by Cabinet Ministers in charge of Government Departments.
SESAR	The Europe-wide Single European Sky Air Traffic Management Research programme - a joint undertaking is an institutionalised European partnership between private and public sector partners set up to accelerate through research and innovation the delivery of the Digital European Sky (www.sesarju.eu).
SID	Standard Instrument Departure - pre-determined flight path set by Air Traffic Control that aircraft follow when departing an airport.
SME	Subject Matter Expert(s) is a person (are people) who has (have) accumulated great knowledge in a particular field or topic.
SoN	Statement of Need - the means by which the change sponsor sets out what airspace issue or opportunity it is seeking to address and what outcome it wishes to achieve, without specifying solutions, technical or otherwise. East Midlands Airport's SoN can be found online (https://airspacechange.caa.co.uk/documents/download/773).
SPA	Special Protection Area - protected areas for birds classified under the Wildlife and Countryside Act 1981 and protected under the Conservation of Habitats and Species Regulations 2017.
SSSI	Sites of Special Scientific Interest - areas of importance designated and protected by Natural England under the Wildlife and Countryside Act 1981 to recognise the land's wildlife, geology or landform is of special interest.
STAR	Standard Terminal Arrival Route - a pre-determined flight path set by Air Traffic Control that aircraft follow when arriving at an airport.
Step 1B Design Principles Report	A document that formed part of East Midlands Airport's Stage 1 submission to the CAA (https://airspacechange.caa.co.uk/documents/download/5447).

T-Bar	A name given to a type of RNAV final approach procedure. There is a final approach based on an extended centreline from the runway and then perpendicular to that, two Initial Approach Segments are connected to form a 'T' shape.
Technical Coordination Group	Created by ACOG the Group regularly meet to discuss and resolve policy and technical issues affecting airspace design across all airports.
TNT	Abbreviation for the Trent DVOR navigation beacon and routes that use that as a navigation point.
TODA	Take off Distance Available - the length of the paved surface of the take-off runway plus the length of the clearway.
TOS	Traffic Orientation Structure ensures smooth traffic flows and decrease the safety risks associated with crossing traffic.
Track to fix	A Track to Fix (TF) leg is used in PBN procedures to create a line between two waypoints. It is defined by the flight track to the following waypoint and Track to a Fix leg are sometimes called point-to-point legs for this reason.
Tranquillity	There is no universally accepted definition of tranquillity and therefore no accepted metric by which it can be measured. In general terms it can be defined as a state of calm. The consideration of impacts upon tranquillity for airspace change is with specific reference to National Parks and Areas of Outstanding Natural Beauty (AONB), plus any locally identified 'tranquil' areas that are identified through community engagement and are subsequently reflected within an airspace change proposal's design principles.
Transition	The part of the arrival route from the IAF at 7,000ft where aircraft are descending prior to joining the final approach at the FAF.
Transition Altitude	The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes. Above this, the reference is to a Flight Level.
Transport Act 2000	The Transport Act 2000 is an Act of the Parliament of the United Kingdom. The Act provided for a number of measures across the transport industry. In the aviation sector, the Act set a framework for creation of a public-private partnership of National Air Traffic Services.
Uncontrolled airspace	Uncontrolled airspace is airspace where an ATC service is not deemed necessary or cannot be provided for practical reasons. This means there are no restrictions on which aircraft can enter it, what equipment the aircraft must carry, or the routes taken by the aircraft. In airspace classification terms this is also referred to as Class G airspace.
Unviable	Options which would not comply with the rules or for flight procedure design, specifically the requirements of ICAO PANS-OPS 8168, or if they are not compliant with these rules, did not have a supporting safety justification.
VHF	Very High Frequency.
Viable and Good Fit	Options that are viable to design and which would be expected to meet the three design principles with which all design options 'must' comply (design principles Safety, Programme, and Continuity).
Viable but Poor Fit	Options that are viable to design, but which would not be expected to meet the requirements of the design principles Safety, Programme and Continuity.
VNAV	Vertical Navigation - a term for vertical (up/down) navigation used within Performance Based Navigation.
VRP	Visual reference point.

Appendix A: Design Decisions

The table below details the key technical Design Decisions made in the design process which have informed the design envelopes and the comprehensive list of design options shown in this DOR, for both arrivals and departures.

The next logical step in considering airspace change is for individual design options to be combined into operating networks. This will support ongoing engagement and, in turn, will allow for a more detailed evaluation against the design principles. This may require modification or discontinuation of design options and this process is described in section 1.4 Next Steps.

	Reference and decision	Rationale
D1	Envelope Dimensions	All 7,000ft letterboxes shall be designed with a minimum width of 8km or 4.5nm. This applies the rationale and diagrams within CAP1498 (Definition of Overflight) and CAP1616a on the definition of overflight and noise distribution. The rational applied is: • CAP1498 states that a 1,888m lateral displacement at 7,000ft will result in a 3db reduction which is the smallest noise difference that the average person can perceive. • By using a 4,000m lateral displacement either side of centreline this will equate to a total letterbox width of 8,000m or 4.32nm. • For design purposes, this has been rounded up to 4.5nm to create a wide dispersal of noise across the letterbox.
D2	Position of First Turn	In accordance with the Design Principle Safety, the position of the first turn shall align to the rules contained within PANS-OPS 8168 and apply the recommendations within CAP778. The stated PANS-OPS minimum for the first turn is 0.61nm from the DER. However, in the UK, CAP778 recommends that the nominal first turn point should be no closer than 1nm from the DER. This is based on the following calculations: *Taking into consideration the ICAO criteria for height at DER, and minimum PDG (3.3%), this minimum turn height equates to 394ft. However, it is UK policy that the lowest turn height is to be 500ft. Applying an assumed height of 5m (16 ft) over DER and a minimum PDG of 8%, aircraft will achieve 500ft at 1nm beyond DER; therefore, the turn point shall be no closer to DER than 1nm.* However, CAP 778 para 4.1.3 also states that a turn point less than 1nm from DER may be accepted for specific environmental purpose.

		Design decision: By applying the above, and taking into consideration actual aircraft climb performance, the following have been applied to the departure design options: a) When creating replicated ('do minimum') options, the turn point used shall be the same as that of the current procedure, even if this is less than 1nm. This is based upon these current procedures being proven safe and flyable. b) When creating new options, the default process shall use a minimum distance of 1nm from the DER. c) However, where an environmental benefit may be gained by turning at a point less than 1nm from the DER, this shall be explored. d) No turns shall be closer to the DER than the PANS-OPS minimum of 0.61nm DER. Options with a turn less than 1nm for environmental purposes may require a supporting safety case and evidence that aircraft can fly the options without any FMS irregularities or safety issues. This will be subject to CAA approval.
D3	Position of first turn - Replicated departure options.	Replicated departure options shall apply PBN design criteria to the existing conventional routes. In this respect, these options shall seek to replicate the entire procedure, including the position of the existing turn points. In some instances, this turn point is less than 1nm from the DER recommended within CAP778, but this this is based upon these current procedures being proven safe and flyable, and the provision for turns at a point that is less than 1nm from the DER being accepted for specific environmental purpose. See also decision D2
D4	Bank Angles	Bank Angles of no greater than 20° shall be used below 2,000ft aal and no greater than 25° above 2,000ft aal. This is in line with the criteria contained within CAP778. This criteria is greater than that within PANS-OPS 8168 which states that bank angles up to 25° may be used for any turn above 400ft aal. The CAP778 criteria has been applied because of the UK requirement for the minimum turn altitude of 500ft aal, which supersedes the PANS-OPS criteria.

D5	Design Envelopes - Optimising available design space.	Design options should make full use of envelope dimensions as long as technically feasible and the envelope aligns with the identified airspace constraints. This will result in a range of design options, and although some will be more closely aligned to design principles than others, this will allow an effective comparison to be made by stakeholders during engagement activities and within subsequent options analysis.
D6	Departure Design Option - termination points.	Envelopes and design options within them should not be constrained to the SID termination points. Therefore, in order to create a comprehensive range of options, the full width of the design envelope shall be used to create options that align to the design principles, and the routes shall not be constrained to terminating at a common/fixed end point at 7,000ft.
D7	Criteria used to determine a route that is "Unviable"	Unviable design options are defined as design options that have been considered but would not meet the requirements of the Design Principle Safety in respect of: • They would not fully comply with the requirements of PANS-OPS 8168 or; • Would not have an approved safety justification for any lack of compliance with the PANS-OPS criteria. This includes those that may be non-compliant with PANS-OPS in relation to: • Minimum Stabilization Distance (MSD). • Position of the first turn in relation to departure end of runway (DER) within PANS-OPS. • Turn radius based on speed, altitude and climb gradient. • Procedure Design Gradient (PDG). In addition, it covers options that may conflict with, or cause aircraft to fly through notified Danger Areas. The full explanation of the Viability assessment process is provided at section 5.11.

D8	Departure climb gradients.	The baseline climb gradient is 6% (supported by the airline fleet equipage survey). Further work will be conducted to ascertain the percentage of operators that could meet a higher climb gradient if required. The requirement for this higher gradient may be as a result of safety (separation or containment) requirements or environmental (noise purposes). Climb gradients and their application is described in section 6.10.
D9	Arrival descent gradients (CDA).	The descent gradient required for an arrivals option to be classified as Viable and Good fit is between 3.5° and 1.5°. This is within PANS-OPS CDO recommended range for CDAs and also encompasses the optimal descent gradient identified within CAA Low Noise Arrival Metric (CAP2302). Options that have a gradient outside of this range will be classified as Viable but Poor fit.
D10	Airspace containment.	Design options should seek to conform with the CAA Controlled Airspace Containment Policy Statement (January 2014 superseded in August 2022) and remain 3nm or more from the boundary of Class G airspace. However, if there are benefits to be achieved from routes that do not align with this policy, these routes will be created, but the impact of any misalignment will be assessed within the DPE and IOA. It is recognised that any misalignment to this policy will require a supporting safety case to be approved by the CAA.
D11	Departures design speeds	Departure designs should be created in line with the design speeds contained within CAP778. However, where a turn at a lower speed has the potential to better align with a design principle or create a benefit, these options may be created but noting the variance against the CAP778 criteria. Taking this into account, the following design speeds were used for departure route options: • Routes without a turn and/or above 3,000ft aal = 250kts • Turns below 3,000ft aal = 210kts. • The minimum speed with a turn below 3,000ft aal = 190kts. Options which use a speed below these criteria may require a supporting safety case and evidence that aircraft can fly the options without any FMS irregularities or safety issues. This will be subject to CAA approval.

D12	Arrivals design speeds	The design of arrivals speeds should align to CAP778 and the provisions of existing operations within the UK AIP entry for EMA (section AD2.20) which states that: *'aircraft should be flown no faster than 250 KT from the Speed Limiting Points and 250 KTS-210 KTS during the intermediate approach phase'.* This shall be taken into account in the design of the EMA arrivals options. Any variations to these speeds these shall be noted in the design criteria and these options may be subject to flyability and or safety assessments that will be subject to CAA approval.
D13	Arrivals design – Intermediate segment.	In order to create options that provide the opportunity for noise relief when turning onto final approach, the arrivals design options shall provide variable joining points onto the Final approach segment. For EMA this shall be created by varying the length of the Intermediate segment of the arrivals designs by altering the position of the Intermediate Fix (IF). • For runway 09 the IF shall be at either 3.85nm, 5.1nm or 6.9nm. • For runway 27, the IF has been placed at either 3.85nm or 5.1nm. No IF shall be created at 6.9nm to ensure containment of routes within CAS. Further details on how this has been applied are contained at section 19.6.
D14	Arrivals: Position of Final Approach Fix (FAF)	The FAF shall be created at a minimum altitude of 2,000ft which aligns with the current position.

Appendix B: NERL Requirements

As detailed in section 3, the design of the airspace at EMA and the NATS (NERL) network must be aligned in order to be compliant with the aims of the AMS. A set of airspace requirements have been agreed between EMA and the NERL project teams to create this alignment in the designs of both parties as part of the FASI project.

These requirements detail what EMA require the NERL airspace project (referred to as 'the Project' in this table) to deliver as part of their ACP.

The process followed was for EMA to define the core requirements for our future airspace and operations which were informed by both the design principles and the CONOPS. These were combined with those from other airports to create a set of 'NERL Generic' requirements and text.

These were agreed and applied to each airport as appropriate. Therefore, if a NERL Generic requirement (e.g. Generic 2) does not appear in this list, it was agreed as not being applicable to the EMA ACP.

Requirement no.	NERL Generic reference	Requirement of the NERL Network
1	Generic 7	The Airspace Design should facilitate free flow departures for all airports within the Project area of responsibility where applicable.
2	Generic 8	The Airspace Design shall support the anticipated increase in capacity at the airports within the Project area of responsibility.
3	Generic 10	The NERL Airspace design shall ensure the network design above 7,000ft effectively integrates with the airport airspace.
4	Generic 11	The NERL Airspace Design shall accommodate the minimum prescribed separation standard between departing traffic.
5	Generic 12	The Project shall ensure fair and equitable access to the airspace for every airport.
6	Generic 16	The Project should facilitate a system of silent releases/handovers, which minimises telephone co-ordination between en-route (NERL) ATCOs and airport ATCOs.

7	Generic 17	The Project shall ensure that no airport structures or routes provisions impact negatively on any other airport's structure or routes, except where formally agreed.
8	Generic 18	The project shall ensure that airspace systemisation effectively manages arrivals and departures within TMA.
9	Generic 19	The Project shall ensure the systemisation of the airspace reduces the need for tactical intervention.
10	Generic 21	The Project shall design the Airspace to provide a delay absorption method to the airport above 7000ft.
11	Generic 35	The NERL Airspace design shall safely manage the effects of unusual events listed below plus all additional unusual events identified. • An airport problem preventing landings • Aircraft emergencies • A partial ATC system failure • Adverse weather conditions • Detect and correct deviations from airborne routes, including PBN routes, for each workload condition.
12	Generic 38	The NERL Airspace design should accommodate the Flexible Use of Airspace (FUA) where necessary.
13	Generic 39	The NERL Airspace Design shall minimise the use of Short Term Air Traffic Flow & Capacity management (ATFCM) Measures (STAMS).
14	Generic 41	The Project shall ensure that the airspace is capable of managing positioning flights between the airports within the TMA.
15	Generic 44	The Project shall follow a Communication and Engagement Plan. The NERL Communication and Engagement Plan should include details of the governance set up whereby the Project takes the responsibility to centrally co-ordinate and report on the Project airport airspace changes. One of the drivers to follow this approach is to meet the stakeholder engagement requirements of

		CAP1616 Stages 2 and 3 and enable a co-ordinated ACP consultation.
16	Generic 47	The Project shall collaborate with the ACOG FASI Masterplan for Deployments and support the process.
17	Generic 72	The NERL Airspace Design shall ensure that it can support a mix of aircraft equipage (PBN and non-PBN).

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