

Glasgow Airport FASI-N Airspace Change Proposal Step 2B Initial Options Appraisal

Date:	August 2022
Document Version:	V1.4
Status:	Final document for CAA Submission (Public)
Document History:	 V1.0 Submitted to the CAA in April 2022 V1.1 Submitted to the CAA in July 2022 (Please see Change Record on CAA Airspace Change Portal for details of updates) V1.2 Following CAA request, text changes between V1.0 and V1.1 highlighted. We would recommend reading the change record in order to understand the requirement for and the context of the clarifications. V1.3 Updates to conclusion section following clarification meeting with the CAA (highlighted). V1.4 Updates following consistency check requested following Stage 2A Gateway (highlighted)

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1. Introduction

Airspace Modernisation Strategy

Following the publication of the strategic rationale for airspace modernisation¹, the Government directed the Civil Aviation Authority (CAA) to "prepare and maintain a coordinated strategy and plan for the use of UK airspace up to 2040, including its modernisation". As a result, in 2018 the CAA published the Airspace Modernisation Strategy (AMS)², which replaced the earlier 2011 Future Airspace Strategy. The AMS sets out the initiatives required to modernise the existing Airspace System by upgrading the airspace design, technology, and operations. The CAA is in the process of reviewing the AMS and expects to publish an updated version of the strategy in early 2022.

One of the most important initiatives required to achieve the AMS objective is known as FASI (Future Airspace Strategy Implementation). 21 airports in the UK comprise FASI and Glasgow Airport is one of them. This FASI initiative is considered the UK's Airspace Change National Infrastructure Programme (the Programme). The Programme encompasses the requirement to fundamentally redesign the National Airspace System at lower altitudes and in the terminal airspace that serves commercial air transport across the busiest regions of the UK, making the most of the capabilities of modern aircraft and satellite-based navigation technology. These airspace design projects are sponsored by the 21 airports (for the local arrival and departure routes below 7000ft) and by NERL (for the airspace structures and route network above 7000ft).

Performance Based Navigation (PBN)

Today's national route network is designed with reference to a grid of ground navigation beacons distributed across the UK. Some of these beacons are outdated and reaching their end of life. Meanwhile, 99% of the current commercial air transport fleet operates almost exclusively using avionics that rely on satellite navigation. Aircraft are able to follow routes designed to satellite navigation standards (known as Performance-based Navigation or PBN) with greater precision than conventional ground navigation. The widespread deployment of routes designed to satellite navigation standards is a cornerstone of airspace modernisation. The opportunity to design a new network of PBN routes with far greater accuracy and flexibility offers the potential to address many of the issues set out in the Government's strategic rationale. Significant improvements in airspace capacity and efficiency can be achieved by positioning routes so that they are safely separated and optimised by design.

Whilst more precise routes can be used to avoid noise sensitive areas, they may also concentrate the impacts of overflight. For this reason, the use of multiple route options that can distribute the impacts more equitably, or be configured to offer predictable relief from noise, must be considered in consultation with local stakeholders when routes are being developed for deployment at lower altitudes.

Airspace Change Organising Group (ACOG) and the Masterplan

The number, complexity and overlapping scope of the individual Airspace Change Proposals (ACPs) needed to deliver the Programme requires a strategic coordination mechanism in the form of a single joined up implementation plan or Masterplan.

Given the large number of organisations involved (21 airports and NATS EnRoute Limited (NERL)), the CAA and Department for Transport (DfT) also required NERL to set up an impartial body, The Airspace Change Organising Group (ACOG) to develop a Masterplan, coordinate the Programme and lead the necessary engagement with external stakeholders. In this context, ACOG was established in 2019 as a unit within NERL, separate and impartial from the organisation's other functions.

Masterplan Iteration 2³ was accepted by CAA on 27th January 2022. The purpose of Iteration 2 is to provide a system-wide view of the scope of the constituent ACPs and identify the potential interdependencies between the proposals. Collectively, the ACPs that are included in the Masterplan are referred to as the 'constituent airspace change proposals'. Each individual ACP is developed following the same detailed process steps laid out in the CAA's guidance for changing the airspace design – known as CAP1616⁴. The CAA evaluates the progress of every ACP through each stage of the process, via a series of (seven) regulatory gateways and make decisions on whether to approve further development and ultimately the implementation of the proposed changes. A summary of the CAP1616 process is available in the <u>next section</u>.

Iteration 2 places Glasgow Airport in the 'STMA regional cluster' alongside Edinburgh and Aberdeen Airports and the NATS Scottish TMA.

Our Airspace Change

Glasgow Airport Limited (GAL) began their ACP to modernise their airspace in June 2019 and passed through Stage 1 of CAP1616 in December 2019. Shortly after this, the project and much of the wider Programme was paused due to COVID-19 pandemic whilst the aviation industry focussed on managing the pandemic and its recovery from it. The Programme was remobilised in March 2021 following the provision of DfT grant funding, allowing GAL to recommence their ACP in May 2021.

This document forms part of the GAL Stage 2 submission to the CAA. It takes the options that progressed from the Design Principle Evaluation at Step2A and undertakes a more rigorous qualitative appraisal of their benefits and impacts as part of what's called an Initial Options Appraisal (IOA). The IOA is the first of three appraisals that will take place as part of the Airspace Change Process with each appraisal increasing in quantitative analysis.

All airspace design options in this document are subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation with all our stakeholders.

All airspace design options in this document are subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.

1.1. CAP1616

In December 2017 the Civil Aviation Authority (CAA) published CAP1616⁵ Airspace Design: Guidance on the regulatory process for changing airspace design, including community engagement requirements. The guidance sets out the process for the airspace change process, which a change sponsor of any permanent change to the published airspace design must follow. The airspace change process is split into 7 Stages;

Stage 1 DEFINE	Step 1A	Assess requirement
	Step 1B	Design principles
		DEFINE GATEWAY
Stage 2	Step 2A	Option development
DEVELOP and ASSESS	Step 2B	Options appraisal
		DEVELOP AND ASSESS GATEWAY
Stage 3	Step 3A	Consultation preparation
CONSULT	Step 3B	Consultation approval
		CONSULT GATEWAY
	Step 3C	Commence consultation
	Step 3D	Collate & review responses
Stage 4	Step 4A	Update design
UPDATE and SUBMIT	Step 4B	Submit proposal to CAA
Stage 5	Step 5A	CAA assessment
DECIDE	Step 5B	CAA decision
		DECIDE GATEWAY
Stage 6 IMPLEMENT	Step 6	Implement
Stage 7 PIR	Step 7	Post-implementation review
Figure 1 CAP1616 7 Sta	ades	

1.2. Glasgow Airspace Change Proposal

This Airspace Change Proposal is required to follow the CAP1616 process detailed in the section above. Table 1 below summarises the CAP1616 stages already undertaken for this ACP and the stage where we are at now, providing links to previous submission documents with further information.

Table 1 ACP progress to date

Airspace Change Stage	Summary	Link to Documents (Also available on the ACP portal)		
	In June 2019, Glasgow Airport submitted their following statement of need (SoN) to the CAA	Statement of Need on CAA's Airspace Change Portal		
Stage 1A	Glasgow Airport participated in an assessment meeting with the CAA on the 18 th June 2019 as part of Step 1A of the CAP1616 process. The purpose of the assessment meeting is for the change sponsor to present and discuss their SoN and to enable the CAA to consider whether the proposal falls within the scope of the formal airspace change process.	Assessment meeting minutes		
Stage 1B	At Stage 1B Glasgow developed a set of design principles with identified Stakeholders. The aim of the design principles is to provide high-level criteria that the proposed airspace design options should meet. They also provide a means of analysing the impact of different design options and a framework for choosing between or prioritising options. The final design principles outlined within the Stage 1B submission.			
Stage 2A	Stage 2A requires change sponsors to develop and assess options for the airspace change. In Stage 2A, the change sponsor develops a comprehensive list of options that address the Statement of Need and that align with the design principles from Stage 1. We then share those options with our Stakeholder representatives (the same ones engaged with on the Design Principles). Feedback from the engagement may then be used to refine and/or generate further options where feasible at this stage or later in the process. Finally, we qualitatively assess all options developed against the Design Principles and produce a Design Principle Evaluation (DPE). Our comprehensive list of options is then shortlisted before progressing to Stage 2B. Our Stage 2A document provides details of this process, and our shortlisted options following the DPE. Our shortlist is also shown in the 'Overview of options under assessment' part of this document.	Stage 2A DPE Submission Document		
Stage 2B	At Stage 2B an Airspace Change Sponsor is required to undertake an Initial Options Appraisal (IOA) of the airspace change options which proceed from Stage 2A. This is where we are now. The following sections of the document initially describe the options under assessment and the baseline option, followed by explaining the methodology used to assess each option, and then the IOA outcome. At the end of the document we explain, based on the IOA, the options which we intend to take forward to Stage 3 and our preferred option(s).	This document		

2. Overview of options under assessment

Our comprehensive list of options included 32 options. These are split into easterlies and westerlies, arrivals, and departures.

As part of Stage 2A, we undertook a <u>Design Principle Evaluation</u> where we evaluated each option against each Design Principle. This was the first opportunity to shortlist options before we progress to this IOA. The outcome of our Stage 2A Design Principle Evaluation was that some options were discontinued including the baseline 'Do Nothing' options.

Although the 4 baseline 'do nothing' scenarios (easterly departures, easterly arrivals, westerly departures, and westerly arrivals) did not progress as options, CAP1616 requires the baseline scenario to be appraised in this IOA as it provides a means of testing the options against the current day operations to better understand and highlight the benefits and impacts of each new option. The baseline will also continue to be appraised as part of the Full Options Appraisal and Final Options Appraisal at Stage 3 and Stage 4.

Use of pure PBN for arrivals into Glasgow did not perform well in the Design Principle Evaluation and is not a viable option for Glasgow going forwards. However, the option of a mix of PBN and vectoring does come through very favourable. In this scenario, we would want to use the best performing PBN routes, so we have taken the remaining PBN arrival options into the Initial Options Appraisal for further assessment.

The following sections summarise the airspace change options we have taken through to this IOA. More information about how we have developed and evaluated these options is available in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>. The <u>Initial Options Appraisal section</u> of this document and technical appendix A also contain larger images and a more details of each option.

All airspace design options in this document are subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.

2.1. Runway 23 Westerly Departures

Table 2 Runway 23 Westerly Departure Options

Option name	Summary	Image
RWY 23 Dep Option A	Offset right departures with turns at 2nm and 7nm from the runway. Offset left departures with turns at 1nm from the runway. NORBO traffic is shared between a left turn departure route and the departure route that offsets right and then turns left at 7nm with both routes available at the same time.	
RWY 23 Dep Option B	Offset right departures with turns at 2nm from the runway. Offset left departures with turns at 1nm and 5nm from the runway. NORBO traffic is shared between two departure routes however they are the same route until 5nm from the runway.	
RWY 23 Dep Option C	This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure period. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use different flight path which offsets to the left, with the rest of the routes remaining the same.	
RWY 23 Dep Option D	This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure periods. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a different flight path which follows a straight line from the runway until splitting at 5nm, with the rest of the routes remaining the same. This option is similar to Option C except that the non-peak NORBO route is different.	
RWY 23 Dep Option E	Straight ahead departures only (no offsets) with turns at 1nm and 9nm from the runway NORBO is traffic is shared between a route that turns left at 1nm and one that descrift turn until 9nm from the runway	LOMNFOYLE PERTH R0890



Further information around our Options can be found in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>

2.2. Runway 05 Easterly Departures

Table 3 Runway 05 Easterly Departure Options

Option name	Summary	Image
RWY 05 Dep Option A	Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 3nm from the runway. NORBO is offset left with turn at 1nm	
RWY 05 Dep Option B	Offset right departures with turns at 2nm from the runway. Offset left departures with turns at 1nm and 5nm from the runway. NORBO traffic is shared between two departure routes however they are the same route until 5nm from the runway.	
RWY 05 Dep Option C	Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 4nm from the runway.	FUILLAUKON BISBICC 219 KORDOTEN LUSV
RWY 05 Dep Option D	Straight ahead departures only (no offsets) with turns at 1nm, 4nm and 6nm from the runway.	
RWY 05 Dep Option E	Offset left departures with turns at 1nm from the runway. Straight ahead departures with turns at 2nm and 6.5nm from the runway. NORBO is straight ahead to 2nm with a right turn.	
RWY 05 Dep Option F	This option shares NORBO traffic between a left and right turn with only one of those routes in use at a time. The rest of the routes remain in the same configuration. When turning left, the NORBO would offset left then turn further left at 1nm When turning right, the NORBO would go straight ahead to 2nm then a right turn	
RWY 05 Dep Option G	This option has two, quite different route configurations and assumes one configuration would be used for the peak departure period. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between a left turn departure and a right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a single flight path turning right, but that path could be different to the one used for the peak periods.	
RWY 05 Dep Option H	This option was generated as a result of Community and ATC feedback in our engagement. They proposed that ROBBO/CLYDE/LOMON SIDs could also turn left immediately, together with the left turn NORBO SID. Predictable respite is not a feature.	LOBON FORE PHILE HOREOCHE NOREOCHE NOREOCHE
RWY 05 Dep Option I	This option is the same as Option H except that track adjustments do not feature. This is due to a concern that a track adjustment followed by an immediate left 180° turn for the NORBO/ROBBO/CLYDE/LOMON departure could be too technically challenging. This has a knock-on impact in that the PERTH/FOYLE would also not feature a track adjustment.	

2.3. Runway 23 Westerly Arrivals

Table 4 Runway 23 Westerly Arrival Options

Option name	Summary	Image
RWY 23 Arrival Option C	PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 8nm.	
RWY 23 Arrival Option D	PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 9nm.	
RWY 23 Arrival Option E	PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 10nm.	
RWY 23 Arrival Vectors only	This option would see all arrivals continuing to be vectored with no PBN paths available for routine use. Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet, so there is not an illustration for this option. For the Design Principle Evaluation and this Initial Options Appraisal, we will assume similar impacts as the baseline however for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft.	Note: Image shows existing vectoring swathe. Visualisation of option to be developed at Stage 3 once further information around airspace above 7000ft is known, alongside more information about departures and CAS arrangements.
RWY 23 Arrival Vectors and PBN hybrid	This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing. The PBN arrival(s) would likely be the 'best performing' of Options C-E above which are then optimised in Stage 3 to balance CO2, noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation.	Note: Image shows existing vectoring swathe alongside the centrelines for Options A-D. Visualisation of option to be developed at Stage 3 once PBN shortlist is known and there is further information around vectoring arrangements.

Further information around our Options can be found in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>

2.4. Runway 05 Easterly Arrivals

Table 5 Runway 05 Easterly Arrival Options

Option name	Summary	Image
RWY 05 Arrival Option A	PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway.	
RWY 05 Arrival Option B	PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the south at approximately 10nm.	
RWY 05 Arrival Option C	PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway. Slightly different track to Option A above 5000ft.	
RWY 05 Arrival Option D	PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the south at approximately 10nm. Slightly different track to Option B above 5000ft	
RWY 05 Arrival Vectors only	 This option would see all arrivals continuing to be vectored with no PBN paths available for routine use. Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet so there is not an illustration for this option. For the Design Principle Evaluation and Initial Options Appraisal we will assume similar impacts as the baseline however, for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft. 	Note: Image shows existing vectoring swathe. Visualisation of option to be developed at Stage 3 once further information around airspace above 7000ft is known, alongside more information about departures and CAS arrangements.
RWY 05	This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.	Note: Image shows existing vectoring swathe alongside the overflight contours for Options A-D. Visualisation of option to be developed at Stage 3 once PBN shortlist is known and there

RWY 05 Arrival Vectors and PBN hybrid RWY 05 Arrival Vectors and PBN hybrid RWY 05 Arrival Vectors and PBN hybrid RWY 05 Arrival PBN hybrid RWY 05 Arrival PBN hybrid RWY 05 Arrival PBN arrival(s) would likely be the 'best performing' of Options A-D above which are then optimised in Stage 3 to balance CO2, noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation.

once PBN shortlist is known and there is further information around vectoring arrangements.

Further information around our Options can be found in our Stage 2A submission document on the <u>CAA Airspace Change Portal</u>

3. Initial Options Appraisal Methodology

The Initial Options Appraisal (IOA) is the first stage in a three-phase appraisal of airspace change options. It involves the mainly qualitative appraisal of the airspace change options that have proceeded from Stage 2A (outlined in <u>Section 2</u> of this document). As options progress through the airspace change process, the two following appraisals, the Full Options Appraisal and Final Options Appraisal undertaken at Stage 3 and 4, will quantitively evaluate options in further detail. The following sections outline the methodology we have followed whilst appraising our airspace change options as part of this IOA.

3.1. Baseline and Year of Implementation

As part of this IOA, CAP1616 requires airspace change sponsors to set a baseline which is used for environmental evaluation of the options. CAP1616 explains that this will be a 'do nothing' scenario and will largely reflect the current-day scenario, although taking due consideration of known or anticipated factors that might affect that baseline, for example a planned housing development close to an airport, forecast growth in air traffic, or expected changes in airlines' fleet mix. Therefore, all environmental assessments must illustrate the difference between a pre-implementation ('do nothing') scenario and a post-implementation scenario, ensuring that the periods are comparable.

Owing to the impact of COVID-19 on the aviation industry throughout 2020 and 2021, we have selected to use 2019 movement data as the baseline data that we will use as the basis for the environmental assessment as part of this initial appraisal, as this is most representative of a recovered COVID-19 scenario. We will qualitatively describe the growth of this baseline to the year of implementation (see below).

Year of Implementation

At present the exact implementation date for the FASI-S airspace changes is unknown as the timeline for implementation will be dependent on a number of factors, including the airspace changes above 7000ft which form part of a separate ACP sponsored by NATS NERL. Current deployments of the Scottish-TMA within Masterplan Iteration 2 suggest to expect an implementation date of around 2025, however this will be subject to alignment with masterplan iteration 3. For the purpose of this IOA, we will qualitatively describe the anticipated factors that are expected to impact the baseline, such as any forecast growth, fleet mix changes and planned developments based on implementation in 2025.

Traffic Forecast: Movement numbers and schedule

For the purposes of environmental assessment, Airspace Change sponsors are required to use a 92-day summer period between 16 June to 15 September inclusive. In 2019, there were 25,275 movements during this 92-day period to/from Glasgow Airport. A movement is considered either an arrival or a departure.

Runway	Number of operations	Percentage
23 (Westerly Operations)	20,658	81.7
05 (Easterly Operations)	4,617	18.3
Total	25,275	

Table 6 GLA 2019 92-day summer movements

When reviewing the movement data in table 6, in 2019 82% of flights operated on runway 23 (westerly operations when aircraft take off and land towards the south-west), and 18% of flights operated on runway 05 (easterly operations when aircraft take off and land towards the north-east). This modal split will be used for this IOA. We have also analysed the 92-day 2019 data to find out information about SID usage and existing departure directions.

Traffic Forecast

2019 is considered the year that most reflects a scenario where Glasgow airport has recovered from the impacts of COVID-19. We expect this recovery to have occurred by 2025 and therefore, as part of this IOA, we do not currently expect any fundamental changes to the movement numbers outlined above at the year of implementation. Owing to the uncertain nature of the aviation sector as a result of COVID-19, this approach to forecasting is considered proportionate at this stage of the CAP1616 process. When considering the future forecast (10 years after the year of implementation), given the number of options that form part of this appraisal, the qualitative nature of large parts of the appraisal, and the methodology applied where quantified information has been used, it is not considered proportionate to also appraise all options against this future traffic scenario in Stage 2; as part of our Stage 3 Full Options Appraisal, we will fully quantitatively appraise the pre-implementation baseline and options for the year of implementation and future scenarios (plus 10 years).

The methodology applied to appraise each option as part of this Initial Options Appraisal focuses on the % split of movements distributed across Glasgow's arrival and departure routes. These % are derived from the actual flight track data and known factors which will influence the baseline in 2025 (see sections below). We expect the southerly directional bias will continue for any future forecast given the geographic location of Glasgow compared to London and Europe. Specific numbers of movements have not been applied to the assessments; this will form part of the detailed quantitative noise and environmental modelling that will be undertaken as part of the Stage 3 Full Options Appraisal.

Fleet Mix

In 2019 Turbo prop aircraft made up around 25% of traffic arriving and departing from Glasgow Airport. Due to factors such as the change in aircraft operators and passenger habits, Glasgow Airport expect to see a shift towards more jet aircraft going forward than was the norm in 2019 and preceding years. This will be considered as part of our qualitative appraisal of the options. In Stage 3 we will quantify the changes to the baseline as a result of the expected fleet mix at the year of implementation.

Planned developments

As part of our preparation of the baseline, we have identified planned developments in the area surrounding Glasgow airport so that these can be considered as part of appraisal of the benefits and impacts of each option:

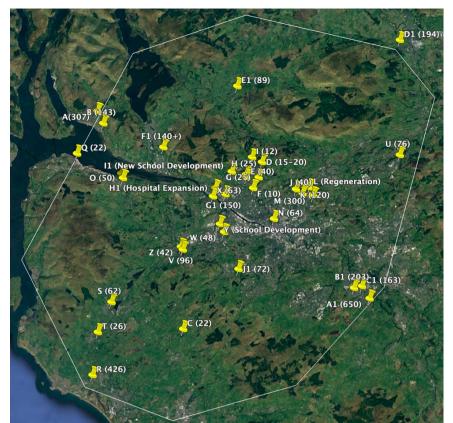


Table 7 Planned Developments around Glasgow Figure 2 Planned Developments around Glasgow Airport

Ref	Local Authority	Location	Type of Development	Size of Development	Status (if known)	Further information
А	Argyll & Bute	Helensburgh Golf Course	Housing	307	Approved (Feb 21)	Planning Page
В	Argyll & Bute	Hermitage Academy, Helensburgh	Housing	143	Nearly complete	Developer
С	East Ayrshire	KA3 4BD	Housing	23	Registered (Mar 22)	Planning Page
D	East Dunbartonshire	G62 8BY	Housing	15-20	Awaiting decision (Mar 22)	Planning Page
Е	East Dunbartonshire	Bearsden Golf Course	Housing	40	Unknown	Planning Page
F	East Dunbartonshire	Crarae Avenue, Bearsden	Housing	10	Decided	Planning Page
G	East Dunbartonshire	Milngavie Road, Bearsden	Housing	25	Awaiting decision (Mar 22)	Planning Page
I	East Dunbartonshire	Nithsdale Crescent, Bearsden	Housing	26	Awaiting decision (Mar 2020)	Planning Page
-	East Dunbartonshire	Craigton Road, Milngavie	Housing	120	Unknown	_1
J	East Dunbartonshire	Auchinairn, Bishopbriggs	Housing	40	Unknown	_1
Κ	East Dunbartonshire	Bishopbriggs Town Centre	Housing	220	Public Consultation (2021)	Article
L	East Dunbartonshire	Westerhill, Bishopbriggs	Regeneration	TBC	Public Consultation (2021)	Article
Μ	Glasgow City	G33 1TG	Housing	300	Awaiting Approval (Feb 22)	<u>Developer</u>
Ν	Glasgow City	Finnieston	Flats	64	Submitted (Nov 21)	Planning Page
0	Inverclyde	PA14 6PP	Housing/Flats	50	Nearly complete (Apr 22)	Planning Page
Ρ	Inverclyde	PA14 6PR	Housing/Flats	40	Nearly complete (Apr 22)	Planning Portal
Q	Inverclyde	PA16 8DA	Flats	22	Pending consideration (Mar 22)	Planning Page
R	North Ayrshire	Byrehill Place, Kilwinning	Housing	426	Pending consideration (Feb 22)	Planning Page
S	North Ayrshire	Knoxville Road, Kilbirnie	Housing	62	Pending consideration (Feb 22)	Planning Page
Т	North Ayrshire	Bridgene Mill, Dalry	Housing	26	Approved (Dec 21)	Planning Page
U	North Lanarkshire	Kildrum, Cumbernauld	Flats	76	Unknown	Planning Page
V	Renfrewshire	PA5 0SP	Housing	96	Awaiting Decision (Mar 22)	Planning Page
W	Renfrewshire	East Lane, Paisley	Flats	48	Awaiting Decision (Mar 22) Awaiting Decision (Mar 22)	Planning Page
Х	Renfrewshire	Erskine	Housing/Flats	59/24	Awaiting Decision (Mar 22)	Planning Page
Y	Renfrewshire	Renfrew Road, Paisley	New School	-	Approved	Article
Z	Renfrewshire	Elm Drive, Johnstone	Housing/Flats	36/6	Awaiting Decision (Mar 22)	Planning Page
A1	South Lanarkshire	Strathaven Road, Hamilton	Housing	650	Registered (Oct 21)	Planning Page
B1	South Lanarkshire	Earnock Road, Hamilton	Housing	203	Awaiting Decision (Jul 21)	Planning Page
C1	South Lanarkshire	ML3 9BZ	Housing	163	Approved (Sep 21)	Planning Page
D1	Stirling	Cambusbarron	Housing	194	Under construction	Website
E1	Stirling	Killearn	Housing	89	Under construction	Website
F1	West Dunbartonshire	Bellsmyre	Housing	140+	Under construction	Regeneration Plan
G1	West Dunbartonshire	Queens Quay	Housing/Flats	150	Under construction	Website
H1	West Dunbartonshire	Clydebank	Golden Jubilee Hospital Expansion	-	Permission issued	
11	West Dunbartonshire	Faifley	New School	-	Post consultation (Sep 21) period	Article
J1	East Renfrewshire	Lyoncross Farm, Barrhead	Housing	72	Registered (Jan 22)	Planning Page

¹ Information provided by email from East Dunbartonshire council – no information available online

3.2. Initial Options Appraisal Categories and Criteria

At Stage 2B CAP1616 requires sponsors to carry out an initial qualitative assessment of the benefits and impacts of each option, tested against the 'do nothing' baseline scenario. The purpose of this initial appraisal is to highlight the change to sponsors, stakeholders and the CAA and the relative differences between the impacts, both positive and negative, of each option.

Our assessment criteria shown in table 8 below have been categorised based on the example in CAP1616 Appendix E, however we have added an additional category called 'Interdependencies, conflicts and trade-offs' to satisfy the requirements to outline potential interdependencies with other FASI-N ACPs, and 'Airspace Modernisation Strategy' to satisfy the 7 confirmed indicators that the CAA will use to assess whether this Stage 2 submission accords with the AMS including iteration 2 of the Masterplan. We will follow this table structure across the appraisal of all of our options.

Table 8 Initial Options Appraisal Assessment Criteria (Based on CAP1616 Appendix E)

Group	Impact
Communities	Noise impact on health and quality of life
Communities	Air Quality
	Greenhouse gas impact
Wider Seciety	Capacity / resilience
Wider Society	Tranquillity
	Biodiversity
General Aviation	Access
General Aviation / Commercial airlines	Economic impact from increased effective capacity
General Aviation / Commercial annues	Fuel burn
Commercial airlines	Training costs
Commercial annues	Other costs
	Infrastructure costs
Airport / Air navigation service provider	Operational costs
	Deployment costs
All	Safety
All	Interdependencies, conflicts, and trade-offs
All	Airspace Modernisation Strategy (AMS) (CAP1711)

17

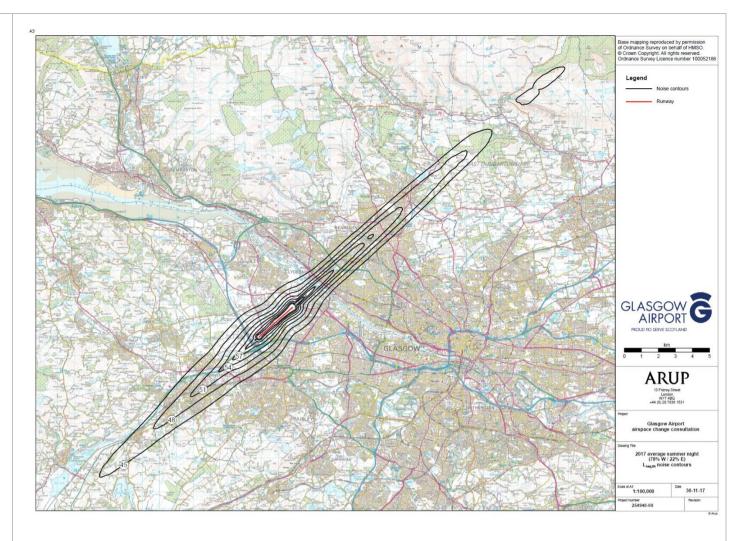
3.3. Initial Options Appraisal: Methodology

Table 9 below presents the IOA methodology that will be followed. This methodology will be used to compare the airspace change options against the baseline.

Table 9 IOA Methodology

IOA Methodolo	97	
Group	Impact	Qualitative Assessment
Group Communities	Impact Noise impact on health and quality of life	<text><text><text><text></text></text></text></text>

18



WebTAG

The data from L_{Aeq,16hr} (daytime noise) and L_{Aeq,8hr} (night time noise) contours form part of a key input into WebTAG. WebTAG is the Department for Transport's suite of guidance on how to assess the expected impacts of transport policy proposals and projects. These workbooks can be used to monetise certain aspects of the noise impact, given the correct inputs are available.

As explained above, owing to the number of permutations and the complexity of the noise modelling, we will qualitatively describe the expected changes to the LAeq contours as part of this IOA. As we do not have the quantitative information, we are unable to use the WebTAG workbook at this stage, however this analysis will be undertaken as part of our Stage 3 Full Options Appraisal.

Overflight Contours

Technical Appendix A includes images and data tables of overflight information which we have used to inform our qualitative assessment of each option. There are two types of overflight information that we have termed 'centreline' and 'vectoring'.

Centreline Overflight Data

The centreline overflight contours are based on a single event, i.e. one departure or one arrival using the CAA's 48.5 degree definition of overflight as defined in CAP1498. This departure is assumed to follow the SID route from 0-7000ft therefore this data does not take into account any vectoring. This is particularly important to note when considering the baseline data, as we know that the majority of aircraft today are typically vectored rather than following the full SID centreline.

The contours are generated using a standard AEDT (Aviation Environmental Design tool) profile of an 737-800 aircraft and we have added qualitative statements as part of this IOA assessment (particularly for departures) about how the overflight contours may change when considering Glasgow's fleet mix. We chose the B738 as it is one of the largest and noisier aircraft that regularly flies at GLA and therefore tends towards the worst case.

The contour images shown in this IOA and in Technical Appendix A include an indication of the anticipated use of each route which has been based on actual 2019 data, with adjustments made on an option-by-option basis (for example where the option introduces a respite route).

The data-tables use the latest available CACI population data for 2021, PointX data to identify noise sensitive buildings (schools, hospitals, and places of worship). National Parks, National Scenic Areas, Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest have been collected from the Scottish Government's catalogue of spatial data (https://www.spatialdata.gov.scot/geonetwork/srv/eng/catalog.search#/home). In addition, designated quiet areas in Glasgow City were mapped using information taken from the Glasgow City Development Plan (http://www.glasgow.gov.uk/CHttpHandler.ashx?id=35882&p=0)

It's important to note that the overflight contours only look at a single overflight along the PBN centreline, and therefore at this stage the data does not take into account frequency of overflight. This will be qualitatively described as part of this IOA and then fully quantified at Stage 3 Full Options Appraisal.

Data includes overflight counts and areas (km²) of: Population, National Scenic Areas (NSA), Parks and gardens, special areas of conservation (SAC), sites of special scientific interest (SSSI), special protection areas (SPA), national parks, designated guiet areas (DQA), schools, hospitals, and places of worship.

At this stage, owing to the complexity of modelling vectoring, we have modelled each option based on aircraft flying the PBN centreline however vectoring below 7000ft may still occur. We have noted throughout the IOA where this applies and added a qualitative assessment alongside the data. As part of our Stage 3 Full Options Appraisal noise modelling of the vectoring will be investigated.

When considering the centreline data for the arrivals baseline, it's important to note that a centreline for the existing arrivals does not actually exist in reality; we created one based on the area's most frequently overflown by arrivals in today's airspace arrangement for comparative purposes.

Vectoring (Baseline) Overflight data

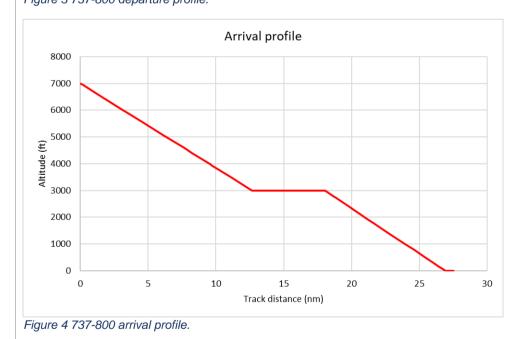
As described above, owing to the nature of vectoring, it is very complex to model and at this stage of the process, given the number of options, it is not proportionate to undertake full modelling.

In order to illustrate the difference between the today's baseline flight tracks over the ground (also known as a vectoring swathe) and the PBN options, we have included some information about the baseline vectoring scenario. This has been generated using noise track keeping (NTK) data for the 92-day period, and therefore is not generated in the same way as the overflight contours which use a standard vertical profile of one aircraft. We have however applied the CAA's 48.5 degree overflight cone to the NTK data. The outcome are the baseline heatmaps, which are shown in Technical Appendix A, which help us to articulate the current vectoring swathe and any areas of concentration which occur today. Alongside the images, we have included overflight data as part of our Technical Appendix and IOA. This data does not consider frequency of overflight but instead takes account of any areas that are overflown at least once, based on the NTK data; this allows some preliminary comparison to be drawn between the option's overflight contours and what happens today.

60dB and 65dB LAMax

As part of this IOA, we have calculated 65dB L_{Amax} (day) and 60dB L_{Amax} (night) contours and data using an Airspace Optioneering Tool. The indicative noise calculations in the tool are based on the methods set out in ECAC Doc 29 (https://www.ecac-ceac.org/images/documents/ECAC-Doc_29_4th_edition_Dec_2016_Volume_1.pdf) and have been verified against calculations using the FAA's Aviation Environmental Design Tool (AEDT) (<u>https://aedt.faa.gov/</u>). The optioneering tool is not a full noise model complying to the standards required by CAP2091, but we have agreed with the CAA that it is a proportional method to use at this stage of the analysis. The optioneering tool does not take airport specific atmospheric conditions into account and assumes standard atmospheric attenuation rates set out in SAE-AIR-1845. The source of the acoustic data used in the tool is the international Aircraft Noise and Performance (ANP) database (<u>https://www.aircraftnoisemodel.org/</u>). Arrival and departure flight profiles for a Boeing 737-800 have been calculated as a function of track distance using the default departure / arrival procedural steps for Aircraft ID 737800 in the ANP database. The procedure for maximum take-off weight has been used as this is the most conservative profile in noise terms due to the low climb rate. The departure and arrival profiles are shown as a function of track distance in the figures below.





Similar to the overflight contours, these are based on a single noise event i.e. based on one departure or one arrival. 60dB and 65dB L_{Amax} contours are an indication of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. These are required by the CAA to help with engagement on noise and airspace change, and to further differentiate between airspace options which have a similar impact with respect to the L_{Aeg} metrics.

The 60dB and 65dB L_{AMax} data contained within the Technical Appendix is based only on centreline data and assumes no dispersion around the centreline; this means that for the baseline, it does not reflect the vectoring that occurs today. As explained above, to model vectoring is complex and something that we will do as part of our Stage 3 Full Options Appraisal. As part of this IOA, we will use the data as a starting point for comparison between the baseline and the options and we will also provide some additional qualitative analysis.

		CAP2091 At this stage in the airspace change process, we have not calculated L_{Aeq} contours (see section above) and instead we will qualitatively describe anticipated changes based on the most recent contours generated for Glasgow's 2017 noise action plan. The contours in the noise action plan were generated to CAP2091 category D/E standards however the output shows that the airport should move to category C for future noise modelling as there were 83,200 people within the 51dB _{LAeq,16h} contour which is above the mandated minimum threshold of 25,000 (and below the maximum threshold
		of 200,000) for category C. In Stage 3, when the L _{Aeq} contours are fully quantified, all noise modelling will therefore be undertaken to category C standards. When considering future forecast 10 years from implementation, although a full quantified <u>10 year forecast</u> is not available at this stage, given the current population levels are 116,800 below the maximum daytime category C threshold (76,800 below the recommended minimum daytime threshold for category B) and also given the low density of conurbations outside of the 51dB contour, it is expected that the daytime contours will remain within the category C threshold as it would require at least a doubling of population within the 51dBLAeq,16h contour to be required to move up a category. The night-time contour differences are a similar magnitude. The CAP2091 category will be confirmed at Stage 3 when full quantified noise modelling takes place and a 10 year forecast will be available.
		Continuous Climb As part of some of the departure options, we describe how they are anticipated to continuously climb to above 6000ft. The scope of this Level 1 ACP is up to 7000ft and therefore typically we would seek continuous climb to 7000ft. As discussed in our Stage 2A document, even with a redesign and modernisation of the airspace there is another significant and fixed constraint that requires consideration when looking at continuous climb up to 7000ft. This is the Transition Altitude (TA), which is 6000ft in the Scottish TMA.
		In summary, any SIDs that climb above 6,000ft need to climb continuously from the runway, to at least FL90 in order to guarantee continuous climb above 7000ft. As the NATS NERL ACP, which looks at the airspace above 7000ft, is not yet at the stage to be able to inform whether climb to FL90 is achievable, for the basis of this IOA we have assumed that aircraft will be able to continuously climb to 7000ft for the purposes of the noise modelling at this stage. We will revisit this as part of our Full Options Appraisal when we have further information from NERL around the upper airspace network.
		Due to the effects of mixing and dispersion, emissions of NOx, PM10 and PM2.5 from aircraft travelling from aircraft above 1,000 feet are unlikely to have a significant impact on local air quality. The DfT's Air Navigation Guidance (2017) states that: "Studies have shown that NOx emissions from aviation related operations reduce rapidly beyond the immediate area around the runway. Due to the effects of mixing and dispersion, emissions from aircraft above 1,000 feet are unlikely to have a significant impact on local air quality. Therefore, the impact of airspace design on local air quality is generally negligible compared to changes in the volume of air traffic and that of the local transport infrastructures feeding the airport." ICAO's Airport Air Quality Manual (International Civil Aviation Organization. Doc 9889 Airport Air Quality Manual. Second Edition, 2020. ICAO, Canada.) similarly states that 1,000ft is the typical limiting altitude for ground-level NO2 impacts from aircraft emissions.
	Air Quality	Assessment of Arrival Options As part of this IOA we will qualitatively describe any expected changes below 1000ft. Aircraft arriving at Glasgow fly a standard 3-degree angle of approach and descend through 1000ft whilst aligned with the extended runway centreline. This is in the last stages of the final approach. It's therefore very unlikely that any arrivals options will offer any significant impact air quality however we will review each option for changes below 1000ft.
		Assessment of Departure Options Aircraft departing Glasgow have varying climb performance depending on aircraft type and therefore different aircraft reach 1000ft at different locations. Today, virtually all Glasgow departures climb straight ahead for 5nm and during this they climb above 1000ft. Our IOA will qualitatively describe any changes to the lateral locations of flight paths which could occur below 1000ft; whilst a change in route will not impact the totality of emissions, it may result in a change in location of the emissions which we will qualitatively describe.
	Greenhouse gas impact	As emissions of greenhouse gases arise from the combustion of aviation fuel and fuel burn is linked to track mileage, for this IOA we have estimated the differences in track miles between the baseline and each route which forms part of the options. We have then applied a percentage weighting, based on the anticipated usage of the routes, to understand the overall performance of the option. This weighting is based on 2019 movement data. A table with full details is shown in Technical Appendix A.
		As part of the Full Options Appraisal (Stage 3A), we appraise track mileage, fuel burn and the associated greenhouse gas impact in further detail.
	Capacity / resilience	Subject matter experts will qualitatively assess any impacts to capacity and/or resilience against the baseline scenario.
Wider Society		CAP1616 outlines the consideration of impacts upon tranquillity 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.
	Tranquillity	In Scotland, the equivalent of AONB are National Scenic Areas (NSA) and we've therefore included overflight data around these, National Parks, and designated quiet areas (DQA) as part of our Tranquillity assessment. At this stage of the ACP, we will qualitatively assess whether the option differs from current day and whether this has the potential to impact tranquillity with regards to noise and AONB.
	Biodiversity	The effects of airspace change on ecology or biodiversity are expected to be minimal. CAA guidance states that "In general, airspace change proposals are unlikely to have an impact upon biodiversity because they do not involve ground-based infrastructure. As such they are unlikely to have a direct impact that would engage the Birds or Habitats legislation." Though there is limited research available on the effects of aircraft noise on wildlife, there is some evidence that disturbance effects associated with aircraft can occur during take-off and landing where aircraft are below around 500m (~1,640ft). [Drewitt, A. (1999) Disturbance effects of aircraft on birds. English Nature Birds Network Information Note]. Consideration will therefore be given to the effects on ecology and biodiversity where aircraft overfly Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interest, particularly at altitudes below 2,000ft.
General Aviation	Access	As part of this IOA, we will qualitatively describe the potential impacts and benefits to general aviation access as a result of each option. This will be partially informed by the engagement undertaken with GA users during Stage 2. At the full options appraisal stage, we will have detailed plans for CAS and will quantify any increase or decreases in CAS volume.
General Aviation / Commercial airlines	Economic impact from increased effective capacity	The IOA will qualitatively estimate the differences between the option and the baseline. As part of the FOA at Stage 3 we will quantitively appraise any economic benefits or impacts in further detail.

	Fuel burn	As the combustion of aviation fuel is linked to track mileage, for this IOA we have estimated the differences in track miles between the baseline and each route which forms part of the options. We have then applied a percentage weighting, based on the anticipated usage of the routes, to understand the overall performance of the option. This weighting is based on 2019 movement data. Tables with full details are shown in Technical Appendix A. Alongside the estimated quantitative information, we will provide a qualitative statement around continuous climb and continuous descent operations which also have the potential to impact fuel burn.				
Commercial	Training costs	The IOA will qualitatively estimate whether any training costs would be incurred by Commercial airlines in order to implement the option.				
airlines	Other costs	The IOA will qualitatively estimate whether any other costs would be incurred by Commercial airlines in order to implement the option.				
Aimont / Air	Infrastructure costs	The IOA will qualitatively estimate whether any infrastructure costs would be incurred by the airport or ANSP in order to implement the option.				
Airport / Air navigation service	Operational costs	The IOA will qualitatively estimate whether any operational costs would be incurred by the airport or ANSP in order to implement the option.				
provider	Deployment costs	The IOA will qualitatively estimate whether any deployment costs would be incurred by the airport or ANSP in order to implement the option.				
All	Safety	A qualitative safety assessment of each option will be undertaken which compares against the baseline.				
AII	Interdependenci es, conflicts, and trade-offs	An airspace change proposal at a Stage 2 gateway in the CAP 1616 process should specify any interdependencies with other airspace changes identified in Iteration 2 of ACOG's Airspace Change Masterplan. This IOA will take the information contained within the masterplan document around potential areas of conflict/ interdependencies and identify if the option falls within these areas. This will give an indication of whether there is the potential for trade-offs with othe airspace change sponsors required during Stage 3. The figure below shows the illustration provided within the masterplan that outlines Glasgow's potential interdependencies. Figure 5 Potential Scottish TMA GLA EDI Interactions (From ACOG Masterplan)				
All	Airspace Modernisation Strategy	 Our IOA will include a qualitative, high level, assessment of how the design options perform against the vision and parameters/strategic objectives of the <u>Airspace Modernisation Strategy</u>. CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. And the parameters as: create sufficient airspace capacity to deliver safe and efficient growth of commercial aviation progressively reduce the noise of individual flights, through quieter operating procedures and, in situations where planning decisions have enabled growth which may adversely affect noise, require that noise impacts are considered through the airspace design process and clearly communicated 				

are considered through the airspace design process and clearly communicated
use the minimum volume of controlled airspace consistent with safe and efficient air traffic operations
in aiming for a shared and integrated airspace, facilitate safe and ready access to airspace for all legitimate classes of airspace users, including commercial traffic, General Aviation, and the military, and new entrants such as drones and spacecraft
not conflict with national security requirements (temporary or permanent) specified by the Secretary of State for Defence.

4. Initial Options Appraisal

The following tables outline our Initial Options Appraisal for each option and provide an assessment of the four baseline scenarios.

4.1. Runway 23 Westerly Departures Baseline

Runway 23 Westerly Departures Baseline

		-		
	LON		RTII	
CLYDE			//	
		LS!	1	
ROBBO				
A	SUC			
			A H	
\nearrow			5	X
\searrow				SIVILA
NORBOT	RN //			

This option represents the do-nothing scenario for Glasgow Westerly SIDs. Today, all Glasgow SIDs climb straight ahead to 5nm before turning. This means that the minimum departure interval between successive departing aircraft is at least 2 minutes. The result is that during peak departure times, aircraft are held on the runway and at the runway holding points, leading to increased emissions and delay. Beyond 5nm, aircraft are typically vectored off the SID centrelines by ATC, resulting in broad swathes.

Some aircraft less than 5700kg MTWA do not have to depart via the SIDs. These are usually non-jet aircraft and therefore slower than jet aircraft. These aircraft are vectored by ATC which helps them turn towards their destination early, reduces track miles and reduces departure delays.

Glasgow Airport's current SIDs are dependent on conventional ground-based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is an interim measure that only can only be used to bridge the gap ahead of FASI implementation. The AMS mandates airports implement IFPs based on PBN and doing nothing does not meet that national requirement.

For more information on our do-nothing scenario, which was discontinued as part of the Design Principle Evaluation, please see our Stage 2A document on the CAA's Airspace Change Portal.

		Evaluation, please see our Stage 2A document on the CAA's Airspace Change Portal.			
Group	Impact	Qualitative Assessment			
		Due to wind direction, westerly operations on qualitative assessment has considered this m Aircraft above 5700kg departing from Glasgo are typically vectored off the SID centrelines vectoring heatmaps below which have been g	odal split with daily movements av w climb straight ahead to 5nm be by ATC resulting in dispersion. T	eraged across the year. fore turning. Beyond 5nm, aircraft	
				1	
Communities	Noise impact on health and quality of life	Figure 6 Runway 23 Departure Vectoring Swa The Technical Appendix to this document in important to note that this vectoring data is n however it does provide a preliminary mean options. Table 10 below includes data based of for if aircraft were to follow the centreline of the Table 10 Westerly departures baseline overfli	cludes a larger version of this m not modelled in the same way as ns of comparison between this b on this NTK vectoring map and dat e current published SID:	the centreline overflight contours, aseline and the airspace change	
		System	Area (km²)	Population	

RWY23	141.18
Baseline (Centreline – optioneering tool)	141.10

RWY 23 Baseline – Vectoring (NTK data)

163216

29838

The data from these tables will be used to compare the westerly departure options against the 'do nothing' baseline.

547.32

In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals, and places of worship; the full data around these is shown in Technical Appendix A, and as part of this IOA we will provide a qualitative statement around this data.

60dB and 65dB L_{Amax}

Technical Appendix A includes 60dB and 65dB L_{Amax} contours and data for the centreline baseline, to aid comparison between the baseline and the options. 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal.

Table 11 Runway 23 Departures Baseline LAMax Data

	60dB L _{Amax}		65dB L _{Amax}	
System	Area (km²)	Population	Area (km²)	Population

		RWY23 Baseline (Cer optioneering too	treline – 285.37 I)	9 9 ⁷	120 95.69	53704
		The data from these tables will be used to compare the westerly departure options against the 'do nothing' baseline.				
			artures make up a compon rs from 2017, as an indica			
		Noise Abatemen As this baseline re	t Procedures flects current day, there w	ould be no changes	to NAPs as a result of th	nis option.
			configuration does not offe approach within 5nm of th			
			ity are considered for chan nt impact on local ground		000ft (200m). Aircraft flyi	ng above this are unlikely
	Air Quality	aircraft reach 1000 during this they cli	Glasgow have varying cl Oft at different locations. To mb above 1000ft. Our IOA occur below 1000ft.	day, virtually all Gla	sgow departures climb st	raight ahead for 5nm and
		is linked to track	nhouse gases arise from t length, we have initially lo ssessment is therefore linl	ooked at the track	length for the baseline v	vesterly departures. The
		Table 12 Westerly	v departure baseline – Indie	cative track miles		
		RWY 23		Baseline (Centreli		
			TON	nm	% Weighting	Score
				38.50	3.69	142.065
			NORBO – SUBUK NORBO – LAKEY	93.40	26.2	2447.08
				93.40	32	2988.8
	Greenhouse gas		LUSIV-DCS	84.80	10.66	903.968
	impact	DEPS	TLA	54.70	0.41	22.427
			PERTH	69.80	1.23	85.854
			FOYLE	33.00	0.82	27.06
			LOMON	26.70	2.05	54.735
			CLYDE	19.50	2.87	55.965
			ROBBO	19.60	2.05	40.18
				Т	otal 82%	6768.134
		advantages/disad shorter than a typi	he differences between th vantages of the option. Th cal flight today. As CO ₂ em describe anticipated green	is estimation will co hissions are linked to	nsider whether the aircra	ft tracks will be longer o n fuel burnt, this will allow
Wider Society				e majority of depar	tures flying straight ahea	
Wider Society		Glasgow's current results in a capac This leads to hold movement number	t SID configuration, with the ity constraint on the airpo ding on the ground which rs at the airport will result i tion are not fit for purpose	rt, as aircraft are or results in increase n increases in grour	nly able to depart with at d emissions and delays. nd holding and delay and	d to 5nm before turning least 2-minute intervals Any future increases in
Wider Society	Capacity / resilience	Glasgow's current results in a capac This leads to hold movement numbe existing configurat In future, increase disbenefits. As tra the additional com subsides, howeve	t SID configuration, with the ity constraint on the airpo- ding on the ground which rs at the airport will result in tion are not fit for purpose the d forecast movements acro- ffic increases, flow restriction plexity and workload. Flow r in doing so they generated	rt, as aircraft are or results in increase n increases in grour for future growth at oss the Scottish TMA ons are likely to be regulations stabilise ground delay for G	aly able to depart with at d emissions and delays. and holding and delay and the airport. A are anticipated to result put in place in order for A e the number of movement clasgow.	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage nts until the peak in traffic
Wider Society	Capacity / resilience	Glasgow's current results in a capac This leads to hold movement number existing configurat In future, increase disbenefits. As tra the additional com subsides, however It is therefore pos delay at Glasgow	t SID configuration, with the ity constraint on the airpo- ding on the ground which rs at the airport will result in tion are not fit for purpose the d forecast movements acro- ffic increases, flow restricting plexity and workload. Flow	rt, as aircraft are or results in increased n increases in grour for future growth at oss the Scottish TMA ons are likely to be regulations stabilise ground delay for G c levels, this baselin no change to the air	aly able to depart with at d emissions and delays. and holding and delay and the airport. A are anticipated to result put in place in order for A e the number of movement ilasgow. The scenario would result respace around Glasgow in	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage nts until the peak in traffic in increases in departure
Wider Society	Capacity / resilience	Glasgow's current results in a capac This leads to hold movement number existing configurat In future, increase disbenefits. As tra the additional com subsides, howeve It is therefore pos delay at Glasgow FASI programme This baseline is do be decommission is currently no lon	t SID configuration, with the ity constraint on the airpo ding on the ground which rs at the airport will result i ion are not fit for purpose d forecast movements acro ffic increases, flow restricting plexity and workload. Flow r in doing so they generate sible that, with future traffic airport. In addition to this,	rt, as aircraft are or results in increased n increases in grour for future growth at oss the Scottish TMA ons are likely to be regulations stabilise ground delay for G c levels, this baselin no change to the air its associated with the ground-based navigo vide programme und gow's SIDs when NE	aly able to depart with at d emissions and delays. and holding and delay and the airport. A are anticipated to result put in place in order for A e the number of movement alasgow. The scenario would result respace around Glasgow in the programme. gation aids called VORs. ler the Airspace Modernis	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage nts until the peak in traffic in increases in departure may also inhibit the wide This equipment is due to sation programme. There
Wider Society	Capacity / resilience	Glasgow's current results in a capac This leads to hold movement number existing configurat In future, increase disbenefits. As tra the additional corr subsides, however It is therefore pos delay at Glasgow FASI programme This baseline is do be decommission is currently no lon critical operationa CAP1616 outlines of Outstanding Na we've therefore in of our Tranquillity	t SID configuration, with the ity constraint on the airpo- ding on the ground which rs at the airport will result in tion are not fit for purpose the d forecast movements acro- ffic increases, flow restricting plexity and workload. Flow r in doing so they generated sible that, with future traffic airport. In addition to this, of change and AMS benefic ependent on conventional ed as part of a NERL UK was g term ² resilience for Glass	rt, as aircraft are or results in increased n increases in grour for future growth at oss the Scottish TMA ons are likely to be regulations stabilise ground delay for G c levels, this baselin no change to the air its associated with the ground-based navig- vide programme und gow's SIDs when NE s of revenue.	aly able to depart with at d emissions and delays. and holding and delay and the airport. A are anticipated to result put in place in order for A e the number of movement alasgow. The scenario would result respace around Glasgow of the programme. gation aids called VORs. ler the Airspace Modernis ERL decommissions the with specific reference to I ent of AONB are National Parks, and designated q gualitatively assess wheth	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage ints until the peak in traffic in increases in departure may also inhibit the wide This equipment is due to sation programme. There /ORs, which will result in National Parks and Areas Scenic Areas (NSA) and uiet areas (DQA) as par ner the option differs from
Wider Society	Capacity / resilience	Glasgow's current results in a capac This leads to hold movement number existing configurat In future, increase disbenefits. As tra the additional com- subsides, however It is therefore pos delay at Glasgow FASI programme This baseline is de be decommission is currently no lon critical operationa CAP1616 outlines of Outstanding Na we've therefore in of our Tranquillity current day and w Table 13 shows de follow Glasgow's of baseline.	t SID configuration, with the ity constraint on the airpo- ding on the ground which rs at the airport will result in tion are not fit for purpose in d forecast movements acro- ffic increases, flow restricting plexity and workload. Flow r in doing so they generated sible that, with future traffic airport. In addition to this, of change and AMS benefic ependent on conventional ed as part of a NERL UK was g term ² resilience for Glass the consideration of impact tural Beauty (AONB). In Secunded overflight data around assessment. At this stage of hether this has the potentian ata on the overflight of the existing SID centrelines. The	rt, as aircraft are or results in increased in increases in grour for future growth at the ons are likely to be regulations stabilise e ground delay for G c levels, this baselin no change to the air its associated with the ground-based navig- vide programme und gow's SIDs when NE s of revenue. the upon tranquillity we cotland, the equivaled and these, National of the ACP, we will de al to impact tranquill se areas, based on the data from this tab	aly able to depart with at d emissions and delays. and holding and delay and the airport. A are anticipated to result put in place in order for A e the number of movement clasgow. The scenario would result respace around Glasgow of the programme. The programme. The Airspace Modernis ERL decommissions the Airspace Modernis	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage ints until the peak in traffic in increases in departure may also inhibit the wide This equipment is due to sation programme. There /ORs, which will result in National Parks and Areas Scenic Areas (NSA) and uiet areas (DQA) as par ner the option differs from and AONB.
Wider Society		Glasgow's current results in a capac This leads to hold movement number existing configurat In future, increase disbenefits. As tra the additional com subsides, however It is therefore pos delay at Glasgow FASI programme This baseline is du be decommission is currently no lon critical operationa CAP1616 outlines of Outstanding Na we've therefore in of our Tranquillity current day and w Table 13 shows d follow Glasgow's o baseline. <i>Table 13 Westerly</i>	t SID configuration, with the ity constraint on the airpo- ding on the ground which rs at the airport will result it ition are not fit for purpose of d forecast movements acro- ffic increases, flow restricti- plexity and workload. Flow r in doing so they generated sible that, with future traffic airport. In addition to this, of change and AMS benefic ependent on conventional ed as part of a NERL UK was g term ² resilience for Glasg issues and significant loss the consideration of impact tural Beauty (AONB). In Sec cluded overflight data arou- assessment. At this stage of hether this has the potenti- ata on the overflight of the existing SID centrelines. The other this baseline – Traffic traffication of the constituent of the constituent of the existing SID centrelines. The	rt, as aircraft are or results in increases in increases in groun for future growth at poss the Scottish TMA ons are likely to be regulations stabilise ground delay for G c levels, this baselin no change to the air its associated with the ground-based navig- vide programme und gow's SIDs when NE s of revenue. The air revenue is a social to impact tranquillity we cotland, the equivale and these, National of the ACP, we will c al to impact tranquill se areas, based on the data from this tab	A are anticipated to result put in place in order for A e the number of movement again aids called VORs. The Airspace around Glasgow of the programme. The programme. The Airspace Modernis ERL decommissions the Airspace to I ent of AONB are National Parks, and designated q qualitatively assess wheth lity with regards to noise the NTK vectoring basel ole will be used to compa	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage ints until the peak in traffic in increases in departure may also inhibit the wide This equipment is due to sation programme. There VORs, which will result in National Parks and Areas Scenic Areas (NSA) and uiet areas (DQA) as par her the option differs from and AONB. ine and if aircraft were to re the westerly departure
Wider Society		Glasgow's current results in a capac This leads to hold movement number existing configurat In future, increase disbenefits. As tra the additional com- subsides, however It is therefore pos delay at Glasgow FASI programme This baseline is de be decommission is currently no lon critical operationa CAP1616 outlines of Outstanding Na we've therefore in of our Tranquillity current day and w Table 13 shows de follow Glasgow's of baseline.	t SID configuration, with the ity constraint on the airpo- ding on the ground which rs at the airport will result it ition are not fit for purpose of d forecast movements acro- ffic increases, flow restricti- plexity and workload. Flow r in doing so they generated sible that, with future traffic airport. In addition to this, of change and AMS benefic ependent on conventional ed as part of a NERL UK w g term ² resilience for Glasg l issues and significant loss the consideration of impact cluded overflight data arou- assessment. At this stage of hether this has the potenti- ata on the overflight of the existing SID centrelines. The departure baseline – Traffic NSA area	rt, as aircraft are or results in increased in increases in groun for future growth at the ons are likely to be regulations stabilise e ground delay for G c levels, this baselin no change to the air its associated with the ground-based navig- vide programme und gow's SIDs when NE s of revenue. the upon tranquillity we cotland, the equivale and these, National of the ACP, we will call to impact tranquill se areas, based on the data from this tab	A are anticipated to result put in place in order for A e the number of movement asgow. The scenario would result respace around Glasgow respace around Glasgow result attraspace around Glasgow result attraspace around Glasgow result space around Glasgow result attraspace Address and the programme. The programme. The Airspace Modernis ERL decommissions the version of AONB are National Parks, and designated qualitatively assess wheth lity with regards to noise the NTK vectoring basel one will be used to compa	d to 5nm before turning least 2-minute intervals Any future increases in therefore the SIDs in the in capacity and resilience TC and pilots to manage ints until the peak in traffic in increases in departure may also inhibit the wide This equipment is due to sation programme. There /ORs, which will result in National Parks and Areas Scenic Areas (NSA) and uiet areas (DQA) as par ner the option differs from and AONB.

² Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		RWY23 Baseline (Centreli Optioneering to		0	0		0	0		0	0	
		In addition to the dat alongside the depart			•••		s maps wł	nich show I	NSAs, Na	tional Pa	irks and I	JQAs
		 The effects of airspace change on ecology or biodiversity are expected to be minimal. CAA guidance sta "In general, airspace change proposals are unlikely to have an impact upon biodiversity because they do not ground-based infrastructure. As such they are unlikely to have a direct impact that would engage the I Habitats legislation." Though there is limited research available on the effects of aircraft noise on wildlife, some evidence that disturbance effects associated with aircraft can occur during take-off and landing where are below around 500m (~1,640ft). Consideration will therefore be given to the effects on ecology and biod where aircraft overfly Special Protection Areas, Special Areas of Conservation, National Parks, National Areas, and Sites of Special Scientific Interest, particularly at altitudes below 2,000ft. Table 14 shows data on the overflight of these areas, based on the NTK vectoring heatmap and if aircraft follow Glasgow's existing SID centrelines. The data from this table will be used to compare options aga westerly departure baseline. <i>Table 14 Biodiversity – baseline areas overflown</i> 								do not in e the Bir vildlife, th y where a nd biodiv ational S	volve eds or ere is ircraft ersity cenic ere to	
	Biodiversity	System	SAC count	SAC area	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area
		RWY 23 Baseline – Vectoring (NTK data)	3	1.42	32	65.82	12	58.95	1	1.68	1.00	0.02
		RWY 23 Baseline (Centreline – Optioneering tool)	0	0	3	23.69	1	21.89	0	0	0	0
		Below 2000ft based Conservation, Natior of aircraft. Lower an Barr Lochs SSSI, ho to follow the NAP an	nal Parks d slower wever th	a, National S aircraft, clin is is likely to	Scenic Area mbing at be o be infrequ	as, and S elow a 6% uently as	ites of Sp % climb gr lower and	ecial Scien adient, ma slower aire	tific Intere	est for the	e vast ma le Sempl	ajority e and
		This baseline scena place today. The opt								(CAS) ar	rangeme	nts in
General Aviation	Access											
	Figure 7 Glasgow Airport Control Zone and Control Area Chart (See eAIP for full details) Within c.35nm of Glasgow airports are Edinburgh and Glasgow Prestwick Airport each with their own O Airspace (CAS) volumes. In addition to this, the Scottish TMA airspace sits above and around the airports which generates the volumes shown in Figure 5. The controlled airspace at Glasgow has varying lower a								ports' airs	space		

Airspace (CAS) volumes. In addition to this, the Scottish TMA airspace sits above and around the airports' airspace which generates the volumes shown in Figure 5. The controlled airspace at Glasgow has varying lower and upper limits with the volume closest to the airport going down to ground level. This is the Glasgow CTR shown in red outline. Also, in this figure can be seen Cumbernauld Airport approximately 15nm to the east of Glasgow airport which sits outside CAS where the base of the CTA is 3000ft. This is indicated with a yellow dot.

		It is apparent from previous continual GA engagement by Glasgow and CAA's Airspace Classification Review that the CAS structures to support Glasgow Airport's operation are out of date and the CTR itself can likely be reduced in size. Whilst the existing baseline scenario will not result in the requirement for more airspace, this option offers no opportunity to simplify the airspace boundaries or reduce the size of CAS which is something Glasgow has been specifically working with GA stakeholders to try to achieve.
	Economic impact from increased effective capacity	There will be no change from today as a result of this option; later in this IOA we will qualitatively estimate the differences between this, and the airspace change options.
General Aviation / Commercial airlines	Fuel burn	As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline westerly departures. When departing from Glasgow, the majority of aircraft fly straight ahead until 5nm and then are vectored by air traffic control, this means that track length is varied from flight to flight. For the purposes of comparing our westerly SID options against the baseline scenario, we have taken the track length of the SID centrelines as an initial indication of 'do nothing' track length. We have then applied a weighting based on SID usage to provide an overall total track mileage for the system. At the Stage 3 full options appraisal track length and fuel burn will be modelled

		in further detail.						
		Table 15 Westerl	y SID Track Mileage					
			Baseline (Centreline)					
		RWY 23		nm	% Weighting	Score		
			TRN	38.50	3.69	142.065		
			NORBO – SUBUK	93.40	26.2	2447.08		
			NORBO – LAKEY	93.40	32	2988.8		
			LUSIV-DCS	84.80	10.66	903.968		
			TLA	54.70	0.41	22.427		
		DEPS	PERTH	69.80	1.23	85.854		
			FOYLE	33.00	0.82	27.06		
			LOMON	26.70	2.05	54.735		
			CLYDE	19.50	2.87	55.965		
			ROBBO	19.60	2.05	40.18		
			<u> </u>	otal	_	6768.134		
		coordination with We will qualitative anticipated advar aircraft tracks will climb.	other traffic in the airspace ely estimate the differenc ntages/disadvantages of t be longer or shorter than	ce. es between this basel he option against curr a typical flight today ar	ine and the option, to ent day. This estimation ad will also consider the	mbing due to the tactical understand if there are any on will consider whether the e opportunity for continuous		
Commercial airlines	Training costs	As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
annies	Other costs	As this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
	Infrastructure costs	As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
Airport / Air navigation service provider	Operational costs	this IOA we will e Glasgow Airport's are currently und substitution to mit the gap ahead of	stimate the difference be current SIDs are depend ergoing a rationalisation igate VOR rationalisation FASI implementation. Fa	tween our options and lent on conventional g programme by NATS however this is an inte ailure to mitigate the in	this baseline. round-based navigatic NERL. Glasgow is cu erim measure that only npacts of VOR rationa	e will be no change; later in on equipment (VORs) which urrently investigating RNAV can only be used to bridge lisation in the long term will ing the requirements of the		
	Deployment costs		already in operation, there I estimate the difference I			ere will be no change; later		
All	Safety	growth could how	ever result in increased o	complexity and workloa	ad for Air Traffic Contro	at Glasgow. Future traffic ollers and pilots, which may g on the ground, in order to		
All	Interdependencies, conflicts, and trade- offs	which are separa existing ScTMA	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with Westerly departures which are separated from Prestwick's airspace and do not conflict with Edinburgh's traffic below 7000ft. The existing ScTMA route structure shares airways for use by both Edinburgh and Glasgow results in higher ATC workload and less efficient profiles in the airspace above 7000ft.					
AII	AMS	Deliver quicker, q by UK airspace. Doing nothing wit maximise benefit	h Westerly departures wil	I not align with the AM of the ScTMA. No cl	IS. It will not enable ar	e who use and are affected by environmental benefits or to ACP submission will not		

4.2. Runway 23 Westerly Departure Option A

Runway 23 W	esterly Departures – (Option A
TRY ID	DORNHFOUL PERTI	Offset right departures with turns at c.2nm and c.7nm from the runway. Offset left departures with turns at c.1nm from the runway. NORBO traffic is shared between a left turn departure route and the departure route that offsets right and then turns left at c.7nm with both routes available at the same time. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. Overflight This option would see the NORBO route which accounts for 58% of Glasgow's overall movements, split into two with offset left and right departures. This would mean that westerly departures would not overfly the same areas as easterly approaches, providing some noise relief for communities such as Howwood and Johnstone under the final approach. It would however mean that areas not currently overflown frequently by departures will now be overflown on a more frequent basis. Option Overflight Contours (Black outline) with estimated % of overall departures 2019 baseline average summer day overflight swith:
		3% 3% 32% 32% 26% 10%
Communitie s	Noise impact on health and quality of life	Figure 8 Westerly Option A Overflight and 2019 baseline NTK data The NTK vectoring baseline data and population data shows that the offset to the left removes overflight of some areas of Johnstone and Elderslie, however this is shifted to parts of east Elderslie and also captures some westerly parts of Foxbar. Beyond this point the route, which would account for around 26% of overall departures, overflies the populated areas of Uplawmoor, Dunlop and Stewarton. The offset to the right NORBO route accounts for around 32% of overall departures, and results in overflight of Linwood and Kilbarchan at lower levels, and overflight of parts of Lochwinnoch and Kilbirine at higher levels. From the NTK vectoring data shown in Figure 8, we can see that these two offset routes would result in some areas not overflown by westerly departures today, or overflown at a relatively low rates, to be overflown at a higher frequency in future albeit splitting the NORBO departures into two will help to mitigate this through a reduction of frequency of overflight should there be just one NORBO route. The ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs offset right, moving the overflight contours closer to the populated area of Linwood and the Bridge of Weir. Above 4000ft, the routes largely avoid dense areas of population instead routing across Loch Lomond National Park, and along the River Clyde. The overflight contours do however overfly

in future would be expected to concentrate traffic, albeit at comparatively low percentages compared to other routes such as NORBO. At higher altitudes the CLYDE/LOMON/FOYLE SIDs overfly areas not currently overflown by westerly departures and this occurs over areas with lower population density.

parts of the port of Glasgow, Dumbarton and Alexandria. The vectoring baseline data demonstrates that these SIDs mainly route over areas already overflown today, however there is currently broad dispersion, whereas PBN routes

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the Highlands and Islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, it is not expected that the contours would increase in size to overfly any additional dense areas of population with the exception of the CLYDE/LOMON/FOYLE routes, which may overfly Cardross although they are currently positioned over the River Clyde where possible.

The Technical Appendix to this document includes images and data which illustrate the NTK vectoring baseline data, the baseline centreline overflight contour data and the option's centreline overflight contour data. It's important to note that the vectoring baseline data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between the baseline, and the airspace change option.

Overflight data

Table 16 gives an overview of the Option A overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown

more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is an increase in the area of the overflight contours and the number of population overflown which can be attributed to introducing an additional NORBO SID to split the traffic; the benefits and impacts of this will be quantified at Stage 3 should this option progress.

Table 16 Westerly departures option A overflight data

System	Area (km²)	Population	
RWY 23 Baseline (Vectoring)	547.32	163216	
RWY23 Baseline (Centreline)	141.18	29838	
RWY23 Option A	262.55	58671	

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number overflown compared to the baseline centreline data. Compared to the vectoring data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage the data does not consider the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option A against the baseline. 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 17 shows an increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour. This is due to the earlier divergence of SIDs compared to the baseline, however the baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 17 60dB and 65dB LAMax Data – Rwy23 Dep Option A

	60dE	3 L _{Amax}	65dB L _{Amax}		
System	Area (km²)	Area (km ²) Population		Population	
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704	
RWY 23 Dep Option A	493.41	143425	178.62	77760	

L_{Aeq}

The westerly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall shape of the L_{Aeq} contours. The offset departures deviate from current day, and it is expected that this change will result in the daytime L_{Aeq} contours shortening compared to current day, however also extending further north-west and south-east to reflect the offset tracks. Review of the population density suggests that this may reduce the shape/size over Howwood, however it may result in population within Linwood and Elderslie being in a higher dB contour than today. Some areas of Linwood, and Foxbar, not currently within the L_{Aeq} contours may now fall into the lower dB contours.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeg contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

Noise mitigations

The option offers noise relief for those communities currently located under immediate climb out and final approach, as the offset departures route aircraft away from the final approach track. It also aims to share the impacts of noise by splitting the NORBO departures (which make up 58% of Glasgow's overall movements). Unlike other options, it does not offer respite configurations that would be alternated and achieve predictable respite.

Air Quality Air Quality There may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be

		slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic (M8/A737) to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option A will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
	Capacity / resilience	This option sees the SIDs splitting before 5nm, which will improve capacity compared to the baseline as aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. In addition to this, this option splits the NORBO departures across two routes which will enhance operational performance throughout the day and reduce ground delays and CO ₂ contributions. In order to gain the full benefits of this, future investment may be required in additional taxiway infrastructure to enable aircraft to be 'lined up' in the correct order before take-off however this is not within scope of an Airspace Change project. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids,
		which provides resilience. This equipment is due to decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term ³ resilience for Glasgow's SIDs when NERL

³ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

			awal progr		UI PDIN C	sids is a	bsolutely e	ssential fo	or the Gia	asgow op	eration	rollowing
		Table 18 shows data follow Glasgow's exis	a on the c	overflight o		eas, bas	ed on the N	NTK vecto	ring base	line and i	f aircraf	t were to
		Table 18 RWY 23 Westerly Departures Option A – Tranquillity overflown										
		System	N	SA area	NSA co		lational ks count	Nationa Parks are		count	DQA aı	rea
	Tranquillity	RWY 23 Baseline Vectoring (NTK da		0.02	1		1.68	1		0	0	
	rianquinty	RWY23 Baseline (Centreli		0	0		0	0		0	0	
		Optioneering too RWY 23 Option		0	0		0	0		0	0	
		The data shows that National parks compa contour of this option	ared to th	e vectoring	g baseline.	Technic	al appendix	A contair	is a map	which sho		
		Table 19 shows data to follow Glasgow's e				areas up	o to 7000ft b	ased on th	ne NTK he	eatmap ar	nd if airc	raft were
		Table 19 Runway 23	B Departur	e Option A	– Biodive	rsity – aı	reas overflo	wn betwee				
		System	SAC count	SAC area	SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area
		RWY 23 Baseline – Vectoring (NTK data)	3	1.42	32	65.82	12	58.95	1	1.68	1.00	0.02
	Biodiversity	RWY 23 Baseline (Centreline – Optioneering tool)	0	0	3	23.69	1	21.89	0	0	0	0
		RWY 23 Dep Option A	0	0	26	34.66	13	33.33	0	0	0	0
		Below 2000ft no ove Scenic Areas, and S baseline, Castle Sem	ites of Sp	ecial Scier	ntific Intere	ests is ex	kpected for					
		Lower slower aircraft Barmufflock Dam and SID and the vast maj will be very minimal. We will fully quantify	d Chlocho jority of ai	odrick Ston rcraft will c	e SSSIs b climb abov	elow 200 e 2000ft	00ft. Given t before ove	he low ove rflying the	erall % of site, it is	aircraft expected	cpected that any	to fly the impacts
		Appraisal at Stage 3. Option A is likely to c existing CAS whilst o	ontribute						this optic	on can be	contain	ed within
General Aviation	Access	We created an "illus departure options con understand if there is compared to existing c.47nm ³ smaller.	strative C/ mbined to s scope to	AS volume help stake reduce the	e" which w eholder en e total volu	as a sin gagemer ıme of C	gle volume nt on potent AS. The tot	of CAS r ial impacts al volume	s. We hav of the "ill	e also use ustrative"	ed this v airspace	olume to e volume
	Economic impact from increased effective capacity	We expect the increat commercial air traffic								sitive ecor	nomic in	pact on
		We estimate that Op track mileage. This is reductions in the LU frequently than the N	s mainly o SIV, TAL	driven by t	he reducti	on in tra	ck mileage	of the NO	RBO LAP	KEY route	. There	are also
		RWY 23					e (Centrelin % Weig		ore	A		Score
			TRN			nm 38.50	3.69	_	2.065	nm 39.4		145.386
General Aviation /				BO – SUB BO – LAK		93.40 93.40	26.2 32		47.08 88.8	94.: 84.4		2470.66 2700.8
Commercial airlines	Fuel burn		LUS	IV-DCS		34.80	10.66		3.968	81.3		866.658
		DEPS	TLA PER	тц		54.70	0.41		.427	47.9		19.639
			FOY			69.80 33.00	1.23 0.82		.854 .06	60.2 26.3		74.046 21.566
			LOM	ON	:	26.70	2.05	54	.735	18.1	1 :	37.105
			CLY ROB			19.50 19.60	2.87 2.05		.965 18	16. 17 ·		47.929 35.055
		Total	RUB	00		9.60	2.00	_	.18 68.134	17.1		35.055 6418.844
		Given the improvem (subject to the NATS	S NERL					rcraft to cl	imb conti		o at lea	st 6000ft
Commercial airlines	Training costs	improvement in fuel the Flight procedures are their procedures account of the procedures account	e updated									

	Other costs	No other airline costs are foreseen.
Airport / Air navigation service	Infrastructure costs	Glasgow currently operates a homeowner relocation scheme for residential properties within the 69dB L _{Aeq,16h} contour area and noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63dB L _{Aeq,16h} contour area and residential properties within the 66dB L _{Aeq,16h} contour area. The UK Government's current aviation policy now requires financial assistance to be offered towards the noise insulation of residential properties in the 63dB L _{Aeq,16h} noise contour or above. Therefore, Glasgow Airport are currently developing a new Noise Insulation Policy for 2022, which will cover the varied property types situated within the 63dB contour area. The L _{Aeq} modelling in Stage 3 will determine if there are any increases in households within the 63dB L _{Aeq,16h} area as a result of this options as a result of the track adjustments on departure. If it does and track adjustments are proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow, with regards funding their Noise Insultation Scheme.
provider	Operational costs	This airspace change proposal is not anticipated to change airport nor ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁴ ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick Centre and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal, when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER.
		Other than the use of track adjustments on departure no safety issues are expected. The early right turn on ROBBO/FOYLE/LOMON/CLYDE/PERTH departures replicated what is tactically achieved today for most of those departures (excluding PERTH).
All	Interdependencies, conflicts, and trade- offs	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The left hand NORBO departure is separated from Prestwick's airspace and does not conflict with Edinburgh's traffic below 7000ft. In NERL's ScTMA ACP, they have options on their proposed shortlist which would cater for a duel NORBO southbound track structure. As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace.
		In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered. This option is dependent on changes to the network.
		CAP1711 describes the objective as:
		Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
All	AMS	This option would support the modernisation of the airspace by accommodating future demand in an efficient manner. The option would be expected to generate significant CO2 reductions, provide relief from noise to those most frequently overflown by Glasgow arrivals and departures and a dual NORBO track structure would mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a single NORBO SID structure).
		However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

⁴ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.3. Runway 23 Westerly Departure Option B

Runway 23 Wes	terly Departures – Optic	on B
CLYDE	LOMONFOYLE	Offset right departures with turns at c.2nm from the runway. Offset left departures with turns at c.1nm and c.5nm from the runway. NORBO traffic is shared between two departure routes however they are the same route until c.5nm from the runway. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
ROBDO		
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data
		and qualitative assessment has considered this modal split with daily movements averaged across the year. Overflight This option would see offset left and right departures. This would mean that westerly departures would not overfly the same areas as easterly approaches, providing some relief for communities such as Howwood and Johnstone under the final approach. It would however mean that areas that are not currently overflown frequently by
		departures will now be overflown on a more frequent basis. The heatmap (Figure 9) shows that the offset left departure, which equates for the largest % of departures, deviates away from the area's most frequently overflown today. The NORBO route, which accounts for approximately 58% of overall traffic, offsets to the left which results in the
		overflight contour picking up some areas not currently overflown today. The NORBO route initially follows the same track and then splits into two however based on the 737-800 climb profile, the benefits of this split mostly occur beyond 7000ft. The route initially flies over Elderslie however then endeavours to avoid areas of dense population with the exception of Barrmill which is overflown at higher altitudes. Unlike other options, this option does not share the impacts of the NORBO route, and therefore this option will result in populations overflown at a higher frequency in future without any other mitigations.
		Option Overflight Contours (Black outline) with estimated % of overall departures 2019 baseline average summer day overflight
		swathe:
Communities	Noise impact on health and quality of life	
		Figure 9 Westerly Option B Overflight and 2019 baseline NTK data
		The LUSIV and TALLA SIDs also offset left and routes over Neilston.
		The ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs offset right, moving the overflight contours closer to the populated area of Linwood and the Bridge of Weir. Above 4000ft, the routes largely avoid dense areas of population instead routing across Loch Lomond National Park, and along the River Clyde. The overflight contours do however overfly parts of the port of Glasgow. Dumbarton, and Alexandria. The heatmap demonstrates that

do however overfly parts of the port of Glasgow, Dumbarton, and Alexandria. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would be expected to concentrate traffic, albeit at comparatively low percentages compared to other routes such as NORBO.

Overflight data

The Technical Appendix to this document includes images and data which illustrate the NTK vectoring baseline data, the baseline centreline overflight contour data and the option's centreline overflight contour data. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 20 gives an overview of the Option B overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is an increase in the area of the overflight contours and the number of population overflown.

Table 20 Westerly departures option B overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option B	225.76	37664

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows a decrease in the number of care homes and places of worship overflown compared to the centreline baseline and an increase in the number of schools overflown. Number of hospitals remains the same. Compared to the vectoring data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage the data does not consider the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis, should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB L_{Amax}

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option B against the baseline. 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in Table 21 shows an increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour. This is due to the earlier divergence of SIDs compared to the baseline however the baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today. We'd expect to see a decrease in population compared to the 2019 vectored L_{Amax} contours.

Table 21 60dB and 65dB LAMax Data – Rwy23 Dep Option B

	60dE	B L _{Amax}	65dB L _{Amax}		
System	Area (km²)	Population	Area (km²)	Population	
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704	
RWY 23 Dep Option B	433.35	121890	160.28	70853	

L_{Aeq}

The westerly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall L_{Aeq} contours.

Most aircraft today fly straight ahead for 5nm before turning and the offset departures that form part of this option deviate from current day. It is expected that this change will result in the L_{Aeq} contours shortening compared to current day. The offset departure to the left, which would operate around 68% of departure movements, is expected to result in the L_{aeq} contour extending further to the south-west to reflect the offset track. When reviewing population density, this suggests there may be some benefit to Howwood and Johnstone, however the lobe would now potentially extend over Foxbar and parts of Ferguslie. The equivalent ROBBO/CLYDE/LOMON/FOYLE/ PERTH SIDs operate a far lower percentage of flights and so are likely to have less influence on the overall shape of L_{Aeq} contours however the offset route may result in some areas of Linwood, which currently sit in the lower dB L_{Aeq} contours, to move into a higher dB contour.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

Noise Mitigation

The option offers relief for those communities currently located under immediate climb out and final approach as the offset departures route aircraft away from the final approach track. Unlike other options, it does not offer respite configurations that would be alternated and achieve predictable respite. This option would not mitigate the effects for those newly overflown by a NORBO departure by splitting the NORBO departures across 2 tracks.

This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral

		tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic (M8/A737) to local air quality.			
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option B will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.			
Wider Society		This option sees the SIDs splitting before 5nm which will improve capacity compared to the baseline as aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels.			
	Capacity / resilience ⁵	However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand. Splitting the NORBO departures across two routes would enhance operational performance and reduce ground delays and CO ₂ contributions, particularly at peak periods.			
		The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide			

⁵ Summary colour corrected

Air Quality

		programme under the Glasgow's SIDs when I Glasgow operation follo	NERL decom	missions	the VORs.	Introduction			
		Glasgow operation following NERL's VOR withdrawal programme. Table 22 shows data on the overflight of these areas, based on the NTK vectoring baseline and if aircraft were to follow Glasgow's existing SID centrelines							
		to follow Glasgow's existing SID centrelines. <i>Table 22 RWY 23 Westerly Departures Option B – Tranquillity overflown</i>							
		System	NSA ar	-	A count	National	National	DQA area	DQA coun
	Tranquillity	RWY 23 Baseline - Vectoring (NTK data	0.02		1	Parks area 1.68	Parks count	0	0
		RWY23 Baseline (Centreline			0	0	0	0	0
		Optioneering tool) RWY 23 Option B	0		0	0	0	0	0
		The data shows that there is no change in overflight of DQA's and there is a reduction in overflight of National parks compared to the vectoring baseline. Technical Appendix A contains a map which overflight contour of this option alongside the baseline centreline contour, with tranquil sites also sho							ich shows th
		Below 2000ft no overfli Scenic Areas, and Site the baseline Castle Ser	ght of Specia s of Special S	al Protection Scientific	on Areas, S Interests is	Special Areas expected for	of Conservati	on, National F	arks, Nation
	Biodiversity	Lower slower aircraft, c and Barmufflock Dam s vast majority of aircraft very minimal.	SSSIs below	2000ft. G	Given the lo	w overall % o	of aircraft expe	ected to fly the	SID, and th
		We will fully quantify the Appraisal at Stage 3.	e overflight of	fbiodivers	se sites usi	ng the full Gla	asgow fleet mix	x, as part of o	ur Full Optior
		Option B is likely to con within existing CAS whi						his option car	n be containe
General Aviation	Access We created an "illustrative CAS volume" which was a single volume of CAS red departure options combined to help stakeholder engagement on potential in volume to understand if there is scope to reduce the total volume of CAS. The airspace volume compared to existing CAS in the same lateral area is c.1000						otential impact CAS. The tota	ts. We have a al volume of th	also used thine "illustrative
		The Glasgow CTR was	c.47nm ³ sma	aller.					
	Economic impact from increased effective capacity	We expect the small in economic impact on co however the continuation	ncreased effe ommercial air on of NORBO	ective cap r traffic co) departure	ompared wi es in a sing	th the baselir le track would	ne do nothing d not deliver the	westerly depa e biggest ecor	arture baselin nomic benefit
	increased effective	We expect the small in economic impact on co	ncreased effe ommercial air on of NORBO n B, when cons mainly drive	ective cap traffic co departure mpared to en by the	ompared wi es in a sing baseline r reduction in	th the baselir le track would ominal centre n track mileag	ne do nothing d not deliver the elines, will resu ge of the NOR	westerly depa e biggest ecor ult in an overal BO LAKEY ro	arture baselin nomic benefit I improvemen ute. There ar
	increased effective	We expect the small in economic impact on co however the continuation We estimate that Option in track mileage. This is also small reductions in	ncreased effe ommercial air on of NORBO n B, when con s mainly drive n the TRN,	ective cap r traffic co departure mpared to en by the NORBO S – <i>Fuel Bu</i>	ompared wi es in a sing baseline r reduction in SUBUK, LU urn Option I	th the baselir le track would ominal centre track mileag JSIV, TALLA	ne do nothing d not deliver the elines, will resu ge of the NOR , PERTH, LO	westerly depa e biggest ecor ult in an overal BO LAKEY ro	arture baselin nomic benefit I improvemen ute. There ar
	increased effective	We expect the small in economic impact on co however the continuation We estimate that Option in track mileage. This is also small reductions in routes.	ncreased effe ommercial air on of NORBO n B, when con s mainly drive n the TRN,	ective cap r traffic co departure mpared to en by the NORBO S – <i>Fuel Bu</i>	ompared wi es in a sing b baseline r reduction in SUBUK, LU <i>urn Option I</i>	th the baselir le track would ominal centre track mileag JSIV, TALLA B	ne do nothing d not deliver the elines, will resu ge of the NOR	westerly depa e biggest ecor ult in an overal BO LAKEY ro	arture baselir nomic benefit I improveme ute. There a
	increased effective	We expect the small in economic impact on co- however the continuation We estimate that Option in track mileage. This is also small reductions in routes. Table 23 Track Length	TRN	ective cap r traffic co departure mpared to en by the NORBO - <i>Fuel Bu</i> Baseline	ompared wi es in a sing b baseline r reduction in SUBUK, LU <i>urn Option I</i>	th the baselir le track would ominal centre track mileag JSIV, TALLA	ne do nothing d not deliver the elines, will resu ge of the NORI , PERTH, LOI B nm	westerly depa e biggest ecor ult in an overal BO LAKEY ro MON, CLYDE	arture baselir nomic benefit I improveme ute. There a
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General Aviation / Commercial airlines	increased effective capacity	We expect the small in economic impact on co- however the continuation We estimate that Option in track mileage. This is also small reductions in routes. <i>Table 23 Track Length</i> RWY 23 DEPS DEPS Total Given the improvement (subject to the NATS N improvement in fuel built Flight procedures are u	Arreased effeormmercial air on of NORBO an B, when consistent of NORBO an B, when consistent of NORBO an the TRN, and the	ective cap r traffic co departure mpared to en by the NORBO S - Fuel Bu Baseline nm 38.50 93.40 93.40 93.40 93.40 93.40 84.80 54.70 69.80 33.00 26.70 19.50 19.50 19.60	baseline r reduction in SUBUK, LU um Option I e (Centreli % Weigh 3.69 26.2 32 10.66 0.41 1.23 0.82 2.05 2.87 2.05 2.87 2.05	th the baselin le track would nominal centra n track mileag JSIV, TALLA 3 ne) ting Score 142.065 2447.08 2988.8 903.968 22.427 85.854 27.06 54.735 55.965 40.18 6768.13 on for all airc as part of an	ne do nothing a not deliver the elines, will resurds of the NORI ge of the NORI <	westerly depare biggest ecor a biggest ecor ult in an overal BO LAKEY ro MON, CLYDE 138.375 2399.92 2723.2 866.658 19.639 74.046 21.566 37.105 47.929 35.055 6363.493 ontinuously to at this option	arture baselin homic benefit I improvemen ute. There ar and ROBB

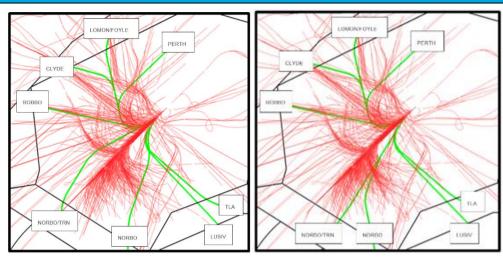
⁶ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow with regards funding their Noise Insultation Scheme.
		The initial deployment phase of the ACP may require some ATC system engineering amendments.
	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁷ ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick Centre and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER.
		Other than the use of track adjustments on departure no safety issues are expected. The early right turn on ROBBO/FOYLE/LOMON/CLYDE/PERTH departures replicated what is tactically achieved today for most of those departures (excluding PERTH)
All	Interdependencies, conflicts, and trade-	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The left hand NORBO departure is separated from Prestwick's airspace and does not conflict with Edinburgh's traffic below 7000ft. In NERL's ScTMA ACP, they have options ion their proposed shortlist which would cater for a duel NORBO southbound track structure, noting that the split of NORBO traffic takes place above 7000ft in this option. As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need
	offs	to be cognisant of their airspace. In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered. This option is dependent on changes to the network.
		CAP1711 describes the objective as:
		Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
		This option would be expected to generate significant CO_2 reductions, provide relief from noise to those most frequently overflown by Glasgow arrivals and departures.
All	AMS	However, this option would not accommodate future demand in the most effective manner as a single initial NORBO departure would likely generate future ground delay. In addition, positioning all NORBO departures over the same newly overflown communities would not mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to sharing across a dual NORBO SID structure).
		However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise.
		This option could be expected to result in reductions in the volume of Glasgow's CAS

⁷ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.4. Runway 23 Westerly Departure Option C

Runway 23 Westerly Departures – Option C



This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure periods. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a different NORBO flight path which offsets to the left, with the rest of the routes remaining the same. The reason for this would be to mitigate the small increase in mileage of a NORBO route which offsets to the right, compared to the baseline SID.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Figure 11 Option C Peak Hours

Figure 10 Option C Rest of the day

Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see offset left and right departures. This would mean that westerly departures would not overfly the same areas as easterly approaches, providing some noise relief for communities such as Howwood and Johnstone under the final approach. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis. Option Overflight course (Black outline) with estimated % of overall departures (based on 4 peak hours a day) 2019 baseline average summer day overflight swelts: 1
		9% 41% 8% 9% 9% 9% 9% 9% 9% 9% 9% 9% 9% 9% 9% 9%
		Figure 12 Westerly Option C Overflight and 2019 baseline NTK data
Communitie s	Noise impact on health and quality of life	In this appraisal we have assumed the dual NORBO SID structure is used for the first rotation only. Period 1 (Peak departure Hours) overflight (NORBO Route changing) During peak hours, particularly in the morning period, the majority of aircraft are flying to destinations routing south from Glasgow, and therefore the NORBO direction becomes the predominantly used SID. In this option, during peak hours the NORBO route is split into two which would share the noise. Both of these NORBO routes are offset, one left and one right, which would mean that westerly departures would not overfly the same areas as easterly approaches, providing accesses relief for communities on the previous and the final entrance.
		providing some relief for communities such as Howwood and Johnstone under the final approach. It would however mean that areas that areas not currently overflown frequently by departures will now be overflown on a more frequent basis. The heatmap (Figure 12) shows that the offset to the left removes overflight of some areas of Johnstone and Elderslie, however this is shifted to parts of east Elderslie and also captures some westerly parts of Foxbar. Beyond this point the route, which would account for around 8% of overall departures, overflies the populated areas of Uplawmoor, Dunlop and Stewarton. Some overflight of these areas is required in order to achieve respite for communities living under the NORBO SID during the off-peak hours which account for around 41% of overall departures for around 2% of overall departures and results in

trom Glasgow. The offset to the right NORBO route accounts for around 9% of overall departures, and results in overflight of Linwood and Kilbarchan at lower levels, and overflight of parts of Lochwinnoch and Kilbarchan at higher levels.

Period 2 overflight

During the off-peak periods the NORBO departure, which accounts for approximately 41% of overall traffic (assuming this route is used all day after the first rotation), offsets to the left but follows a different path than the peak hours offset-left SID. The initial section of the NORBO route follows the same path as the peak period configuration, and therefore there is very limited respite for communities living under the early parts of these routes who will experience around 49% of departures overall. From the heatmap, this level of overflight would be a significant change from current day, where those areas are typically experiencing somewhere between 1 - 10 flights per day on average. The route initially flies over Elderslie however then endeavours to avoid areas of dense population with the exception of Barrmill which is overflown at higher altitudes. The LUSIV and TALLA SIDs also offset left and route over Neilston; beyond this they largely avoid dense areas of population.

The ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs offset right, moving the overflight contours closer to the populated area of Linwood and the Bridge of Weir. Above 4000ft, the routes largely avoid dense areas of population instead routing across Loch Lomond National Park, and along the River Clyde. The overflight contours do however overfly parts of the port of Glasgow, Dumbarton, and Alexandria. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would concentrate traffic albeit at comparatively low percentages compared to other routes such as NORBO.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, it is not expected that the contours would increase in size to overfly any additional dense areas of population.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option C. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Overflight data

Table 24 gives an overview of the Option C overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is a significant increase in the area of the contours and the number of population and noise sensitive sites overflown; this is due to the nature of having multiple NORBO routes, an additional NORBO respite route and also avoiding the easterly final approach track whereby more people are overflown. However, the noise is shared and therefore it is overflight on a less frequent basis than for those who live under easterly final approach currently experience.

Table 24 Westerly departures option C overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option C	305.53	60931

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools, care homes and places of worship overflown compared to the centreline baseline. Number of hospitals remains the same. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option C against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in Table 25 shows an increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour however the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 25 60dB and 65dB LAMax Data – Rwy23 Dep Option C

	60dE	3 L _{Amax}	65dB L _{Amax}	
System	Area (km²)	Population	Area (km²)	Population
RWY23 Baseline (Centreline - Optioneering tool)	285.37	99120	95.69	53704
RWY 23 Dep Option C	563.66	146232	206.59	80377

The westerly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall L_{Aeq} contours.

Most aircraft today fly straight ahead for 5nm before turning and the offset departures that form part of this option deviate from current day. It is expected that this change will result in the L_{Aeq} contours shortening compared to current day. The offset departure to the left, which would operate around 60% of departure movements, is expected to result in the L_{Aeq} contour extending further to the south-west to reflect the offset track. When reviewing population density, this suggests there may be some benefit to Howwood and Johnstone, however the lobe would now potentially extend over Foxbar and parts of Ferguslie. The equivalent ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs operate a far lower percentage of flights and so are likely to have less influence on the overall shape of L_{Aeq} contours however the offset route may result in some areas of Linwood, which currently sit in the lower dB L_{Aeq} bands, to move into a higher dB contour.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

Noise Mitigation

The option offers relief for those communities currently located under immediate climb out and final approach as the offset departures route aircraft away from the final approach track. Having 2 NORBO SIDs also reduces the frequency of overflight for communities situated under just one NORBO SID, but only for the first rotation. It also offers an alternative respite configuration during peak departure periods for communities who live under the NORBO departure which accounts for the majority of departures from Glasgow airport however the benefits of this are minor as the respite configuration mainly benefits communities to the north-west (See overflight section above).

The introduction of alternative predictable respite arrangements also increases population overflown and the 60dB and 65dB L_{Amax} outcomes compared to other options; the benefits and impacts of this will be further analysed as part of the Full Options Appraisal at Stage 3 when we have quantitative information about the frequency of overflight should this option progress.

	Air Quality	This option has a emissions in their quality. Where late 1000ft today there overflying areas to increases in the co be small compared	totality, the eral tracks may be slig the side o oncentratio	ere will be a are moving ght decreas of the straig ons below th	a change in the g away from th ses in the conce ght-ahead dep hese flightpath	e location of e ne standard 's entrations belo parture route (ns. However, i	emissions be straight ahea ow these fligi (known as 'c it should be	elow 1000ft wh ad' departure t htpaths. Where offset departur noted that the	ich could affe hat aircraft fo e lateral track es') there ma	ect local air blow below s are newly ay be slight
	Greenhouse gas impact	compared to the b	Dur fuel burn assessment (see below) has anticipated that Option C will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.							
		This option sees the able to depart in in This is expected to of this will be seen	ntervals 1 i o reduce gr	minutes ap round holdii	art (subject to ng which in tur	safety case a	and NERL a ground-base	bility to accept	t 1-minute se	eparations).
	Capacity / resilience ⁸	However, this opti gain the full benefi be 'lined up' in the availability of the c daily peaks in dem	its of this, f correct or dual NORB	future inves rder before 60 structure	tment may be take-off howe during the ex	required in ac ver this is not	dditional taxi t within scop	way infrastructer of an Airspa	ture to enable ce Change p	e aircraft to project. The
		The introduction of which provides res the Airspace Mode decommissions the VOR withdrawal p	silience. Th ernisation p e VORs. Int	iis equipme programme itroduction c	nt is due to be . There is cur	decommission	oned as part g term ⁹ resili	of a NERL UK ence for Glas	wide prograi gow's SIDs w	mme under vhen NERL
		Table 26 shows da Glasgow's existing			these areas, b	ased on the N	ITK vectorin	g baseline and	l if aircraft we	re to follow
Wider Society		Table 26 RWY 23 W	/esterly Dep	artures Optic	on C – Tranquil	lity overflown				
,		System		NSA area	NSA count	National Parks area	Nationa Parks co	$1 100 \Delta ar$	ea DQA co	bunt
		RWY 23 Basel		0.02	1	1.68	1 Parks CO	0	0	
	Tranquillity	Vectoring (NTK RWY23 Baseline (Centr	eline –	0	0	0	0	0	0	
		Optioneering RWY 23 Optio		0	0	0	0	0	0	
		The data shows th parks compared to this option alongsi	the vector	ring baselin	e. Technical A	ppendix A co	ntains a map	o which shows		
		Below 2000ft no or Areas, and Sites of Castle Semple and	of Special S	Scientific In	terests is expe	ected for the v				
	Biodiversity	Lower slower aircr Barmufflock Dam of aircraft will climi	SSSIs belo	ow 2000ft. G	Given the low o	overall % of air	rcraft expect	ed to fly the S	D, and the va	ast majority
		We will fully quan Appraisal at Stage		erflight of b	oiodiverse site	s using the fu	Ill Glasgow	fleet mix, as	part of our F	ull Options
		Option C is likely t existing CAS whils						se this option	can be conta	ined within
General Aviation	Access	We created an "illu options combined if there is scope to existing CAS in the	to help stal	keholder er e total volui	ngagement on me of CAS. Th	potential impane total volum	acts. We hav e of the "illus	e also used th strative" airspa	is volume to ace volume co	understand ompared to
	Economic impact from increased effective capacity	We expect the incl commercial air tra NORBO departure	iffic compa	red with the	e baseline do	nothing west	erly departu	re baseline. H	owever, the	merging of
		 NORBO departures in a single track for the majority of the day would not deliver the biggest economic We estimate that Option C, when compared to baseline nominal centrelines, will result in an overall track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route he overall reductions in all routes. 								
		Table 27 Track Leng	yth Calculati	ions – Fuel E	3urn Option C					
					(Centreline)			С		
General Aviation /		RWY 23		nm V	weighting		m P1 nm P2			
Commercial airlines	Fuel burn		TRN NORBO - SUBUK	38.50 3 - 93.40 2			9.4 37.5 4.3 91.6	38.45 92.95	141.8805 2435.29	
			NORBO				4.4 85.1	84.75	2712	
		DEPS	LUSIV-					81.3	866.658	
			DCS TLA						19.639	
			PERTH				7.947.90.260.2	47.9 60.2	74.046	
			FOYLE LOMON		0.82 27	7.06 2	6.3 26.3	26.3	21.566	

 ⁸ Summary colour corrected
 ⁹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

			CLYDE ROBBO	19.50 19.60	2.87 2.05	55.965 40.18	16.7 17.1	16.7 17.1	16.7 17.1	47.929 35.055
		Total				6768.134			-	6391.169
Commercial	Training costs	to the NATS NERL fuel burn. In the Ful Flight procedures a their procedures ac	ACP for t I Options re update cordingly	he airspa Appraisa d or intro and und	ace above Il at Stage duced wor ertake trai	7000ft), it is and 3 we will investi Idwide as part o	icipated gate trac f an AIR	that this on the this of the	option woul in further of As part of t	to at least 6000ft (sub d see an improvemen detail. this cycle, airlines upc not anticipated to req
airlines	Other costs	any additional traini No other airline cos	0		S.					
Airport / Air navigation	Infrastructure costs	Glasgow currently of area and noise ins contour area and ro policy now requires LAeq,16h noise contou 2022, which will cor will determine if the of the track adjustn there will be an incr	operates a ulation so esidential financial ur or abov ver the va re are any nents on o eased cos	a homeov chemes f propertie assistance ried prop increase departure st for Gla	or sensitives within the set of the o	e buildings, such the 66dB L _{Aeq,16h} fered towards th gow Airport are situated within holds within the and track adju regards funding	ch as so contour e noise currently the 63dl 63dB L/ stments their No	hools and area. The insulation developi 3 contour are propo bise Insult	d hospitals, e UK Gove of resident ng a new N area. The I as a result osed in Gla ation Scher	
service provider	Operational costs		ge propos s Glasgo	al is not w's depe	anticipated	to change airp n conventional	ort or Al ground-	NSP opera	ational cost	nents. s. The implementation quipment (VORs), wh
	Deployment costs	This option is expe Prestwick and Glas Full Options Apprai	ected to r gow Airpo sal when 0ft and in	equire a ort. The s we are a terdepen	ir traffic co cale and n ppraising co dencies w	ontroller training ature of this trai our shortlist of op ith Edinburgh. C	for the ning req ptions ar Dwing to	controlle uires furth id once fu the respir	rs and ass er explorati rther inform te configura	istants located at NA ion as part of the Stag nation is known about ation, there may be m
A II	Safety	CAA IFP department the aircraft doesn't required during IFP DER. A SID structure from expected that perhat an option where a staffer departure intri- introducing other is wrong SIDs and the *As an example, mi- with completely diffe	twanted turn befor ground va m the san aps a muc SID utilisa oduces ha sues*. Su wrong tir tigations i erent nam places in t	a 'not be re the en alidation ne runwa h more s tion wou azards to ch hazar ne of day dentified es. How he netwo	low 500ft ² ad of the ru to ensure t ay which c subtle char Id change to the oper ds are not y but also f for SIDs s ever, flight ork are req	ilyover WP posit inway. PANS O he WP is accept hanges during t ige to a SID stru- significantly fror ation which at t just associated tuman Factor (H witching to fund planning and A	ioned at PS does table, es he day i icture ca m a left his stag l with air HF) issue lamental	the Decla sn't require pecially for s uncharte n be safel curn to a ri e cannot craft inade es associa different es previous	ered End of e this. Addi ollowing and ered territor ly accommo ight turn (or considered vertently fly ated with A directions a sly identifie	but in a recent ACP, Runway (DER) to ensitional assurances will other turn shortly after ry for the UK. Whilst i odated, ATC advised f r vice-versa) immedia to be mitigated with ring (or being issued) TC confusion. after departure were S d by NERL requires S turn would mean sim
AII	Interdependencies , conflicts, and trade-offs	NORBO departures In NERL's ScTMA A track structure, noti As highlighted in Gl cognisant of their a	are separ ACP, they ng these s asgow Pro irspace. nulative ef be co-orc	rated from have opt SIDs wou estwick A ffect on o linated a	m Prestwic ions ion th uld then me Airport's fe other airsp nd conside	k's airspace and eir proposed sho erge into one init edback in Stage ace users as a f ered.	l does no ortlist wh tial track 2A, the	ot conflict v ich would for the re final prop	with Edinbu cater for a c st of the da osed CAS a	this option. The left ha rgh's traffic below 700 dual NORBO southbor y arrangements need to Glasgow, Edinburgh a
All	AMS	CAP1711 describes Deliver quicker, qui UK airspace. This option would b most frequently ove	s the objecter, and be expected erflown by	ctive as: cleaner j ed to ger Glasgow	ourneys al nerate sigr v arrivals a	nd more capacit nificant CO ₂ redu nd departures liv	uctions, ving und	provide re er final ap	elief and reapproach.	o use and are affected spite from noise to the

All	AMS	departure track for the majority of the day would likely generate future ground delay. In addition, positioning that single NORBO departure over the same newly overflown communities for the rest of the day would not mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a dual NORBO SID structure).
		However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise. This option could be expected to result in reductions in the volume of Glasgow's CAS.

¹⁰ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.5. Runway 23 Westerly Departure Option D

Runway 23 Wes	sterly Departures – Opt	ion D	
	ONFOYLE PERTH TLA NORBO	This option has two, slightly different route configurations and assumes one configuration would be used for the peak departure period. The configuration would then switch for the rest of the day. In the peak periods, the NORBO traffic is shared between an offset left turn departure and an offset right turn departure with both routes available at the same time. For the rest of the day, all the NORBO traffic would then use a different NORBO flight path which follows a straight line from the runway until splitting at 5nm, with the rest of the routes remaining the same. The reason for this would be to mitigate the small increase in mileage of a NORBO route which offsets to the right, compared to the baseline SID as well as mitigating the effects for those newly overflown by the peak NORBO SIDs. This option is similar to Option C except that the daytime (non-peak) NORBO route is different. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.	
Group	Impact	Qualitative Assessment	
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise dat qualitative assessment has considered this modal split with daily movements averaged across the year.	ta and
		This option would see offset left and right departures. This would mean that westerly departures would not of the same areas as easterly approaches, providing some relief for communities such as Howwood and John under the final approach. It would however mean that areas that are not currently overflown frequen departures will now be overflown on a more frequent basis.	stone
		In this appraisal we have assumed the dual NORBO SID structure is used for the first rotation only.	
		Period 1 (Peak departure Hours) overflight (NORBO Route changing) During peak hours, particularly in the morning period, the majority of aircraft are flying to destinations routing from Glasgow, and therefore the NORBO direction becomes the predominantly used SID. In this option, of peak hours the NORBO route is split into two, which would share the noise. Both of these NORBO route offset, one left and one right, which would mean that westerly departures would not overfly the same are easterly approaches, providing some relief for communities such as Howwood and Johnstone under the approach. It would however mean that areas that are not currently overflown frequently by departures will no overflown on a more frequent basis. The heatmap Figure 13 shows that the offset to the left removes overflist some areas of Johnstone and Elderslie, however this is shifted to parts of east Elderslie and also captures westerly parts of Foxbar. Beyond this point the route, which would account for around 8% of overall flights, ov the populated areas of Uplawmoor, Dunlop and Stewarton. Some overflight of these areas is required in or achieve respite for communities living under the NORBO SID during the off-peak hours which account for a 42% of overall departures from Glasgow. The offset to the right route accounts for around 9% of overall depart and results in overflight of Linwood and Kilbarchan at lower levels, and overflight of parts of Lochwinnoc	during es are eas as e final ow be ight of some erflies der to round tures,
		Kilbirine at higher levels. Option Overfil Contours (Bla with estimated overall depart (based on 4 pri a day)	ck outline) 1 % of ures
		2019 baseline summer day of swathe:	
Communities	Noise impact on health and quality of life	Joint	

Figure 13 Westerly Option D Overflight and 2019 baseline NTK data

Period 2 overflight

During the off-peak periods the NORBO departure, which accounts for approximately 42% of overall traffic (assuming this route is used all day after the first rotation) would fly straight ahead, similar to how aircraft fly the NORBO route today. At 5nm the route would then split into two, with 21% of departures continuing straight ahead and 21% turning south. The initial straight-ahead section between the runway and 5nm overflies Johnstone, Elderslie and Howwood as the majority of departures do today. The straight-ahead section beyond 5nm overflies Beith and parts of Kilbirnie however this will be different to current day owing to the concentration of traffic along the PBN routes. From the NTK data we can see that the route to the south route would increase the frequency of overflight compared to today however this route largely avoids areas of dense population with the exception of parts of Dunlop at around 7000ft.

In both periods, the ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs offset right, moving the overflight contours closer to the populated area of Linwood and the Bridge of Weir. Above 4000ft, the routes largely avoid dense areas of population instead routing across Loch Lomond National Park, and along the River Clyde. The overflight contours do however overfly parts of the port of Glasgow, Dumbarton, and Alexandria. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would be expected to concentrate traffic albeit at comparatively low percentages compared to other routes such as NORBO.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option D. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Overflight data

Table 28 gives an overview of the Option D overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is a significant increase in the area of the contours and the number of population overflown; this is partially due to the nature of the respite routes whereby more people are overflown, however the noise is shared and therefore it is overflight on a less frequent basis.

Table 28 Westerly departures option D overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option D	332.84	82804

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools, care homes and places of worship overflown compared to the centreline baseline. Number of hospitals remains the same. Compared to the vectoring data, there is a decrease in potentially noise sensitive buildings overflown, but it's important to note that at this stage the data does not consider the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB L_{Amax}

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option D against the baseline. 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in Table 29 shows a significant increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour however the baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 29 60dB and 65dB LAMax Data – Rwy23 Dep Option D

	60dE	B L _{Amax}	65dB	L _{Amax}
System	Area (km²)	Population	Area (km²)	Population
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704
RWY 23 Dep Option D	583.18	153095	214.24	84120

L_{Aeq}

The westerly departures make up a component of the overall L_{Aeq} day time and night time contours. We have used the overall contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall L_{Aeq} contours.

Most aircraft today fly straight ahead for 5nm before turning and the offset departures that form part of this option deviate from current day. Unlike some other options, the NORBO offset routes are only used for a small part of the day, with the majority of the NORBO departures continuing to fly straight ahead to 5nm as they do today. The introduction of the offset routes overall may result in a small change in the L_{Aeq} contours shortening compared to current day. The offset departures to the left, which would operate around 19% of departure movements, is expected to result in the L_{Aeq} contour extending slightly further to the south-west to reflect the offset track, this change is likely to occur over an area with low population however it would require further quantitative investigation at Stage 3 should this option progress. The offset departures to right, which would operate around 21% of departure movements, is expected to result in the L_{Aeq} contour extending slightly further to the north-east to reflect the offset track, this change is likely to occur over Linwood however it would require further quantitative investigation at Stage 3 should this option progress.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

	Noise Abatement Procedures A change to the existing NAPs would be required to accommodate the offset departures and turns.
	Noise Mitigations The option offers an alternative respite configuration during peak departure periods for communities who live under the NORBO departure which accounts for the majority of departures from Glasgow airport. This means that overall, the NORBO noise is shared across three different routes although the straight-ahead off-peak route, which is similar to current day, sees the majority of the traffic.
	The other routes remain the same during peak and off-peak periods however they have comparatively lower percentages of overall flights operating.
	The introduction of alternative predictable respite arrangements (for those communities newly overflown by the peak NORBO) increases population overflown and the 60dB and 65dB L_{Amax} outcomes compared to other options; the benefits and impacts of this will be further analysed as part of the Full Options Appraisal at Stage 3 when we have quantitative information about the frequency of overflight (should this option progress).
Air Quality	This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral

		tracks are newly overf there may be slight inc	reases in	the cond	centrations be	elow these flig	htpaths	. Howeve	r, it should	be noted t	
	Greenhouse gas impact	changes are likely to b Our fuel burn assessm compared to the basel	nent (see ine. We th	below) h	as anticipate expect to see	d that Option a correspond	D will h ling imp	ave an ov rovement	erall impro to greenho	ovement in ouse gas er	
		This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress. This option sees the SIDs splitting before 5nm which will improve capacity compared to the baseline as aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels.									
	Capacity / resilience ¹¹	to gain the full benefit aircraft to be 'lined up' project. The availabilit	However, this option only splits the NORBO departures across two routes during peak departure periods. In ord o gain the full benefits of this, future investment may be required in additional taxiway infrastructure to enab aircraft to be 'lined up' in the correct order before take-off however this is not within scope of an Airspace Chan project. The availability of the dual NORBO structure during the existing peak departure hours only would r accommodate future daily peaks in demand outside of these peak times.							o enable e Change	
		The introduction of PB which provides resilier under the Airspace M when NERL decommis following NERL's VOR	nce. This lodernisat ssions the	equipme tion prog e VORs. I	ent is due to l ramme. The Introduction c	be decommis	sioned , no lor	as part of ig term ¹² i	a NERL U resilience f	IK wide pro	ogramme w's SIDs
		Table 30 shows data of follow Glasgow's exist				, based on th	e NTK [,]	vectoring t	paseline ar	nd if aircraf	ft were to
		Table 30 RWY 23 Weste	erly Departe	tures Optic	on D – Tranqu	illity overflown					
Wider Society		System	NS	SA area	NSA coun	nt Nationa Parks are		ational ks count	DQA ar	ea DQA	count
	Tranquillity	RWY 23 Baseline Vectoring (NTK dat		0.02	1	1.68		1	0		0
		RWY23 Baseline (Centrelin Optioneering tool		0	0	0		0	0		0
		RWY 23 Option D		0	0	0		0	0		0
		The data shows that to National parks compa overflight contour of th	ared to th	ne vector	ring baseline	e. Technical A	Append	x A conta	ains a ma	p which sh	
		Below 2000ft no overf	flight of S								
		Scenic Areas, and Site baseline Castle Semp	es of Spec	cial Scier	ntific Interests	s is expected f					
	Biodiversity	Scenic Areas, and Site	es of Spec le and Ba climbing a SSSIs be	cial Scier arr Lochs at below elow 2000	ntific Interests SSSI would a 6% climb g Dft. Given the	s is expected f be avoided. gradient and fl low overall %	or the v ying the of airc	vast majori e ROBBO : raft expect	ty of aircra SID, may o ted to fly th	ift. Compar overfly Whi ie SID, and	red to the innerston d the vast
	Biodiversity	Scenic Areas, and Site baseline Castle Semp Lower slower aircraft, and Barmufflock Dam majority of aircraft will	es of Spec le and Ba climbing a SSSIs be l climb ab	cial Scier arr Lochs at below elow 2000 pove 200	ntific Interests SSSI would a 6% climb g Oft. Given the Oft before ov	s is expected f be avoided. gradient and fl low overall % erflying the si	or the v ying the of airc ite, it is	e ROBBO raft expect expected	ity of aircra SID, may o ted to fly th that any in	ft. Compar overfly Whi he SID, and mpacts wil	red to the innerston d the vast I be very
	Biodiversity	Scenic Areas, and Site baseline Castle Semp Lower slower aircraft, and Barmufflock Dam majority of aircraft will minimal. We will fully quantify th	es of Spec le and Ba climbing a SSSIs be I climb ab he overflig	cial Scier arr Lochs at below elow 2000 pove 2000 ght of bio	ntific Interests SSSI would a 6% climb g Oft. Given the Oft before ov odiverse sites	s is expected f be avoided. radient and fl low overall % erflying the si s using the ful	ying the of airc ite, it is I Glasg de CAS	e ROBBO raft expect expected ow fleet m	ity of aircra SID, may o ted to fly th that any in hix, as part	overfly Whi be SID, and mpacts wil of our Full	red to the innerston d the vast I be very I Options
	Biodiversity	Scenic Areas, and Site baseline Castle Semp Lower slower aircraft, and Barmufflock Dam majority of aircraft will minimal. We will fully quantify th Appraisal at Stage 3. Option D is likely to c	es of Specile and Ba climbing a SSSIs be climb ab he overflig ontribute hilst offerin ative CAS abined to h is scope existing CA	cial Scier arr Lochs at below elow 2000 pove 2000 ght of bio to a redu ing oppor S volume help stak to reduc	a 6% climb g SSSI would a 6% climb g Oft. Given the Oft before ov odiverse sites uction in bott tunity to redu	s is expected f be avoided. gradient and fl low overall % erflying the si s using the ful clenecks outsi uce the total v a single volu- agement on po- olume of CAS	ying the of airc te, it is I Glasg de CAS olume of me of C otential 5. The t	e ROBBO raft expected expected ow fleet m b because of CAS. CAS requir impacts. V otal volum	ty of aircra SID, may o ted to fly th that any in hix, as part this option red to cont Ve have als ie of the "il	overfly Whi be SID, and mpacts wil of our Full n can be c cain ALL ar so used thi llustrative"	red to the innerston d the vast l be very l Options contained rrival and s volume airspace
	Access Economic impact from increased	Scenic Areas, and Site baseline Castle Sempl Lower slower aircraft, and Barmufflock Dam majority of aircraft will minimal. We will fully quantify th Appraisal at Stage 3. Option D is likely to c within existing CAS wh We created an "illustra departure options com to understand if there volume compared to e	es of Specile and Ba climbing a SSSIs be I climb ab he overflig ontribute hilst offerin ative CAS hbined to h is scope existing CA aller. sed effecti ic compar	cial Scier arr Lochs at below elow 2000 pove 2000 ght of bio to a reduc for a reduc for a popor S volume help stak to reduc AS in the ive capaci	a 6% climb g SSSI would a 6% climb g Oft. Given the Oft before ov odiverse sites uction in bott tunity to redu " which was eholder enga the total vo same lateral city detailed in he baseline d	s is expected f be avoided. radient and fl low overall % erflying the si s using the ful clenecks outsi uce the total v a single volu agement on po olume of CAS area is c.100 in the section to nothing wes	ying the of airc te, it is I Glasg de CAS olume of otential S. The t nm ³ sm above sterly de	e ROBBO raft expected expected ow fleet m b because of CAS. CAS requir impacts. V otal volum haller than will result eparture ba	ty of aircra SID, may of ted to fly th that any in hix, as part this option red to cont ve have als this option red to cont ve have als this option red to cont ve have als the of the "il currently e in a positivaseline. Ho	aft. Compar overfly Whi and SID, and mpacts will of our Full of our Full n can be c cain ALL ar so used thi llustrative" exists. The ve economic owever, the	red to the innerston d the vast l be very l Options contained rrival and s volume airspace Glasgow ic impact e merging
General Aviation	Access Economic impact	Scenic Areas, and Site baseline Castle Sempl Lower slower aircraft, and Barmufflock Dam majority of aircraft will minimal. We will fully quantify th Appraisal at Stage 3. Option D is likely to c within existing CAS wh We created an "illustra departure options com to understand if there volume compared to e CTR was c.47nm ³ sma We expect the increas on commercial air traff	es of Speci le and Ba climbing a SSSIs be I climb ab he overflig ontribute hilst offerin ative CAS hilst offerin bined to h is scope existing CA atler.	cial Scier arr Lochs at below elow 2000 pove 2000 ght of bio to a reduc for a reduc for a reduc AS in the ive capate red with t le track for en compa	a 6% climb g off. Given the Off. Given the Off before ov odiverse sites uction in bott tunity to redu " which was eholder enga e the total vo same lateral city detailed i he baseline o or the majorit ared to basel	s is expected f be avoided. radient and fl low overall % erflying the si s using the ful clenecks outsi uce the total v a single volue agement on po olume of CAS area is c.100 in the section to nothing west y of the day v ine nominal c n in track mile	ying the of airc te, it is I Glasg de CAS olume of otential S. The t nm ³ sm above sterly de vould no entrelin age of f	ast majori e ROBBO raft expected expected ow fleet m b because of CAS. CAS requir impacts. V otal volum haller than will result exparture ba ot deliver t es, will res he NORBO	SID, may of ted to fly th that any in hix, as part this option red to cont ve have als this option red to cont ve have als the of the "il currently e sult in an o O LAKEY i	aft. Compar overfly Whi and SID, and mpacts will of our Full of our Full n can be c cain ALL ar so used thi llustrative" exists. The economic overall impr route howe	red to the innerston d the vast l be very l Options contained rrival and s volume airspace Glasgow ic impact e merging benefits. rovement ever there
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 ¹¹ Summary colour corrected
 ¹² Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		ROBBO 19.60 2.05 40.18 17.1 17.1 17.1 35.055
		Total 6768.134 6411.512
		Given the improvement in track mileage, and the aspiration for all aircraft to climb continuously to at least 6000 (subject to the NATS NERL ACP for the airspace above 7000ft), it is anticipated that this option would see an improvement in fuel burn. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detai
Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airline update their procedures accordingly and undertake training if required. This westerly SID option is not anticipate to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
Airport / Air navigation service	Infrastructure costs	Glasgow currently operates a homeowner relocation scheme for residential properties within the 69dB L _{Aeq,16} contour area and noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63dB L _{Aeq,16h} contour area and residential properties within the 66dB L _{Aeq,16h} contour area. The UK Government's curren aviation policy now requires financial assistance to be offered towards the noise insulation of residential properties in the 63dB L _{Aeq,16h} noise contour or above. Therefore, Glasgow Airport are currently developing a new Noise Insulation Policy for 2022, which will cover the varied property types situated within the 63dB L _{Aeq,16h} area as a result of this options as a result of the track adjustments on departure. If it does and track adjustments are proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow with regards funding their Noise Insulation Scheme.
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), whic contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ¹³ .
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh. Owing to the respite configuration there may be more training required for this option compared to other options that form part of this IOA.
All	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER. A SID structure from the same runway which changes during the day is unchartered territory for the UK. Whilst is expected that perhaps a much more subtle change to a SID structure can be safely accommodated, ATC advised that an option where a SID utilisation would change significantly from a left turn to a straight ahead (or vice-versal immediately after departure introduces hazards to the operation which at this stage cannot considered to be mitigated without introducing other issues*. Such hazards are not just associated with aircraft inadvertently flying (or being issued) the wrong SIDs and the wrong time of day but also HF issues associated with ATC confusion.
		 SIDs with completely different names. However, flight planning and ATM issues previously identified by NERL requires SIDs going to the same places in the network are required to terminate at the same point which in turn would mean similar SID names to match the SID termination point. There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The let hand NORBO departures are separated from Prestwick's airspace and does not conflict with Edinburgh's traffic
All	Interdependencies, conflicts, and trade- offs	below 7000ft. In NERL's ScTMA ACP, they have options on their proposed shortlist which would cater for a dua NORBO southbound track structure, noting these SIDs would then merge into one initial track for the rest of the day. As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace.
		In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburg and the ScTMA need to be co-ordinated and considered. This option is dependent on changes to the network.
All	AMS	 CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would be expected to generate significant CO₂ reductions and provide relief and respite from noise to those communities that would be newly overflown by the peak NORBO Routes. However, that would come at the expense of then overflying the communities most frequently overflown by Glasgow arrivals and departures living under final approach the rest of the day. This option would not accommodate future demand in the most effective manner as a single initial NORBO
		departure track for the majority of the day would likely generate future ground delay. However, as mentioned in the Noise impact on health and quality of life section above, it is currently unknown as to whether the use of track adjustments on departure would result in an increase in the numbers of people adversely affected by aircraft noise.
		This option could be expected to result in reductions in the volume of Glasgow's CAS

¹³ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.6. Runway 23 Westerly Departure Option E

Runway 23 West	erly Departures – Optio	n E
CLYDE ROBBO NORBOITRN	VFOYLE PERTH PERTH TLA USIV	Straight ahead departures only (no offsets) with turns at c.1nm and c.9nm from the runway NORBO is traffic is shared between a route that turns left at c.1nm and one that doesn't turn until c.9nm from the runway. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
Communities	Noise impact on health and quality of life	Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see all departures going straight ahead, however compared to today, some departures would turn at c.1nm, c.2nm and c.9nm rather than all turning at 5nm. Point overling the control of the provided set of the provid
		although this is a significantly lower % than experiences today. The NTK heatmap shown in figure 14 shows that this largely follows the areas where departures fly today. This includes overflight of Johnstone, Elderslie and Howwood, and at higher altitudes, Beith and the south of Kilbirnie. The other 26% of NORBO departures will fly the route that turns at c.2nm. Beyond the 2nm, the turn to the south introduces overflight over some new areas although figure 14 shows these are not densely populated. Aircraft would then route over areas that are currently overflown today including the populated areas of Lugton, Dunlop, western parts of Uplawmoor, and the northwestern parts of Stewarton at 7000ft. From the heatmap, this level of overflight would be a change from current day, where those areas are typically experiencing somewhere between around 1–10 flights per day, on average.

resulting in some new areas of overflight. Figure 14 shows that this largely avoids dense areas of population with the exception of western Neilston which will mainly be overflown by the TALLA departures.

The ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs fly straight ahead before turning right. This initial part of the right turn routes over parts of Johnston and Kilbarchan. Beyond this point, the ROBBO SID which is estimated to be operated by 3% of overall Glasgow departures, routes over areas overflown today, and avoids dense areas of populations. The CLYDE, LOMON and PERTH SIDS turn north and overfly parts of the Bridge of Weir and Quarriers village - these areas will see the cumulative impact of all three SIDs. Beyond this point, the CLYDE SID, which accounts for around 6% of overall Glasgow departures, routes over Kilmacolm before reaching the eastern parts of Port Glasgow. The LOMON SID overflies eastern areas of Kilmacolm, before reaching Langbank and the western parts of Dumbarton at higher altitudes. Finally, the PERTH SID largely avoids areas of dense population with the exception of the easter parts of Dumbarton which are overflown around 7000ft. The heatmap demonstrates that these SIDs route over areas already overflown today, however there is currently broad dispersion whereas PBN routes in future would be expected to concentrate traffic albeit at comparatively low percentages compared to other routes such as NORBO.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LOMON and PERTH SIDs may increase in size and overfly additional parts of Dumbarton and may extend as far as Alexandria.

Overflight data

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option E. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

As shown in Table 32, against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, there is a significant increase in the area of the contours and the number of population overflow; this is due to the routes turning earlier than they do today alongside splitting the NORBO route into two. This does however mean that the noise from the busiest departure route is shared.

Table 32 Westerly departures option E overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	547.32	163216
RWY23 Baseline (Centreline)	141.18	29838
RWY23 Option E	248.01	69308

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools, care homes and places of worship overflown compared to the centreline baseline. Number of hospitals remains the same. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option E against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 33 shows an increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour however the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 33 60dB and 65dB L_{AMax} Data – Rwy23 Dep Option E

	60dE	3 L _{Amax}	65dB L _{Amax}		
System	Area (km²)	Population	Area (km²)	Population	
RWY23 Baseline (Centreline – Optioneering tool)	285.37	99120	95.69	53704	
RWY 23 Dep Option E	458.27	139426	161.26	64472	

L_{Aeq}

The westerly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on westerlies 82% of the year and therefore the westerly departures will have a large influence on the overall L_{Aeq} contours.

Most aircraft today fly straight ahead for 5nm before turning and the departures which turn before 5nm will influence the shape of the L_{Aeq} contour. It is expected that this change will result in the L_{Aeq} contours shortening compared to current day although 32% of NORBO traffic will continue straight ahead and so this reduction is expected to be less than some other options. This may benefit some parts of Howwodd. The NORBO, LUSIV and TALLA turns to the left, which overall account for around 37% of Glasgow departures are expected to result in the L_{Aeq} contour extending further to the south; the heatmap data suggests that this will occur over areas where there are not high levels of population density. The equivalent ROBBO/CLYDE/LOMON/FOYLE/PERTH SIDs operate a far lower percentage of flights and so are likely to have less influence on the overall shape of L_{Aeq} contours however the turns may result in some areas of Johnstone, which currently sit in the lower dB L_{Aeq} bands, to move into a higher dB contour.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

		A change to the existing NAPs would be required to accommodate the offset departures and turns.
		Noise Mitigation The option shares the noise from the existing most heavily used NORBO route into two routes. This offers some noise relief for those communities currently located under immediate climb out and final approach however this would not be predictable respite; having 2 NORBO SIDs reduces the frequency of overflight for communities situated under just one NORBO SID. This option helps to reduce the numbers of newly overflown by having approximately half of the NORBO departures flying straight ahead, as today.
	Air Quality	This option has a change to how aircraft will fly laterally below 1000ft; the majority of departures will climb above 1000ft whilst flying straight ahead as today. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic (M8/A737) to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option E will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.

		This option sees the SID will be able to depart in separations). This is exp delays. The benefits of the relies on achieving at least	intervals 1 r ected to rec his will be se	minutes apart luce ground h een particular	(subject to s olding which ly in future so	afety ca in turn v cenarios	se and NERI	L ability to act ound-based e	cept 1-minute missions and	
	Capacity / resilience	In addition to this, this o performance throughout benefits of this, future in 'lined up' in the correct o	the day an vestment m	nd reduce gro nay be require	und delays and in addition	and CO2 al taxiwa	2 contribution ay infrastruct	is. In order to ure to enable	gain the full aircraft to be	
		The introduction of PBN aids, which provides res programme under the A Glasgow's SIDs when NI Glasgow operation follow	silience. Thi Airspace Mc ERL decomi	s equipment dernisation p missions the \	is due to be rogramme. /ORs. Introdu	decomi There is action of	missioned as currently no	part of a NI long term ¹⁴	ERL UK wide resilience for	
		Table 34 shows data on to follow Glasgow's exist			eas, based or	n the NT	K vectoring b	baseline and i	f aircraft were	
		Table 34 RWY 23 Westerly	Departures	Option E – Tran						
		System	NSA ar	ea NSA co	ount Natio		National Parks count	DQA area	DQA count	
	Tranquillity	RWY 23 Baseline – Vectoring (NTK data)	0.02	1	1.6	88	1	0	0	
	Tranquinity	RWY23 Baseline (Centreline - Optioneering tool)		0	C)	0	0	0	
		RWY 23 Option E	0	0	0		0	0	0	
		The data shows that ther National parks compare overflight contour of this	d to the veo	ctoring baselin	ne. Technica	I Appen	dix A contair	ns a map whi	ch shows the	
		Below 2000ft no overfligh Scenic Areas, and Sites the baseline Castle Sem	nt of Special of Special S	Protection Au	reas, Special ests is expec	Areas o ted for th	f Conservatio	on, National P	arks, National	
	Biodiversity	Lower slower aircraft, climbing at below a 6% climb gradient and flying the ROBBO SID, may overfly Whinnerston and Barmufflock Dam SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the SID, and the vast majority of aircraft will climb above 2000ft before overflying the site, it is expected that any impacts will be very minimal.								
		We will fully quantify the overflight of biodiverse sites using the full Glasgow fleet mix, as part of our Full Options Appraisal at Stage 3.								
		Option E is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained within existing CAS whilst offering opportunity to reduce the total volume of CAS.								
General Aviation	Access	We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existing CAS in the same lateral area is c.100nm ³ smaller than currently exists. The Glasgow CTR was c.47nm ³ smaller.								
	Economic impact from increased effective capacity	We expect the increased effective capacity detailed in the section above will result in a positive economic impact on commercial air traffic compared with the baseline do nothing westerly departure baseline.								
		We estimate that Option E, when compared to baseline nominal centrelines, will result in an overall improvement in track mileage. This is mainly driven by the reduction in track mileage of the NORBO LAKEY route however there are also some reductions all other departure routes.								
		Table 35 Track Length Calo	culations – Fi	lel Burn Option	E					
			Basel	ine (Centrelin	ne)					
		RWY 23	nm	% Weighting			1 Score			
		TRN NOR	BO 02 40	3.69 26.2	142.065 2447.08	37.8	139.482 2423.5			
General		– SU NOR	BUK ^{93.40}			92.5				
Aviation / Commercial		– LA LUSI	KEY ^{93.40}	32	2988.8	83	2656			
airlines	Fuel burn	DEPS DCS	84.80	10.66	903.968	81.7	870.922			
		TLA PER	54.70 TH 69.80	0.41 1.23	22.427 85.854	49 62.6	20.09 76.998			
		FOY	LE 33.00	0.82	27.06	27.7	22.714			
		LOM		2.05	54.735	19.5	39.975			
		CLYI ROB	DE 19.50 BO 19.60	2.87 2.05	55.965 40.18	17.6 17.4	50.512 35.67			
		Total	_	_	6768.134		6335.863			
								-		
		Given the improvement in (subject to the NATS NE improvement in fuel burn detail.	RL ACP for	r the airspace	above 7000	ft), it is a	anticipated the	at this option	would see an	

¹⁴ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly SID option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP. Unlike options that propose track adjustments on departure, this option is unlikely to change the populations within the 63dB L _{Aeq,16h} noise contour and therefore not affect Glasgow's noise insultation scheme costs.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ¹⁵ ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	No safety issues have been identified.
All	Interdependencies, conflicts, and trade- offs	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with this option. The left hand NORBO departure is separated from Prestwick's airspace and does not conflict with Edinburgh's traffic below 7000ft. In NERL's ScTMA ACP, they have options on their proposed shortlist which would cater for a duel NORBO southbound track structure. As highlighted in Glasgow Prestwick Airport's feedback in Stage 2A, the final proposed CAS arrangements need to be cognisant of their airspace. In addition, the cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered. This option is dependent on changes to the network.
All	AMS	 CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace by accommodating future demand in an efficient manner. The option would be expected to generate significant CO₂ reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures and a dual NORBO track structure would mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a single NORBO SID structure). This option could be expected to result in reductions in the volume of Glasgow's CAS

¹⁵ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.7. Runway 05 Easterly Departures Baseline

Runway 05 East	erly Departures Basel	line				
		This option represents the do-nothing scenario for Glasgow Easterly SIDs. Today, all Glasgow SIDs climb straight ahead to 5nm before turning. This means that the minimum departure interval between successive departing aircraft is at least 2 minutes. The result is that during peak departure times, aircraft are held on the runway and at the runway holding points, leading to increased emissions and delay. Beyond 5nm, aircraft are typically vectored off the SID centrelines by ATC, resulting in broad swathes. Some aircraft less than 5700kg MTWA do not have to depart via the SIDs. These are usually non-jet aircraft and therefore slower than jet aircraft. These aircraft are vectored by ATC which helps them turn towards their destination early, reduces track miles and reduces departure delays. Glasgow Airport's current SIDs are dependent on conventional ground-based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is an interim measure that only can only be used to bridge the gap ahead of FASI implementation. The AMS mandates airports implement IFPs based on PBN and doing nothing does not meet that national requirement. For more information on our do-nothing scenario, please see our Stage 2A document on the CAA's Airspace				
<u>Orour</u>	Immost	Change Portal.				
Group	Impact	Qualitative Assessment Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. Aircraft above 5700kg departing from Glasgow climb straight ahead to 5nm before turning. Beyond 5nm, aircraft are typically vectored off the SID centrelines by ATC resulting in dispersion. These swathes can be seen in the vectoring heatmaps below which have been generated using NTK data:				
		<figure></figure>				
Communities	Noise impact on health and quality of life	Figure 15 Runway 05 Departure Vectoring Swathe 2019 The Technical Appendix to this document includes a larger version of this map along with overflight data. It's important to note that this data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline and the airspace change options. Table 36 below includes data based on this NTK heat map and data output from the optioneering tool for if aircraft were to follow the centreline of the current published SID: Table 36 Easterly departures baseline overflight data				
		System Area (km ²) Population				

RWY 05 Baseline – Vectoring (NTK data)	246.99	364763	
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213	
The data from these tables will be used to compare the westerly departure options against the 'do nothing' baseline. In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals, and places of worship; the full data around these is shown in technical appendix A, and as part of this IOA we will provide a qualitative statement around this data.			
60dB and 65dB L _{Amax} Technical Appendix A includes 60dB and 65dE the baseline and the options. 60dB and 65dB quantified at the Stage 3 Full Options Apprais	L _{Amax} contours are an indicator of	•	

			60dE	B L _{Amax}	_65dB	L _{Amax}			
		System	Area (km²)	Population	Area (km²)	Population			
		RWY 05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793			
		The data from these tables will b	ne easterly departure op	ptions against the 'do	o nothing' baseline.				
		L _{Aeq} The easterly departures make u the overall contours from 2017, shape and size.							
		Noise Abatement Procedures As this baseline reflects current	no changes to NAPs a	is a result of this opt	ion.				
		Noise Mitigation The existing SIDs configuration underneath final approach with airport.							
		Impacts to air quality are conside to have a significant impact on le	6		n). Aircraft flying abo	ove this are unlikely			
	Air Quality	Aircraft departing Glasgow hav aircraft reach 1000ft at different during this they climb above 100 of flight paths which could occur	rtures climb straight	ahead for 5nm and					
		Emissions of greenhouse gases is linked to track length, we ha greenhouse gas assessment is	ave initially looked a	t the track length for	the baseline easter	ly departures. The			
		Table 37 Easterly departure baselir	ne – Indicative track mi Baseline (C						
		RWY 05	nm	% Weighting	Sco	re			
		TRN	50.00	0.81	40.5				
		NORBO – SUBI		5.75	644.				
		NORBO – LAKE		7.03	787.				
		LUSIV-DCS	88.80	2.34	207.				
	Greenhouse gas	ΤΙΔ	49.20	0.09	4.43				
	impact	DEPS PERTH	50.30	0.27	13.5				
		FOYLE	19.10	0.18	3.44				
		LOMON	20.00	0.45	9.00				
		CLYDE	25.00	0.63	15.7				
		ROBBO	33.50	0.45	15.0	8			
		Total			1740	0.92			
		We will estimate the differences between this baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks will be longer or shorter than a typical flight today. As CO ₂ emissions are linked to the difference in aviation fuel burnt, this will allow us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data tables are shown in Technical Appendix A.							
Wider Society		Glasgow's current SID configuration, with the majority of departures flying straight ahead to 5nm before results in a capacity constraint on the airport, as aircraft are only able to depart with at least 2-minute i This leads to holding on the ground which results in increased emissions and delays. Any future increasement numbers at the airport will result in increases in ground holding and delay and therefore the SII existing configuration are not fit for purpose for future growth at the airport.							
	Capacity / resilience	In future, increased forecast movements across the Scottish TMA are anticipated to result in capacity and resilier disbenefits. As traffic increases, flow restrictions are likely to be put in place in order for ATC and pilots to mana the additional complexity and workload. Flow regulations stabilise the number of movements until the peak in trasubsides, however in doing so they generate ground delay for Glasgow.							
		It is therefore possible that, with future traffic levels, this baseline scenario would result in increases in departure delay at Glasgow airport. In addition to this, no change to the airspace around Glasgow may also inhibit the wider FASI programme of change and AMS benefits associated with the programme.							
		This baseline is dependent on conventional ground-based navigation aids called VORs. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term ¹⁶ resilience for Glasgow's SIDs when NERL decommissions the VORs which will result in critical operational issues and significant loss of revenue.							
	Tranquillity	CAP1616 outlines the considera Areas of Outstanding Natural E (NSA) and we've therefore incl (DQA) as part of our Tranquillit option differs from current day a AONB.	Beauty (AONB). In Suded overflight data y assessment. At th	cotland, the equivalen a around these, Nation is stage of the ACP w	t of AONB are Nati al Parks, and desig e will qualitatively a	onal Scenic Areas gnated quiet areas issess whether the			
		Table 38 shows data on the ov Glasgow's existing SID centrelin departure baseline.							

¹⁶ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Table 38 Easterly dep	arture bas	seline – Tranc	quil areas ove	erflown						
		System		NSA area	NSA cou		ational (s count	National Parks area	a DQA	count	DQA ar	ea
		RWY 05 Baselin Vectoring (NTK o		0	0		0	0	2	4	0.66	
		RWY 05 Baseline (Centrel Optioneering to		0	0		0	0	2	2	0.38	
		The effects of airspace "In general, airspace ground-based infras Habitats legislation.' some evidence that are below around 50 where aircraft overfl Areas, and Sites of 5 Table 39 shows dat Glasgow's existing 5 departure baseline. <i>Table 39 Biodiversity</i> -	change tructure. Though disturbar 00m (~1, y Special Special S a on the SID centi	As such the there is lime there is lime ce effects a 640ft). Const al Protection Scientific Inte e overflight correlines. The	re unlikely to bey are unlikely to research ssociated w ideration wi Areas, Spe erest, particu- f these area	have ar kely to h h availa ith aircra ll therefo ecial Are ularly at as, base	n impact u have a dir ble on the aft can occ ore be give eas of Cor altitudes t ed on the	pon biodive ect impact effects of a cur during ta en to the effi- nservation, I pelow 2000f NTK heatm	rsity beca that woul aircraft no ke-off and ects on e National I it. ap and if	use they d engag bise on w d landing cology a Parks, N aircraft	do not in e the Bir vildlife, the where ai nd biodiv ational S were to f	tolve rds or ere is ircraft versity Scenic
	Biodiversity	System	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park	park	NSA count	NS/ area
		RWY 05 Baseline – Vectoring (NTK data)	0	0	24	10.46	11	6.37	count 0	area 0	0	0
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0
			as, and pelow a requentl y turned	Sites of Spe 6% climb gr y, as lower a left before r	ecial Scienti adient, may and slower a eaching the	fic Intere overfly aircraft v sites.	est for the the Manse vill typicall	vast majori e Burn and y not be rec	ity of airc Mugdock quired to f	raft. Low Wood S ollow the	ver and s SSIs hov NAP an	lower wever nd will
General Aviation	Access	therefore be tactically turned left before reaching the sites. This baseline scenario would not offer any change from the existing Controlled Airspace (CAS) arrangements in place today. The options will be qualitatively compared against this existing scenario. $I = \int_{1}^{1} \int_{1}^{$										
	Economic impact from increased effective capacity	specifically working There will be no inc estimate the differen	rease to	capacity fro	om today as	s a resu			in this IC	DA we w	ill qualita	atively
General Aviation / Commercial airlines	Fuel burn	As the combustion baseline easterly de When departing fror traffic control, this m SID options against	partures m Glasgo eans tha	ow, the maj it track lengt	ority of aircr h is varied f	aft fly st rom fligh	traight aho t to flight.	ead until 5n For the pur	m and th	en are v comparir	rectored I	by air isterly

		total track mil		the Stage 3 Full C	Options Appraisal, track leng	th and fuel burn will be modelled		
		Table 40 East	erly SID Track Mileage					
				Baseline (Ce	ntreline)			
		RWY 05		nm	% Weighting	Score		
			TRN	50.00	0.81	40.50		
			NORBO – SUBUK	112.00	5.75	644.00		
			NORBO – LAKEY	112.00	7.03	787.36		
			LUSIV-DCS	88.80	2.34	207.79		
		DEPS	TLA	49.20	0.09	4.43		
		DEIG	PERTH	50.30	0.27	13.58		
			FOYLE	19.10	0.18	3.44		
			LOMON	20.00	0.45	9.00		
			CLYDE	25.00	0.63	15.75		
			ROBBO	33.50	0.45	15.08		
		-			Total 18%	1740.92		
		We will quali anticipated a	dvantåges/disadvantage	erences between s of the option a	gainst current day. This esti	n, to understand if there are any mation will consider whether the ler the opportunity for continuous		
Commercial	Training costs	As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
airlines	Other costs	As this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
	Infrastructure costs	As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
Airport / Air navigation service provider	Operational costs	As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Glasgow Airport's current SIDs are dependent on conventional ground-based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is an interim measure that only can only be used to bridge the gap ahead of FASI implementation. Failure to mitigate the impacts of VOR rationalisation in the long term will result in critical operational issues and significant loss of revenue, as well as not meeting the requirements of the AMS.						
	Deployment costs	As this option is already in operation, there are no deployment costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.						
All	Safety	At current traffic levels, there are no safety concerns with the current arrangements at Glasgow. Future traffic growth could however result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic levels within the Scottish TMA being capped, on increased aircraft holding on the ground, in order to maintain safety.						
All	Interdependencies, conflicts, and trade-	There are few interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Laterally deconflicting these would be optimal.						
	offs	The existing ScTMA route structure shares airways for use by both Edinburgh and Glasgow results in higher ATC workload and less efficient profiles in the airspace above 7000ft.						
All	AMS	Deliver quick by UK airspa	CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.					
		Doing nothing with Easterly departures will not align with the AMS. It will not enable any environmental benefits or maximise benefits from NERL's re-design of the ScTMA. No change and therefore no ACP submission will not enable any reduction in the volume of controlled airspace.						

4.8. Runway 05 Easterly Departure Option A

Runway 05 Ea	sterly Departures –	Option A
POYELOMON PORTH POYELOMON PERTH PERTH PERTH PERTH PERTH PERTH TLA		Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 3nm from the runway. NORBO is offset left with turn at 1nm For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see some departures offset to the left with turns at c.1nm and c.6nm, and some departures flying straight ahead before turning at c.3nm. This would mean that all easterly departures would no longer overfly the same areas as westerly approaches, providing some noise sharing for communities under the final approach. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis.
		Figure 17 Easterly Option A Overflight and 2019 baseline NTK data
Communitie s	Noise impact on health and quality of life	The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route offsets left and turns at c.1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap in figure 17 shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the route, which would account for around 13% of overall departures, largely avoids the overflight of populated areas with the exception of Milton and western parts of Bowling. This option does not involve any noise sharing/mitigation therefore these communities will be overflown on a more frequent basis than today. The ROBBO/CLYDE/LOMON/FOYLE/PERTH departures also offset to the left however these departures turn at c.6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated
		areas. The route initially flies over Dumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 7000ft. Figure 17 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

Finally, the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for c.3nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning at c.3nm rather than 5nm. This results in overflight of some areas that are already overflown today however this would be at a higher frequency in future. Review of the population data shows that this route would overfly large areas of the city of Glasgow where there is a high density of population. Although this is not dissimilar to what happens today (the heatmap shows a large swathe across parts of the city), in future concentration of overflight would be expected to occur. The latter parts of the routes will overfly dense areas of population not typically overflown by easterly departures today.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE contour may also extend further over Killearn.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option A. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 41 gives an overview of the Option A overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing

SID centreline data, the area of the contours remains similar however there is a significant increase in the number of population and noise sensitive sites overflown which can be attributed to the offset routes, early turns than today, and the overflight of Glasgow city centre by the LUSIV/TALLA SID. At present, the baseline and option overflight contours do not take into account frequency of overflight which will be important when considering total population overflown; this will be further explored at Stage 3 should this option progress.

Table 41 Easterly departures option A overflight data

System	Area (km²)	Population	
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763	
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213	
RWY 05 Option A	184.58	254041	

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of hospitals, care homes and places of worship overflown compared to the centreline baseline. The number of schools overflown reduces. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

In our Stage 2A engagement, the Mains Estate Residents' Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward, we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option A against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 42 shows an increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour. This is due to the earlier divergence of SIDs compared to the baseline however the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today.

Table 42 60dB and 65dB L_{Amax} Data – Rwy05 Dep Option A

	60dE	3 L _{Amax}	65dB L _{Amax}		
System	Area (km²)	Population	Area (km²)	Population	
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793	
RWY 05 Dep Option A	363.53	458336	129.97	179689	

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{aeq} contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces offset departures and turns at 3nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, the contour may shorten compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full L_{Aeq} contours will be quantified as part of our Stage 3 Full Options Appraisal, if this option is taken forward.

Noise Abatement Procedures

		A change to the existing NAPs would be required to accommodate the offset departures and turns. Noise Mitigation The option does not offer an alternative, predictable respite configuration however it does aim to share the noise by relocating the majority of easterly departures to an offset track, rather than climbing straight ahead over the same areas as final approach, as they do today. This option would put all NORBO departures over newly overflown communities as well as the right turn LUSIV/TLA. The L _{Amax} and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option A will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.

		some aircra minute sepa	aft will be a arations).	able to This is	splitting befo depart in in expected to will be seen	tervals 1 m reduce gro	ninutes ap ound hold	art (subje ing which i	ct to safety n turn will	y case and reduce gr	d NERL ound-ba	ability to a	accept 1-
	Capacity / resilience ¹⁷	However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand.											
		The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term ¹⁸ resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NERL's VOR withdrawal programme.											
					overflight of SID centreli		ranquillity	based on	the NTK v	vectoring b	aseline	and if airc	craft were
		Table 43 Eas	sterly depa	rture – T	Tranquil areas	s overflown							
			ystem		NSA area	NSA co		ational (s count	Nationa Parks are		count	DQA ar	ea
		Vectoring	5 Baseline g (NTK da WY 05		0	0		0	0		4	0.66	
	Tranquillity	Baseline			0	0		0	0		2	0.38	
			05 Option		0	0		0	0		3	0.94	
		in the numb At this stag the full bene Appendix A with tranqui Table 44 sh	ber of DQA e, the frece efits and ir contains il sites also nows data	As over quency mpacts a map o show on the	overflight of	ared to the t has not b n; we will e s the overfli	vectoring een articu xplore this ight conto	baseline h lated in th s further at ur of this o	owever th e data and Stage 3 s ption along	ere is an i d this will l hould this gside the b	ncrease be impor option p baseline	in the ove tant to un rogress. centreline	erall area. Iderstand Fechnical e contour,
		to follow Glasgow's existing SID centrelines. Table 44 Biodiversity – areas overflown											
		Syste		SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area
		RWY 05 B - Vectorin data RWY	ng (NTK a)	0	0	24	10.46	11	6.37	0	0	0	0
	Biodiversity	Basel (Centrel Optione tool	ine line – ering	0	0	10	3.31	0	0	0	0	0	0
		RWY 05 O	ption A	0	0	16	5.84	4	3.25	0	0	0	0
					⁵ Special Pro Scientific Int						onal Park	ks, Nation	al Scenic
		the Marise and the vas be very min	Burn and st majority himal.	Mugdo of airc	ng at below a ck Wood SS raft will climi verflight of b	SIs below b above 20	2000ft. G 000ft befor	iven the lo re overflyir	w overall s ng the site	% of aircra s, it is exp	aft expec ected th	ted to fly at any im	the SIDs, pacts will
		Appraisal a Option A is	t Stage 3. likely to c	ontribu	te to a redu	ction in bot	tlenecks	outside CA	S becaus		-		
General Aviation	Access	We created	d an "illus	trative	opportunity CAS volum to help stak	e" which v	vas a sing	gle volum	e of CAS				
		understand	if there is o existing	scope	to reduce the same l	he total vol	ume of C	AS. The to	tal volume	e of the "il	lustrative	e" airspac	e volume
	Economic impact from increased effective capacity	commercial	l air traffic	compa	ective capac ared with the uld not delive	e baseline	do nothin	g easterly	departure				
General Aviation / Commercial		track mileag LUSIV, TLA	ge. This o A and FOY nen consic	ption s /LE rou dered a	when comp hows small ites. There a gainst the o	reductions are also sm	in track r nall increa	mileage fo ses to the	r the TRN PERTH, I	, NORBO _OMON, (SUNUK CLYDE a	, NORBC	D LAKEY, BO routes
airlines	Fuel burn	Table 45 Tra	ack Length	Calcula	tions – Fuel E	Burn RWY 0	5 Easterly I	Departure (Option A				
		RWY 05		Ba: nm	seline (Cen	treline) Weighting	g Sco	ore	A nm	Sco	'e		
					/0			10				_	

 ¹⁷ Summary colour corrected
 ¹⁸ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		SUBUK									
		NORBO LAKEY	112.00	7.03	787.36	103.60	728.31				
		LUSIV-DCS	88.80	2.34	207.79	87.25	204.17				
		TLA	49.20	0.09	4.43	47.25	4.25				
		PERTH	49.20 50.30	0.03	13.58	50.50	13.64				
		FOYLE	19.10	0.18	3.44	18.50	3.33				
		LOMON	20.00	0.45	9.00	20.30	9.14				
		CLYDE	25.00	0.45	15.75	28.80	18.14				
		ROBBO									
		•	33.50	0.45	15.08	34.60	15.57				
		Total			1740.92		1632.09				
		(subject to the NATS	NERL ACF	for the airsp	ace above 7000ft),	it is anticipat	mb continuously to at least 600 ted that this option would see te track mileage in further detail				
Commercial airlines	Training costs		dingly and ι	Indertake train			As part of this cycle, airlines upd option is not anticipated to requ				
	Other costs	No other airline costs a	re foreseen								
Airport / Air navigation service	Infrastructure costs	area and noise insulati contour area and reside policy now requires fina L _{Aeq,16h} noise contour of 2022, which will cover t will determine if there a result of the track adju	on scheme ential prope ncial assist above. The he varied p are any incr ustments o e an increa	s for sensitive erties within the ance to be offe erefore, Glasg roperty types s eases in hous n departure. I sed cost for Gl	buildings, such as 66dB L _{Aeq,16h} conto red towards the nois ow Airport are currer situated within the 63 eholds within the 63 f it does and track asgow with regards	schools and ur area. The e insulation o tly developin dB contour a dB L _{Aeq,16h} an adjustments funding their	ties within the 69dB $L_{Aeq,16h}$ cont hospitals, within the 63dB L_{Aed} UK Government's current aviat of residential properties in the 63 g a new Noise Insulation Policy area. The L_{Aeq} modelling in Stag rea as a result of this options a are proposed in Glasgow's A Noise Insultation Scheme.				
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ¹⁹ ; This option is expected to require air traffic controller training for the controllers and assistants located at NATS									
	Deployment costs	Prestwick and Glasgow	Airport. Th I when we	e scale and na are appraising	ature of this training our shortlist of optio	requires furth	s and assistants located at NA her exploration as part of the Sta further information is known ab				
All	Safety	CAA IFP department wa the aircraft doesn't turn required during IFP gro the DER. More detailed IFP inves the early left turn depa	anted a 'not before the bund validat stigation sug rtures whic	below 500ft' fly end of the rur ion to ensure ggests a minim h is considere	way. PANS OPS do way. PANS OPS do the WP is acceptable um climb gradient of d achievable for the	at the Declar esn't require e, especially 5.7% climb e majority of	ANS OPS but in a recent ACP, ed End of Runway (DER) to ens this. Additional assurances will following another turn shortly a gradient is required up to 1400ft Glasgow traffic with the except y be required however that airc				
		would not usually be ex There is a lack of globa left turn NORBO agains	pected to o //UK PBN R st the later	perate on the oute Spacing (turn ROBBO/0	NORBO SIDs. Guidance for some o CLYDE departure. Th	f the interacti	ons in this option. Namely the east 6 s created so far have at least 6 e required incurring more CO_2 a				
All	Interdependencies , conflicts, and trade-offs	below 7000ft however E departures. Having an ROBBO/CLYDE traffic This option is expected ScTMA route design b	asterly dep earlier tur routing furth to be possi ut would no 2A feedbac	artures are sor n to the West her to the East ble within the e the make the m k NERL quest	netimes required to b on NORBO depar may increase this in existing network and ost of their propose oned the requirement	be 'stepped u tures reduce teraction, alb can also be a d dual south nt for both a	accommodated within NERL's F bound track structure in the up LUSIV/TLA SID in the future. If t				
			n other airs	pace users as			lasgow, Edinburgh and the ScT				
		CAP1711 describes the	objective a	as:							
		Deliver quicker, quistor	and clean	ar journeve an	h more capacity for t	he henefit of	those who use and are affected				
		Denver quieker, quieter	, and clean	or journeys all	a more capacity for t		anose who use and are allected				

		UK airspace.
AII	AMS	This option would support the modernisation of the airspace. The option would be expected to generate significant CO ₂ reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

¹⁹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.9. Runway 05 Easterly Departure Option B

Runway 05 E	asterly Departures	s – Option B
ROBD	OCLYDE	Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 4nm from the runway. NORBO is offset left with turn at 1nm For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see some departures offset to the left with turns at c.1nm and c.6nm, and some departures flying straight ahead before turning at c.4nm. This would mean that easterly departures would not overfly the same areas as westerly approaches, providing some noise sharing for communities under the final approach. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis.
		Contours (data) durine of overall departures Contours (data) depar
Communiti es	Noise impact on health and quality of life	 Figure 18 Easterly Option B Overflight and 2019 baseline NTK data The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route offsets left and turns at c.1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap in Figure 18 shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the route, which would account for around 13% of overall departures, largely avoids the overflight of populated areas with the exception of Milton and western parts of Bowling. This option does not involve any noise sharing/mitigation therefore these communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent basis than today. The ROBBO/CLYDE/LOMON/FOYLE/PERTH departures also offset to the left however these departures turn at c.6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated areas. The route initially flies over Drumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent to the east, also overflies Killearm at around 7000ft. Figure 18 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

closely follows the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at c.4nm occurring north of Bearsden and routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route would overfly areas of the city of Glasgow however by turning at 4nm there is more opportunity to avoid the most dense areas of population as aircraft are slightly further north. The route also heads towards the south-east rather than turning south as it does today; this too helps to avoid some of the most dense areas of population however it should be noted that the LUSIV route will overfly the Dennistoun and Craigend areas more frequently than today.

c.4nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning at c.4nm rather than 5nm. When reviewed against the heatmap shown in Figure 18, compared to Option A, this route more

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE contour may also extend further over Killearn.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and Option B. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 46 gives an overview of Option B overflight data. Against the NTK baseline vectoring data, there is a decrease in

population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contours reduces and there is also a decrease in the number of population overflown compared to the centreline data. This can be attributed to the LUSIV/TALLA SID turning at 4nm and aiming to avoid areas of dense population.

Table 46 Easterly departures option B overflight data

System	Area (km²)	Population
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option B	174.94	169398

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of schools overflown compared to the centreline baseline. The number of hospitals remains the same and the cares homes and places of worship reduces. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 Full Options Appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

In our Stage 2A engagement, the Mains Estate Residents' Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are any adverse effects as a result of aircraft overflight.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option B against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 47 shows an decrease in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 47 60dB and 65dB L_{Amax} Data – Rwy05 Dep Option B

	60dE	B L _{Amax}	65dB	L _{Amax}	
System	Area (km²)	Population	Area (km²)	Population	
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793	
RWY 05 Dep Option B	349.85	369502	125.22	141512	

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces offset departures and turns at 4nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, the contour may shorten compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full L_{Aeq} contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

		Noise Mitigation The option does not offer an alternative, predictable respite configuration however it does aim to share the noise by relocating the majority of easterly departures to an offset track, rather than climbing straight ahead over the same areas as final approach as they do today. This option would put all NORBO departures over newly overflown communities. The L _{Amax} and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has a change to how aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option B will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
	Capacity /	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute

	resilience ²⁰	separations). This i The benefits of this However, like toda departure demand.	will be see	n particula	arly in future	scenario	s with inc	reased traff	fic levels.				
		The introduction of provides resilience Airspace Modernis decommissions the VOR withdrawal pro	This equi ation progr VORs. Int	pment is o ramme. T	due to be de here is cur	ecommis ently no	sioned as	s part of a m²¹ resilie	NERL U	K wide p Glasgow'	rogramm s SIDs v	ie under when N	r the IERL
		Table 48 shows da follow Glasgow's e>	ta on the o			inquillity	based on	the NTK v	ectoring I	baseline a	and if air	craft wei	re to
		Table 48 Easterly dep	oarture – Tra	inquil areas	s overflown								
		System	N	SA area	NSA cour		tional s count	National Parks area	DQA	count	DQA are	ea	
		RWY 05 Baselin Vectoring (NTK		0	0		0	0	4	4	0.66		
	Tranquillity	RWY 05 Baseline (Centre Optioneering te		0	0		0	0	:	2	0.38		
		Runway 05 Opti		0	0		0	0	;	3	1.01		
		The data shows that the number of DQA this stage, the freque benefits and impact A contains a map we sites also shown.	as overflow uency of ov this op	n compare erflight ha tion; we w	ed to the ve is not been a vill explore th	ctoring ba rticulated is further	aseline ho d in the da at Stage	owever ther ata and this 3 should th	re is an ir s will be ir his option	ncrease in nportant progress	n the ove to unders . Technic	erall area stand the cal Appe	a. A e fu endi
		Table 49 shows da follow Glasgow's ex Table 49 Biodiversity	kisting SID	centreline		areas up	to 7000ft	based on t	he NTK ł	neatmap	and if air	craft we	re to
		System	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area	
		RWY 05 Baseline – Vectoring (NTK data)		0	24	10.46	11	6.37	0	0	0	0	
	Biodiversity	RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0	
		RWY 05 Option B	0	0	16	5.93	4	3.25	0	0	0	0	
		 Below 2000ft no overflight of Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas, and Sites of Special Scientific Interests is expected for the vast majority of aircraft. Lower slower aircraft, climbing at below a 6% climb gradient on the CLYDE/LOMON/FOYLE/PERTH SIDs, may overfly the Marise Burn and Mugdock Wood SSSIs below 2000ft. Given the low overall % of aircraft expected to fly the SIDs, and the vast majority of aircraft will climb above 2000ft before overflying the sites, it is expected that any impacts will be very 											
		minimal. We will full quantify at Stage 3.	the overflig	ght of biod	liverse sites	using the	full Glas	gow fleet m	iix, as pai	rt of our F	ull Optio	ns Appra	aisa
		Option B is likely to existing CAS whilst							se this o	ption car	be cont	ained w	/ithi
General Aviation	Access	We created an "illus options combined to there is scope to rec CAS in the same la	o help stake duce the tot	eholder er al volume	ngagement of CAS. The	n potenti total volu	ial impact ume of the	s. We have "illustrative	e also use e" airspac	ed this vo e volume	lume to ι compare	indersta ed to exis	and
	Economic impact from increased effective capacity	We expect the incre commercial air traf NORBO departure	fic compar	ed with th	ne baseline	do nothii	ng easter	ly departui					
General Aviation / Commercia		We estimate that O mileage. This optio FOYLE routes. The considered against elsewhere.	n shows sr re are also	nall reduc small incre	tions in trac eases to the	c mileage LUSIV, F	e for the T PERTH, Lo	TRN, NORE OMON, CL	30 SUNL YDE and	JK, NORI ROBBO	30 LAKE	EY, TLA wever w	an whe
l airlines	Fuel burn	Table 50 Track Lengt	h Calculation	ns – Fuel B	Burn RWY 05	Easterly D	eparture C	Dption B					
		RWY 05	Base nm	line (Cen	treline) Weighting	Sco	re	B nm	Scor	e			
					noighting	000	· •						
		TRN DEPS NORBO	50.00 - 112.0	0.8	81	40.5 644.	0	49.20 103.60	39.85 595.7	5			

 ²⁰ Summary colour corrected
 ²¹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

			LAKEY								
			LUSIV-DCS	88.80	2.34	207.79	89.10	208.49			
			TLA	49.20	0.09	4.43	48.20	4.34			
			PERTH	50.30	0.27	13.58	50.50	13.64			
			FOYLE LOMON	19.10 20.00	0.18 0.45	3.44 9.00	18.50 20.30	3.33 9.14			
			CLYDE	25.00	0.63	15.75	28.80	18.14			
			ROBBO	33.50	0.45	15.08	34.60	15.57	_		
		Total				1740.92		1636.51			
		to the NA	TS NERL ACF	o for the airs	space above 7		d that this o	ption would see an	least 6000ft (subject improvement in fuel		
Commercia I airlines	Training costs	their proc		ingly and u	ndertake traini				cycle, airlines update ipated to require any		
	Other costs	No other	airline costs ar	e foreseen.							
Airport / Air navigation service	Infrastructure costs	and noise and resid financial or above varied pro- increases departure Glasgow	e insulation sch ential propertie assistance to k Therefore, Gla operty types si s in household e. If it does and with regards fu	nemes for se es within the be offered to asgow Airpo tuated within s within the track adjus unding their	ensitive buildin 66dB L _{Aeq,16h} o owards the noi ort are currently n the 63dB coi 63dB L _{Aeq,16h} tments are pro Noise Insultat	gs, such as schools contour area. The Uk se insulation of resid developing a new N ntour area. The L _{Aeq} area as a result of t posed in Glasgow's	and hospita (Governmend dential proper- loise Insulat modelling in his options a ACP submis	Is, within the 63dB off scurrent aviation erties in the 63dB I ion Policy for 2022 Stage 3 will deter as a result of the t ssion, there will be	L _{Aeq,16h} contour area L _{Aeq,16h} contour area n policy now requires -Aeq,16h noise contour , which will cover the mine if there are any rack adjustments on an increased cost for		
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ²² .									
	Deployment costs	and Glas Appraisa	gow Airport. Th	ne scale and appraising d	d nature of this our shortlist of	training requires fur	rther explora	tion as part of the	d at NATS Prestwick Stage 3 Full Options ut the network above		
AII	Safety	IFP depa aircraft d during IF More det early left the Twin be expec There is a turn NOR	artment wanted oesn't turn befor P ground validation ailed IFP invest turn departure Otter aircraft for ted to operate a lack of global BO against the	a 'not belo pre the end ation to ens tigation sug s which is c or which alte on the NOF /UK PBN Ro e later turn l	w 500ft; flyove of the runway. ure the WP is gests a minim onsidered ach ernative tactica RBO SIDs. oute Spacing (ROBBO/CLYD	er WP positioned at PANS OPS doesn't acceptable, especial um climb gradient of evable for the major I arrangements may Guidance for some of E departure. The illu	the Declare require this ly following a 5.7% climb rity of Glasge be required f the interact istrations cre	d End of Runway Additional assura another turn shorth gradient is require ow traffic with the however that aircr ions in this option. eated so far have a	recent ACP, the CAA (DER) to ensure the nces will be required y after the DER. d up to 1400ft on the exception perhaps of aft would not usually Namely the early left it least 6nm between and potentially more		
AII	Interdependenci es, conflicts, and trade-offs	There are 7000ft he departure ROBBO/ This option ScTMA re In their S progresse The cum	owever Easter es. Having an CLYDE traffic r on is expected oute design, bu Stage 2A feedb ed, we will exp	ly departur earlier tur routing furth to be poss at would not pack NERL lore the abil	res are some rn to the We er to the East sible within the make the mos questioned the ity to remove o	imes required to b st on NORBO dep may increase this int existing network but t of their proposed du e requirement for bo one of these SIDs in	e 'stepped artures redu eraction, alb ut can also b ual southbou oth a LUSIV/ Stage 3.	up' underneath E uces this interaction peit above 7000ft. De accommodated and track structure /TLA SID in the fu	rly departures below Edinburgh's GOSAM on. Conversely the within NERL's FASI in the upper network. ture. If this option is and the ScTMA need		
		CAP1712	I describes the	objective a	s:						
All	AMS	airspace. This option reduction single NO	on would supp is, provide som ORBO departu	ort the mod ne relief fror re route do	ernisation of the m noise to those s not meet for	ne airspace. The opt se most frequently o	ion would be verflown by herefore offe	e expected to gen Glasgow arrivals a er the most econo	d are affected by UK erate significant CO_2 and departures but a mic benefit. It would		
		This optio	on could be ex	pected to re	sult in reductio	ns in the volume of (Glasgow's C	AS.			

²² Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.10. Runway 05 Easterly Departure Option C

Runway 05 I	Easterly Departure	es – Option C
NORDO	TOYLELOMON ROUBOCLYDE	Offset left departures with turns at 1nm and 6nm from the runway. Straight ahead departures with turns at 4nm from the runway. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see all departures initially fly straight ahead before turns at 1nm, 3nm and 6nm from the runway. Today, the majority of departures fly straight ahead until at least 5nm before turning and therefore turns at 1nm and 3nm are a change from current day. As aircraft will fly straight ahead, communities living under the final approach will be overflown by both arrivals and departures.
Communiti es	Noise impact on health and quality of life	 Figure 19 Easterly Option C Overflight and 2019 baseline NTK data The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route turns at 1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap data (Figure 19) suggests that a left turn at 1nm would overfly the populated areas of Drumry and Faifley. Beyond this point the route, which would account for around 13% of overall departures, largely avoids the overflight of populated areas with the exception of Milton and western parts of Bowling. The ROBBO/CLYDE/LOMON/FOYLE departures fly straight ahead before turning left at 6nm. This means that they overfly the same areas as the final approach track before turning and up to around 5nm, this reflects what happens today. Figure 19 shows today's vectoring swathe turning at around 5nm and therefore a turn at 6nm will result in some areas not currently overflown in future however the population data suggests that these areas have very low population levels. The PERTH, which accounts for less than 1% of Glasgow's overall departures, flies straight ahead overfly new areas however these are sparsely populated. Finally, the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for 3nm rather than 5nm. This results in overflight of some areas that are already overflown today however this would be at a higher

where there is a high density of population. Although this is not dissimilar to what happens today (the heatmap shows a large swathe across parts of the city), in future concentration of overflight would occur. The latter parts of the routes will overfly dense areas of population not typically overflown by easterly departures today.

frequency in future. Review of the population data shows that this route would overfly large areas of the city of Glasgow

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option C. It's important to note that the vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 51 gives an overview of the Option C overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contours reduces however there is an increase in the number of population overflown compared to the centreline data. This can be attributed to the earlier turns than today and the LUSIV/TALLA SID turning at 3nm and routing over the centre of Glasgow.

Table 51 Easterly departures option C overflight data

System	Area (km²)	Population								
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763								
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213								
RWY 05 Option C	172.34	251000								

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows a decrease in the number of schools overflown compared to the centreline data. The number of hospitals, care homes and places of worship increases. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option C against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data, as shown in table 52 shows an increase in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 52 60dB and 65dB LAmax Data – Rwy05 Dep Option C

	60dE	B L _{Amax}	65dB	L _{Amax}
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option C	339.28	453932	121.06	175911

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces turns at 1nm, 3nm and 6nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, due to the turns, the contour may shorten compared to current day which may benefit parts of Milngavie. The NORBO departure to the left may result in the component part of the contour extending further to the northwest to reflect the earlier turn; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

The full L_{Aeq} contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the turns at 1nm, 3nm.

Noise Mitigation

The option does not offer an alternative, predictable respite configuration and would continue to see all departures (except NORBO) to climb straight ahead as today. The early left turn on NORBO departures would reduce the volume of traffic that climbs straight ahead however it would be positioned over newly overflown communities as well as the right turn LUSIV/TLA. The L_{Amax} and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.

This option has a change to how some lower slower aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.

			compared to the contribution of road traffic to local air quality.
		Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option C will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
-	Wider Society	Capacity / resilience ²³	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term ²⁴ resilience for Glasgow's SIDs when NERL decommissions the
			VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NERL's VOR withdrawal

²³ Summary colour corrected

Air Quality

²⁴ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

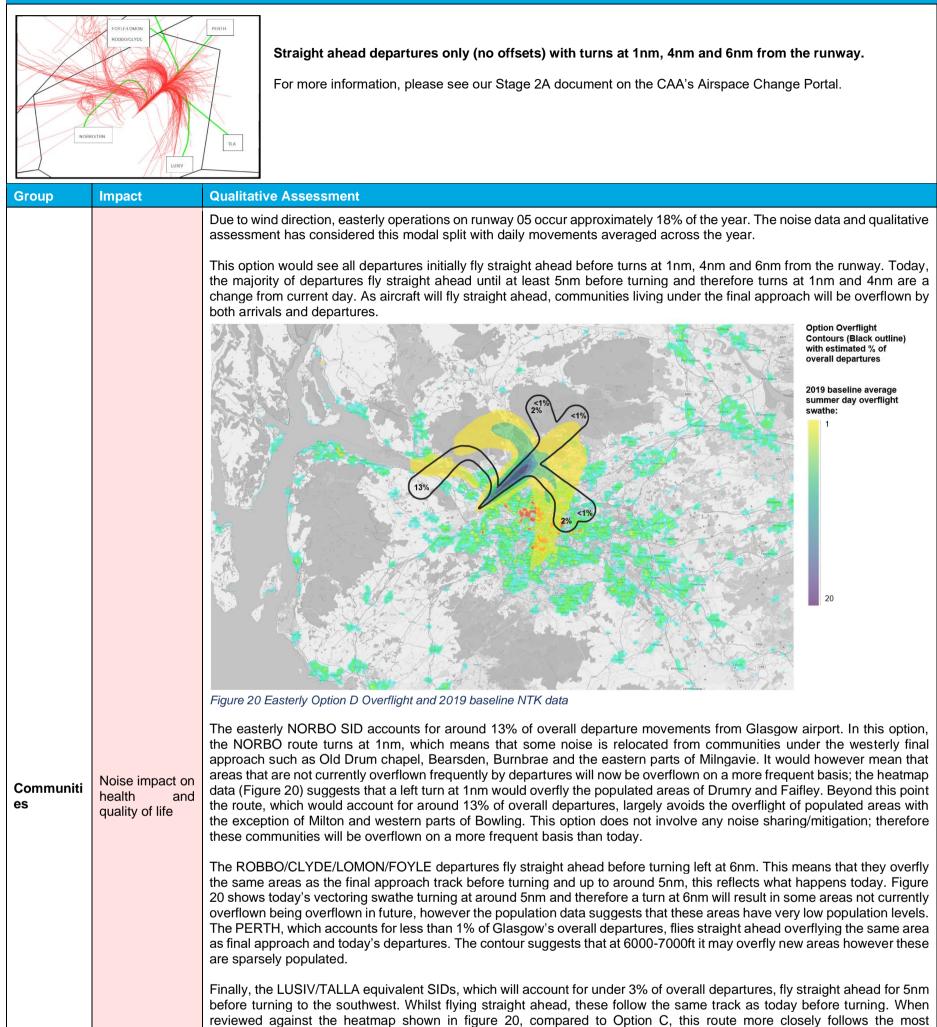
		follow GI	asgow's exist	ing SID			ranquillity	/ based o	n the NTK v	rectoring	baseline	e and if a	ircraft we
		1 able 33	Lasieny uepan	Table 53 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and if a follow Glasgow's existing SID centrelines: Table 53 Easterly departure – Tranquil areas overflown									
		National											
			System		SA area	NSA cou		s count	Parks area	DQA	count	DQA ar	ea
			05 Baseline ring (NTK da RWY 05		0	0		0	0		4	0.66	
	Tranquillity		ne (Centrelin pneering too		0	0		0	0	:	2	0.38	
		Runw	ay 05 Option	C	0	0		0	0	:	3	0.94	
		number stage, th and impa	a shows that the of DQAs over e frequency o acts of this opt hich shows the	rflown co f overflig tion; we v	ompared to ht has not will explore	o the vecto been articu e this furthe	ring base lated in th r at Stage	line howe ne data an 9 3 should	ever there is d this will be this option p	an incre importa progress.	ease in th nt to und . Technic	ne overa erstand t al Appen	ll area. At he full ben dix A cont
			shows data asgow's exist				areas up	o to 7000f	t based on t	the NTK	heatmap	and if a	ircraft we
			Biodiversity – a	•									
		Sy	stem	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park	National park	NSA count	NSA area
	Biodiversity	- Vecto	5 Baseline ring (NTK ata)	0	0	24	10.46	11	6.37	count 0	area 0	0	0
		RV Bas (Cent Optio	VY 05 seline creline – neering	0	0	10	3.31	0	0	0	0	0	0
			ool) 5 Option C	0	0	14	5.57	4	3.32	0	0	0	0
		Below 20	000ft no over ad Sites of Sp										
			is likely to co									•	
Aviation	Access Economic impact from increased effective capacity	We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existing CAS in the same lateral area is c.100nm ³ smaller than currently exists. The Glasgow CTR was c.47nm ³ smaller. We expect the increased effective capacity detailed in the section above will result in a positive economic impact on commercial air traffic compared with the baseline do nothing easterly departure baseline. However, having a single NORBO departure track would not deliver the biggest economic benefits.											
		mileage. TLA rout same. M decrease	nate that Opti This option s es. There are /hen conside es elsewhere. <i>Track Length</i> 0	hows sn also sm red agai	nall reduct all increas nst the ov	tions in trac ses to the F verall % m	k mileage OYLE, LO ovements	e for the T OMON, C at GLA,	RN, NORB LYDE and R any increa	O SUNU	K, NORE outes. TI	BO LAKE	Y, LUSIV
					line (Cent		,			С			
Concret		RWY 05		nm		Weighting			nm	Scor	е		
Seneral Viation /			TRN NORBO	50.00			40.5		49.40	40.01			
Commerci I airlines			SUBUK	⁻ 112.0			644		103.90	597.4			
	Fuel burn		LAKEY LUSIV-DCS	112.0 88.80			787 207		103.90 87.25	730.4 204.1			
		DEPS	TLA	49.20	0.0	09	4.43	3	47.25	4.25			
			PERTH FOYLE	50.30 19.10			13.5 3.44	-	50.30 20.40	13.58 3.67	3		
			LOMON	20.00			9.00		20.40	10.85	5		
			CLYDE	25.00	0.6	63	15.7	75	33.10	20.85	5		
		Total	ROBBO	33.50	0.4	45	15.0)8 0.92	39.00	17.55 1642		_	
		the NAT	e improvemer S NERL ACP the Full Optio	for the	airspace a	above 7000	,)ft), it is a	inticipated	I that this op	otion wo	uld see a		
		burn. In the Full Options Appraisal at Stage 3 we will investigate track mileage in further detail. Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This easterly SID option is not anticipated to require any											
Commerci	Training costs	additional training costs for airlines.											

r		
Airport /	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP. Unlike options that propose track adjustments on departure, this option is unlikely to change the populations within the 63dB L _{Aeq,16h} noise contour and therefore not affect Glasgow's noise insultation scheme costs.
Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ²⁵ ;
P . C . 1 2 C .	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 1400ft on the early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception perhaps of the Twin Otter aircraft for which alternative tactical arrangements may be required however that aircraft would not usually be expected to operate on the NORBO SIDs.
O "	Guicty	There is a lack of global/UK PBN Route Spacing Guidance for some of the interactions in this option. Namely the early left turn NORBO against the later turn ROBBO/CLYDE departure. The illustrations created so far have at least 6nm between the interactions but if this is deemed not sufficient, a wider turn would be required incurring more CO ₂ and potentially more CAS.
		There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having an earlier turn to the West on NORBO departures reduces this interaction. Conversely the ROBBO/CLYDE traffic routing further to the East may increase this interaction, albeit above 7000ft.
All	Interdependenci es, conflicts, and trade-offs	This option is expected to be possible within the existing network and can also be accommodated within NERL's FASI ScTMA route design but would not make the most of their proposed dual southbound track structure in the upper network. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3.
		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
		CAP1711 describes the objective as:
		Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
All	AMS	This option would support the modernisation of the airspace. The option would be expected to generate significant CO ₂ reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

²⁵ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.11. Runway 05 Easterly Departure Option D

Runway 05 Easterly Departures – Option D



do today. This results in avoidance of some of the most densely populated parts of Glasgow city centre although it results in overflight of Bishopbriggs and other densely populated areas of north-east of Glasgow city centre. The NTK heatmaps show that overflight already occurs in these areas today. The latter parts of the LUSIV/TALLA routes at higher altitudes overfly areas not currently overflown by Glasgow departures such as Dennistoun and Craigend.

concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 5nm occurring over an area with lower population density as aircraft do

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the LUSIV/TALLA contours may extend slightly over additional areas of dense population within the city of Glasgow.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option D. The vectoring data is not modelled in the same way as the overflight contours; however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 56 gives an overview of the Option D overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contours reduces and there is a decrease in the number of population overflown compared to the

centreline data.

Table 56 Easterly departures option D overflight data

System	Area (km²)	Population
RWY 05 Baseline – Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option D	158.16	158513

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows a decrease in the number of hospitals, care homes and places of worship being overflown and schools remaining the same for centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB LAmax

Technical Appendix A includes 60dB and 65dB L_{Amax} contours which compare Option D against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 57 shows a decrease in the population within the 60dB L_{Amax} contour and an increase in population within the 65dB L_{Amax} contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 57 60dB and 65dB LAmax Data – Rwy05 Dep Option D

	60dE	3 L _{Amax}	65dB L _{Amax}			
System	Area (km²)	Population	Area (km²)	Population		
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793		
RWY 05 Dep Option D	320.66	364573	111.91	133584		

LAeq

The easterly departures make up a component of the overall L_{Aeq} day ime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces turns at 1nm, 3nm and 6nm and therefore deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, due to the turns, the contour may shorten compared to current day which may benefit parts of Milngavie. The NORBO departure to the left may result in the component part of the contour extending further to the northwest to reflect the earlier turn; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

The full L_{Aeq} contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the turns at 1nm and 3nm.

		Noise Mitigation The option does not offer an alternative, predictable respite configuration and would continue to see all departures (except NORBO) to climb straight ahead as today. The early left turn on NORBO departures would reduce the volume of traffic that climbs straight ahead, however it would be positioned over newly overflown communities. The L _{Amax} and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has a change to how some lower slower aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below that these changes are likely to be small compared to the contribution of road traffic to local air quality.
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option D will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Wider		This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels.
Society	Capacity / resilience ²⁶	However, like today, this option has all NORBO departures on one initial route which would not cater for future peak departure demand.
		The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term ²⁷ resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NERL's VOR withdrawal programme.

²⁶ Summary colour corrected

²⁷ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

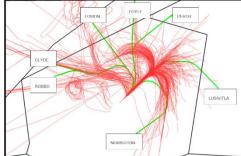
		Table 58 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and if aircraft were to follow Glasgow's existing SID centrelines:											
			Easterly depart	U									
			System	N	ISA area	NSA co		ational	National	DQA	count	DQA ar	ea
		RWY	05 Baseline		0	0	Park	cs count 0	Parks area	a	4	0.66	ca
		Vecto	ring (NTK dat RWY 05	ta)	0	0		0	U		4	0.00	
	Tranquillity		ne (Centrelin oneering tool		0	0		0	0		2	0.38	
			ay 05 Option		0	0		0	0		3	1.01	
		number stage, th and impa	a shows that th of DQAs over he frequency of acts of this opt which shows th	rflown co f overflig tion; we v	ompared to tht has not will explore	o the vecto been artic e this furth	oring base ulated in tl er at Stage	eline how he data ar e 3 should	ever there is nd this will be d this option	s an incr e importa progress	ease in tl ant to und s. Technic	he overa erstand t cal appen	ll area. At th he full benefi idix A contair
		follow G	9 shows data o lasgow's exist	ing SID	centrelines		e areas u	p to 7000	ft based on	the NTK	heatmap	o and if a	ircraft were t
		Table 59	Biodiversity – a	ireas ove	rflown								
			/stem	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area
	Biodiversity	– Vecto d	5 Baseline bring (NTK lata) WY 05	0	0	24	10.46	11	6.37	0	0	0	0
		Bas (Cent Optio	seline treline – oneering	0	0	10	3.31	0	0	0	0	0	0
			ool) 5 Option D	0	0	14	5.66	4	3.32	0	0	0	0
			000ft no overl ind Sites of Sp										
		Areas, and Sites of Special Scientific Interests is expected which would offer some small benefits compared Option D is likely to contribute to a reduction in bottlenecks outside CAS because this option can be contained CAS whilst offering opportunity to reduce the total volume of CAS.									ontained	within existir	
General Aviation	Access	We crea options of there is s	We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and depart options combined to help stakeholder engagement on potential impacts. We have also used this volume to underst there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to ex CAS in the same lateral area is c.100nm ³ smaller than currently exists. The Glasgow CTR was c.47nm ³ smaller.							o understand ared to existir			
	Economic impact from increased effective capacity	We expect the increased effective capacity detailed in the section above will result in a positive economic impact on commercial air traffic compared with the baseline do nothing easterly departure baseline. However, having a single NORBO departure track would not deliver the biggest economic benefits.											
		We estimate that Option D, when compared to baseline nominal centrelines, will result in an overall improvement in mileage. This option shows small reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAKEY an routes. There are also small increases to the LUSIV, FOYLE, LOMON, CLYDE and ROBBO routes. The PERTH re the same. When considered against the overall % movements at GLA, any increase in track miles is outweighed decreases elsewhere. <i>Table 60 Track Length Calculations – Fuel Burn RWY 05 Easterly Departure Option D</i>								KEY and TL ERTH remair			
					line (Cent			Dopartaro		D			
		RWY 05	5	nm		Weighting	g Sco	ore	nm	Sco	re		
eneral viation /			TRN NORBO	50.00) 0.8	31	40.5	50	49.40	40.0	1		
ommerci I airlines			SUBUK	⁻ 112.0	00 5.7	75	644	.00	103.90	597.	43		
	Fuel burn		NORBO LAKEY	-112.0			787		103.90	730.			
		DEPS	LUSIV-DCS TLA	88.80 49.20			207 4.43		89.10 48.20	208. 4.34			
			PERTH	50.30	0.2	27	13.5	58	50.30	13.5	8		
			FOYLE LOMON	19.10 20.00			3.44 9.00		20.40 24.10	3.67 10.8			
			CLYDE	25.00			9.00 15.7		33.10	20.8			
			ROBBO	33.50			15.0		39.00	17.5		_	
		Total					174	0.92		<mark>1647</mark>	'.19		
		the NAT	e improvemer S NERL ACP the Full Optior	for the	airspace a	above 700	Oft), it is a	anticipate	d that this o	ption wo	ould see a		
Commerci	Training costs	Flight pro	ocedures are or res according al training cost	updated	or introdu undertake	ced worldv	vide as pa	rt of an A	IRAC cycle.	As part of	of this cyc		
l airlines	Other costs		r airline costs a										
Airport /	Infrastructure	-	al deployment			P may req	uire some	ATC sys	tem engine	ering am	endment	s howev	er beyond th
				1.1.000			2 00110						

Air	costs	there are not expected to be any changes to infrastructure for the airport or the ANSP.
navigation service provider		Unlike options that propose track adjustments on departure, this option is unlikely to change the populations within the 63dB $L_{Aeq,16h}$ noise contour and therefore not affect Glasgow's noise insultation scheme costs.
	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ²⁸ .
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
A11	Sofoty	More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 1400ft on the early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception perhaps of the Twin Otter aircraft for which alternative tactical arrangements may be required however that aircraft would not usually be expected to operate on the NORBO SIDs.
All	Safety	There is a lack of global/UK PBN Route Spacing Guidance for some of the interactions in this option. Namely the early left turn NORBO against the later turn ROBBO/CLYDE departure. The illustrations created so far have at least 6nm between the interactions but if this is deemed not sufficient, a wider turn would be required incurring more CO ₂ and potentially more CAS.
	Interdependenci es, conflicts, and trade-offs	There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having an earlier turn to the West on NORBO departures reduces this interaction. Conversely the ROBBO/CLYDE traffic routing further to the East may increase this interaction, albeit above 7000ft.
All		This option is expected to be possible within the existing network but can also be accommodated within NERL's FASI ScTMA route design but would not make the most of their proposed dual southbound track structure in the upper network. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3.
		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
		CAP1711 describes the objective as:
		Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
All	AMS	This option would support the modernisation of the airspace. The option would be expected to generate significant CO ₂ reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities.
		This option could be expected to result in reductions in the volume of Glasgow's CAS.

²⁸ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.12. Runway 05 Easterly Departure Option E

	Runway (05 Easterly	Departures –	Option E
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Offset left departures with turns at 1nm from the runway. Straight ahead departures with turns at 2nm and 6.5nm from the runway. NORBO is straight ahead to 2nm with a right turn. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment
Group	Impact	Qualitative Assessment Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see some departures offset to the left with turns at 1nm, and some departures flying straight ahead before turning at 2nm and 6.5nm. Today, the majority of departures fly straight ahead until at least 5nm before turning and therefore the offset departures and turns at 2nm are a change from current day. As around 15% if aircraft will fly straight ahead, communities living under the final approach will be overflown by both arrivals and departures. Option Overflight Contours (Black outline) with estimated % of departures when on easterlies 2019 baseline average summer day overflight swatte: 2019 baseline average summer day overflight swatte:
		Figure 21 Easterly Option E Overflight and 2019 baseline NTK data
Communiti es	Noise impact on health and quality of life	The easterly NORBO SID accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route turns right at 2nm which is a change from the left turn today at 5nm today. This means that some noise is relocated from communities under the westerly final approach such as the northern parts of Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas of high population that are not currently overflown frequently by departures will now be overflown on a more frequent basis by 13% of overall traffic. The heatmap data (figure 21) shows that this overflight would occur over large parts of the city of Glasgow.
		The LUSIV route, which accounts for around 2% of Glasgow's overall departures, flies straight ahead overflying the same area as final approach and today's departures before turning at 6.5nm to head east. The contour suggests that it will route over areas already overflown today and will overfly the densely populated areas of Lennoxtown and Milton of Campsie.
		The ROBBO/CLYDE/LOMON/FOYLE departures all offset left before turning at 1nm. This means that around 4-5% of departures will no longer fly along the final approach resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap in figure 21 shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently frequently overflown below 7000ft.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the NORBO contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option E. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 61 gives an overview of the Option E overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour increases as does the number of population overflown compared to the centreline data. This can be attributed to the overall increase in contour area and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

System	Area (km²)	Population
RWY 05 Baseline Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option E	232.04	249498

Data on the number of noise sensitive buildings (schools, hospitals, and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in Technical Appendix A.

60dB and 65dB L_{aMax}

Technical Appendix A includes 60dB and 65dB L_{aMax} contours which compare Option E against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 62 shows an increase in the population within the 60dB L_{aMax} contour and 65dB L_{aMax} contour. The centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 62 60dB and 65dB LaMax Data – Rwy05 Dep Option E

	60dE	3 L _{aMax}	65dB L _{aMax}		
System	Area (km²)	Population	Area (km²)	Population	
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793	
RWY 05 Dep Option E	427.82	468436	162.05	195679	

The easterly departures make up a component of the overall L_{Aeq} daytime and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces some offset departures with a turn at 1nm and straight-ahead departures with turns at 2nm and 6.5nm and therefore the option deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, due to the offset and turns, the contour may shorten compared to current day which may benefit parts of Milngavie. The NORBO departure to the right may result in the component part of the contour extending further to the southeast to reflect the earlier turn; this may result in northern parts of Westerton moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore, the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full L_{Aeg} contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

Noise Mitigation

The option does not offer an alternative, predictable respite configuration. The majority of the SIDs in this option overfly new communities with the right turn, single NORBO SID potentially having the biggest effect in terms of increasing the numbers of people overflown with a relatively high frequency.

This option has a change to how some lower slower aircraft will fly laterally below 1000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight-ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below that these changes are likely to be small

		compared to the contribution of road traffic to local air quality.
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option E will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Wider Society	Capacity /	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1-minute separations). This is expected to reduce ground holding which in turn will reduce ground-based emissions and delays. The benefits of this will be seen particularly in future scenarios with increased traffic levels. However, like today, this option has all NORBO departures on one initial route which would not cater for future peak
	resilience ²⁹	departure demand. The introduction of PBN SIDs also removes Glasgow's dependency on conventional ground-based navigation aids, which provides resilience. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. There is currently no long term ³⁰ resilience for Glasgow's SIDs when NERL decommissions the VORs. Introduction of PBN SIDs is absolutely essential for the Glasgow operation following NER''s VOR withdrawal

²⁹ Summary colour corrected

Air Quality

³⁰ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

			asgow's exist	U	o normali	a contra di	Option F						
		Table 63	Easterly depart		-		Na	ational	National			DO 1	
			System 05 Baseline-	-	ISA area 0	NSA con	Int	cs count	Parks area 0		count	DQA ar 0.66	ea
	Tranquillity		ring (NTK dat RWY 05 ne (Centrelin		0	0		0	0		2	0.38	
		Optic	oneering tool ay 05 Option)	2.91	1		1	14.3		2	1.27	
		compare Appendix	a shows that t d to the vecto x A contains a sites also sho	ring dat map w	a however	this data d	oes not ta	ake into ac	count freque	ency of c	overflight	at this sta	age. Tecl
			shows data asgow's exist				e areas u	p to 7000f	t based on t	he NTK	heatmap	and if a	ircraft we
		Table 64	Biodiversity - a	reas ove	rflown Optic	on E							
		Sy	stem	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	Park	National park	NSA count	NSA area
	Biodiversity	Base Vector	VY 05 eline 'ing (NTK ata)	0	0	24	10.46	11	6.37	count 0	area 0	0	0
		RV Bas (Cent Optio	VY 05 seline treline – oneering	0	0	10	3.31	0	0	0	0	0	0
			ool) 5 Option E	1	0.46	22	12.6	9	7.73	1	14.3	1	2.91
			000ft no over nd Sites of Sp										
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	Other costs	No other airline costs are foreseen.
Airport / Air navigation service	Infrastructure costs	Glasgow currently operates a homeowner relocation scheme for residential properties within the 69dB L _{Aeq,16h} contour area and noise insulation schemes for sensitive buildings, such as schools and hospitals, within the 63dB L _{Aeq,16h} contour area and residential properties within the 66dB L _{Aeq,16h} contour area. The UK Government's current aviation policy now requires financial assistance to be offered towards the noise insulation of residential properties in the 63dB L _{Aeq,16h} noise contour or above. Therefore, Glasgow Airport are currently developing a new Noise Insulation Policy for 2022, which will cover the varied property types situated within the 63dB contour area. The L _{Aeq} modelling in Stage 3 will determine if there are any increases in households within the 63dB L _{Aeq,16h} area as a result of this options as a result of the track adjustments on departure. If it does and track adjustments are proposed in Glasgow's ACP submission, there will be an increased cost for Glasgow with regards funding their Noise Insultation Scheme.
provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN SIDs removes Glasgow's dependency on conventional ground-based navigation equipment (VORs), which contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ³¹ ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
AII	Safety	This option requires a Track Adjustment on departure. These are possible within PANS OPS but in a recent ACP, the CAA IFP department wanted a 'not below 500ft' flyover WP positioned at the Declared End of Runway (DER) to ensure the aircraft doesn't turn before the end of the runway. PANS OPS doesn't require this. Additional assurances will be required during IFP ground validation to ensure the WP is acceptable, especially following another turn shortly after the DER. More detailed IFP investigation suggests a minimum climb gradient of 5.7% climb gradient is required up to 1400ft on the early left turn departures which is considered achievable for the majority of Glasgow traffic with the exception perhaps of the Twin Otter aircraft for which alternative tactical arrangements may be required.
AII	Interdependenci es, conflicts, and trade-offs	There are no interdependencies, conflicts, or trade-offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having a slightly earlier turn to the West on NORBO departures reduces this interaction. Conversely the LUSIV/TLA traffic routing further to the East may increase this interaction, albeit above 7000ft. This option is not expected to be possible within the existing network as it could require a move of the LANAK hold. It would not make the most of NERL's proposed dual southbound track structure in the upper network. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3. The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter, and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace. The option would be expected to generate CO ₂ reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities. This option could be expected to result in reductions in the volume of Glasgow's CAS.

³¹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.13. Runway 05 Easterly Departure Option F

Runway 05 Easterly Departures – Option F						
FOYLELOMON PERTIN	This option shares NORBO traffic between a left and right turn with only one of those routes in use at a time. The rest of the routes remain in the same configuration. When turning left, the NORBO would offset left then turn further left at 1nm When turning right, the NORBO would go straight ahead to 2nm then a right turn. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal. Period 1 (Left), Period 2 (Right)	ROBBOCZ YDI ROBBOCZ YDI USENTLA NORDOTTN				

Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option has been designed to enable the busiest NORBO departure route to switch from a left turn (with track adjustment) to a right turn to provide predictable respite to communities under both SID tracks. In both of these scenarios, the NORBO SID would overfly new communities. The other routes remain the same between period 1 and period 2.
		Period 1 (NORBO to the left) Period 1 would see the NORBO SID offset to the left and turn at 1nm. This would account for around 6.5% of overall departure movements from Glasgow airport. In this option, the NORBO route offsets left and turns at 1nm, which means that some noise is shared from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap in figure 22 shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the route, which would account for around 6.5% of overall departures, largely avoids the overflight of populated areas with the exception of Milton and western parts of Bowling.
		Period 2 (NORBO to the right) Period 2 would see the NORBO route turn right at 2nm which is a change from the left turn today at 5nm today. This means that some noise is relocated from communities under the westerly final approach such as the northern parts of Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis by 6.5% of overall traffic. The heatmap data (figure 22) shows that this overflight would occur over large parts of the city of Glasgow:
		2% ¹⁹ (2% ¹⁹) (1%) (1%) (1%) (1%) (1%) (1%) (1%) (1%
Commun ities	Noise impact on health and quality of life	to the second se
		Figure 22 Easterly Option F Overflight and 2019 baseline NTK data
		In both configurations, the ROBBO/CLYDE/LOMON/FOYLE/PERTH departures offset to the left however these departures turn at 6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden,

at 6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated areas. The routes initially overfly Drumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 6000-7000ft. Figure 22 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

The LUSIV route, which accounts for around 2% of Glasgow's overall departures, flies straight ahead overflying the same area as final approach and today's departures before turning at 6.5nm to head east. The contour suggests that it will route over areas already overflown today and will overfly the densely populated areas of Lennoxtown and Milton of Campsie.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the right turn NORBO contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend over further parts of Killearn.

The Technical Appendix to this document includes an image which compares the existing SID centrelines and option F. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Table 66 gives an overview of the Option F overflight data. Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour and the population overflown increases. This can be attributed to the overall increase in contour area created

by having alternative respite configurations and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 66 Easterly departures option F overflight data

System	Area (km²)	Population	
RWY 05 Baseline Vectoring (NTK data)	246.99	364763	
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213	
RWY 05 Option F	203.99	246626	

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

In our Stage 2A engagement, the Mains Estate Resident Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

60dB and 65dB L_{aMax}

Technical Appendix A includes 60dB and 65dB L_{aMax} contours which compare Option F against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 67 shows an increase in the population within the 60dB L_{aMax} contour and 65dB L_{aMax} contour. This can be partially attributed to introducing an alternative respite route and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight.

Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 67 60dB and 65dB L_{aMax} Data – Rwy05 Dep Option F

	60dE	B L _{aMax}	65dB L _{aMax}		
System	Area (km²)	Population	Area (km²)	Population	
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793	
RWY 05 Dep Option F	386.14	453065	147.12	200769	

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} day time and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces some offset departures with a turn at 1nm and straight ahead departures with turns at 2nm and 6.5nm and therefore the option deviates from current day. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, the contour may shorten compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Dumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeg contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

Noise Mitigations

The option offers an alternative respite configuration via two NORBO SIDs which could be alternated. For the purposes of this

		IOA we have assumed that this is split 50/50 between the two SIDs on a daily basis however this can be explored in further detail with stakeholders as part of the Stage 3 consultation if this option progresses. Our overflight and L_{aMax} data has shown an increase in the overall population and noise sensitive sites overflown however the impacts of noise are now shared and so there are decreases in the frequency of overflight where the frequency of overflight is currently high. This is something that was requested by stakeholders and formed part of the design principles. The benefits and impacts of this would require further quantitative analysis as part of the Stage 3 Full Options Appraisal should this option progress.
	Air Quality	This option has a change to how some aircraft will fly laterally below 1,000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1,000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1,000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option F will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.
Society	Capacity /	This option sees the SIDs splitting before 5nm which will marginally improve capacity compared to the baseline as some aircraft will be able to depart in intervals 1 minutes apart (subject to safety case and NERL ability to accept 1 minute separations). This is expected to reduce ground holding which in turn will reduce ground based emissions and delays. The benefits of this will be

	resilience ³²		icularly in fut I route which							day, this c	ption ha	s all NOR	BO departu	ures o
		provides Modernis	duction of P resilience. Th ation prograi troduction of	his equij mme. T	oment is di here is cui	ue to be de rrently no l	ecommis ong term	sioned as a	part of a N ce for Glas	ERL UK v gow's SII	vide prog Ds when	gramme u NERL de	nder the Air	irspac ons th
			shows data os existing SII			areas of tr	anquillity	/ based on	the NTK v	ectoring b	aseline a	and if airc	raft were to) follo
		Table 68 E	Easterly depart	ture – Tra	anquil areas	overflown (Option F							
			System	N	ISA area	NSA cou		ational ks count	National Parks are		count	DQA are	ea	
	Tranquillity	Vector	05 Baseline- ing (NTK da RWY 05		0	0		0	0		4	0.66		
	Tranquinty		e (Centrelin neering too		0	0		0	0	:	2	0.38		
		Runwa	ay 05 Option	F	0	0		0	0	:	2	1.27		
		number of the freque impacts of which sho	shows that the shows that the shows over ency of over of this option; bows the over shows data of the	flown co flight ha we will flight coi	ompared to is not beer explore thi ntour of thi	the vector articulate s further at s option alo	ing base d in the Stage 3 ongside t	line howev data and t should thi he baseline	ver there is his will be s option pro e centreline	an increa important ogress. Te e contour,	to unde echnical with trar	e overall a rstand the appendix nquil sites	rea. At this e full benefi A contains also shown	stag its ar a ma n.
		Glasgow'	s existing SII Biodiversity - a	D centre	lines.									
		Sys	stem	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area	
		Base Vectori da	YY 05 eline ng (NTK ata)	0	0	24	10.46	11	6.37	0	0	0	0	
	Biodiversity	Bas (Centr Option	YY 05 seline reline – neering pol)	0	0	10	3.31	0	0	0	0	0	0	
			Option F	0	0	17	6.16	4	3.25	0	0	0	0	
		and Sites Lower slo Marise Bu majority c	00ft no overf of Special S ower aircraft, urn and Mugo of aircraft will ully quantify t	cientific climbin dock Wo climb al	Interests i g at below bod SSSIs bove 2000	s expected / a 6% clin below 2000 ft before ov	for the v nb gradie Oft. Given verflying	ast majorit ent on the n the low o the sites, it	ty of aircraf CLYDE/LC verall % of is expecte	t. DMON/FO aircraft ex d that any	YLE/PE xpected to impacts	RTH SID to fly the s s will be v	s, may over SIDs, and th ery minimal	rfly th he va I.
			likely to cont ering opportu						pecause thi	s option c	an be co	ntained w	vithin existin	ıg CA
General Aviation	Access	We creat options co is scope t	ed an "illustr ombined to h to reduce the lateral area	rative C elp stak e total vo	AS volume eholder er	e" which w ngagement AS. The tot	as a sin on poter al volum	gle volume ntial impact e of the "ill	ts. We have lustrative'' a	e also use airspace v	ed this vo volume c	olume to ι ompared	inderstand i	if the
	Economic impact from increased effective capacity	air traffic	ct the increas compared wi t deliver the b	th the b	aseline do	nothing ea								
General Aviation /		mileage. There are SIDs mea the decre	nate that Opt This option s also small ir ans that when ases elsewh Track Length C	shows re ncreases n consid ere.	eductions s to the LU lered agair	in track mil SIV, TLA, F nst the over	eage for PERTH, rall % mo	the TRN, LOMON, C ovements a	NORBO S LYDE and at Glasgow	SUNUK, N ROBBO I	IORBO I routes. T	_AKEY ai	nd FOYLE r	route IORB
Commer cial					eline (Cent							F		
airlines	Fuel burn	RWY 05		nm	%	Weighting		ore	nm P1	nm F		Averag		
			TRN NORBO	50.00				50	49.20	50.70		49.95	40.4	
			SUBUK	112.(4.00	103.90	104.2		104.05	598.	
		DEPS	NORBO LAKEY	112.0				7.36	103.90	104.2		104.05	731.	
			LUSIV-DCS	49.20	0.0)9	4.4		98.00 51.10	98.00 51.10	C	98.00 51.10	229. 4.60	0
			PERTH	50.30	0.2	21	13.	58	50.50	50.50	J	50.50	13.6	54

 ³² Summary colour corrected
 ³³ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

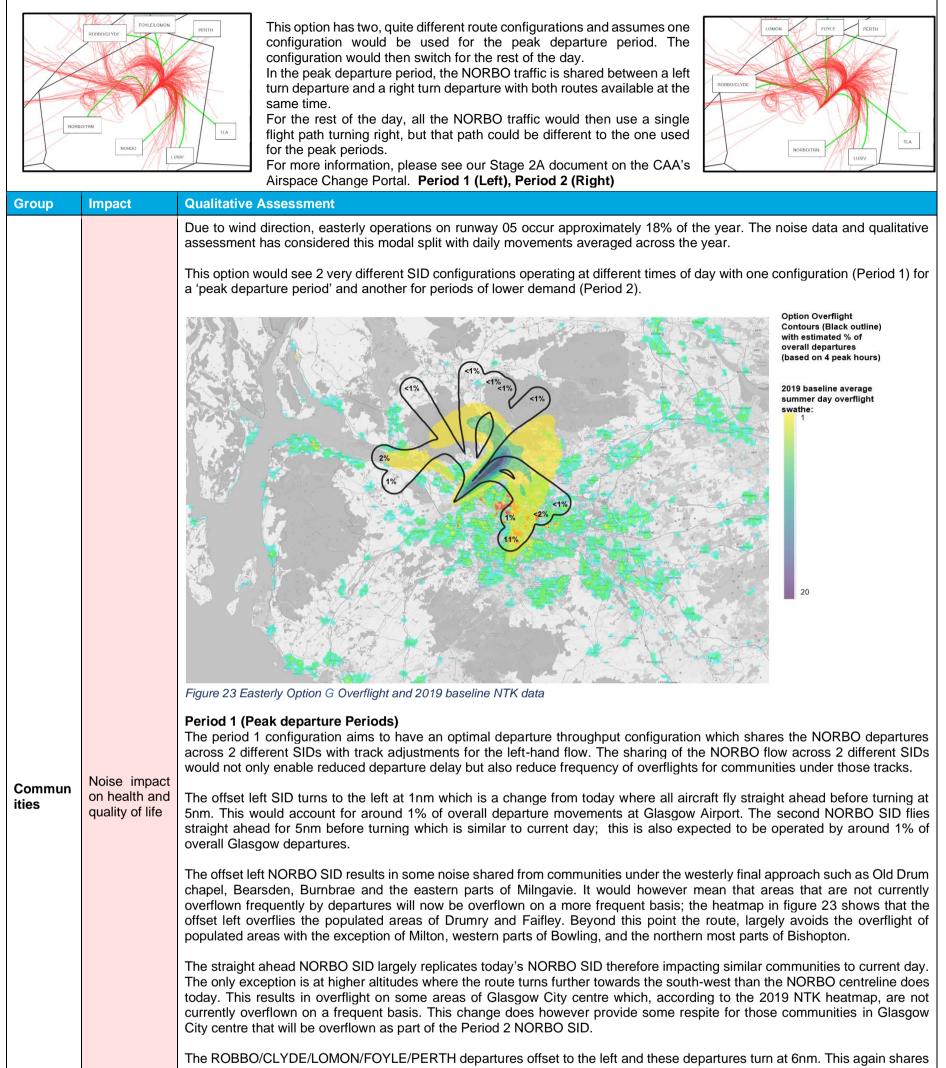
		FOYLE LOMON	19.10 20.00	0.18 0.45	3.44 9.00	17.60 20.30	17.60 20.30	17.60 20.30	3.17 9.14
		CLYDE ROBBO	25.00 33.50	0.63 0.45	15.75 15.08	28.80 34.60	28.80 34.60	28.80 34.60	18.14 15.57
		Total	23100	55	1740.92	0.100	200	000	1663.79
	Training	Given the improvem NATS NERL ACP fo Full Options Apprais Flight procedures ar	r the airspace al at Stage 3 e updated or	above 7000ft), we will investigation introduced wor	, it is anticipated tha ate track mileage in Idwide as part of a	t this option w further detail n AIRAC cycl	vould see an in le. As part of t	nprovement in f	es update their
Commer cial airlines	costs	procedures accordin training costs for airl	ines.		required. This east	erly SID optic	on is not anticip	bated to require	e any additional
	Other costs	No other airline cost							
Airport / Air navigatio	Infrastructure costs	Glasgow currently op noise insulation sch residential properties assistance to be off Therefore, Glasgow types situated within within the 63dB LAeq adjustments are prop Noise Insultation Sch	emes for ser s within the 66 ered towards Airport are cu the 63dB con ,16h area as a posed in Glas neme.	nsitive buildings 6dB L _{Aeq,16h} con 6 the noise insu rrently develop tour area. The L 6 result of this o gow's ACP sub	s, such as schools tour area. The UK G ulation of residentia ing a new Noise Inst _{-Aeq} modelling in Sta options as a result o mission, there will b	and hospitals overnment's I properties in ulation Policy ge 3 will deter f the track ac e an increase	s, within the 6 current aviatio n the 63dB LA for 2022, whic mine if there an djustments on d cost for Glas	3dB L _{Aeq,16h} co on policy now re weq,16h noise cor h will cover the re any increases departure. If it sgow with regard	ntour area and quires financial ntour or above varied property s in households does and track
n service		The initial deployme	nt phase of th	e ACP may req	uire some ATC sys	tem engineer	ing amendmer	nts.	
provider	Operational costs	This airspace chang removes Glasgow's in NERL's operation	dependency of	on conventional	ground based navig				
	Deployment costs	This option is expect Glasgow Airport. The when we are apprain interdependencies we compared to other o	e scale and n sing our sho vith Edinburg	ature of this trai tlist of options h. Owing to the	ining requires furthe and once further in e respite configurat	r exploration formation is	as part of the \$ known about t	Stage 3 Full Op he network abo	tions Appraisa
AII	Safety	This option requires department wanted a turn before the end validation to ensure More detailed IFP in left turn departures Otter aircraft for whice operate on the NOR There is a lack of glo NORBO against the interactions but if this A SID structure from that perhaps a muc a SID utilisation wou hazards to the opera are not just associated issues associated with *As an example, mi completely different same places in the ri- the SID termination	a not below 50 of the runway the WP is acc westigation su which is cons ch alternative BO SIDs. bbal/UK PBN a later turn R s is deemed ru h more subtle Id change sig tion which at ed with aircra ith ATC confu tigations iden names. Howe network are re	Doft flyover WP 2. PANS OPS of exeptable, espect aggests a minimidered achieval tactical arrange Route Spacing OBBO/CLYDE not sufficient, a nway which chas e change to a S nificantly from a this stage cann ft inadvertently sion.	positioned at the De loesn't require this. ially following anoth our climb gradient of ble for the majority ments may be required Guidance for some departure. The illu wider turn would be anges during the da ID structure can be a left turn to a right to ot considered to be flying (or being issues switching to fundanting and ATM issues	eclared End o Additional as er turn shortly of 5.7% climb of Glasgow tr ired however of the interac strations crea required incu- by is uncharte safely accom urn (or vice-v mitigated with ed) the wrong nental differents previously io	f Runway (DEI surances will b after the DER gradient is req affic with the e that aircraft wo tions in this op ated so far ha urring more CC ered territory for modated, ATC rersa) immedia hout introducin g SIDs and the ht directions a dentified by NE	R) to ensure the be required dur a guired up to 140 exception perha- buld not usually otion. Namely th ve at least 6nr 0 ₂ and potentiall or the UK. Whils advised that a tely after depar- ing other issues* wrong time of con- fter departure version	e aircraft does" ing IFP ground off on the early aps of the Twin be expected to be early left turn m between the ly more CAS. It it is expected in option where ture introduces . Such hazards day but also HF were SIDs with Ds going to the
All	Interdepende ncies, conflicts and tradeoffs	There are no interded however Easterly de a slightly earlier turn traffic routing further This option is not ex structure which chan NERL's proposed d requirement for both these SIDs in Stage	partures are to the West to the East m pected to be nges would n ual southbou a LUSIV/TL 3.	sometimes required on NORBO dep nay increase thi possible within ot fit with the e nd track structu A SID in the fut	uired to be 'stepped bartures reduces thi s interaction, albeit the existing network xisting operation. H ure in the upper ne	up' undernes s interaction. above 7000ft. as it could re aving a singl twork. In theis progressed,	ath Edinburgh' Conversely th equire a move e NORBO SIE r Stage 2A fe we will explor	s GOSAM depa e CLYDE/ROB of the LANAK o would not ma edback NERL re the ability to	artures. Having BO/LUSIV/TLA hold and a SID ke the most of questioned the remove one of

		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace. The option would be expected to generate CO ₂ reductions, provide some relief and respite from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown communities. This option could be expected to result in reductions in the volume of Glasgow's CAS.

³⁴ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

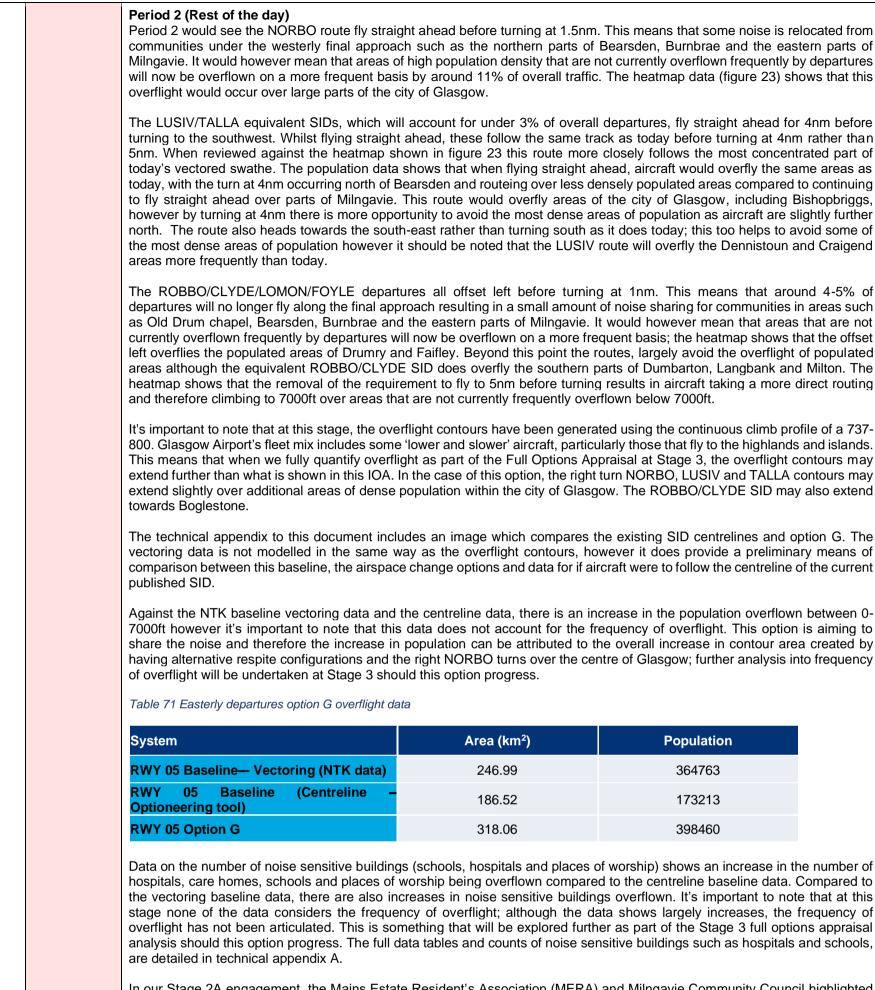
4.14. Runway 05 Easterly Departure Option G

Runway 05 Easterly Departures – Option G



noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight for other populated areas. The routes initially overfly Drumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. The equivalent CLYDE/ROBBO route, which turns to the east, also overflies Killearn at around 6000-7000ft. Figure 23 shows that the latter parts of these routes fly over areas not currently overflown today however these parts largely avoid dense areas of population.

Finally the LUSIV/TALLA equivalent SIDs, which will account for under 3% of overall departures, fly straight ahead for 5nm before turning to the southwest. Whilst flying straight ahead, these follow the same track as today before turning. When reviewed against the heatmap shown in figure 18 these routes more closely follow the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 5nm occurring over an area with lower population density as aircraft do today. Beyond the turn, aircraft would fly towards the south-east, rather than turning towards the south/south-west as they do today. This results in avoidance of some of the most densely populated parts of Glasgow city centre although it results in overflight already occurs in these areas today. The latter parts of the LUSIV/TALLA routes at higher altitudes overfly areas not currently overflown by Glasgow departures such as Dennistoun and Craigend.



In our Stage 2A engagement, the Mains Estate Resident's Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE/LOMON/ROBBO/CLYDE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

60dB and 65dB L_{aMax}

Technical Appendix A includes 60dB and 65dB L_{aMax} contours which compare Option G against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 57 shows an increase in the population within the 60dB L_{aMax} contour and 65dB L_{aMax} contour. This can be attributed to introducing alternative respite routes and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight. Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 72 60dB and 65dB LaMax Data – Rwy05 Dep Option G

	60dE	3 L _{aMax}	65dB	L _{aMax}
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option G	566.65	661368	194.89	229233

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} day time and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located north-east of the airport.

		Most aircraft today fly departures with some											
		a very similar route to expected that this optic Detailed consideration	today ir on woul needs	n the areas ld have min to be given	within the s imal impact to the use o	cope of to the store of the sto	the L _{Aeq} coshape and	ontours. Wh I size of the ts on depart	en we co overall L ure as thi	onsider th _{Aeq} conto is would	nis, and th ours. re-distrib	ne moda ute noise	e at higher
		exposures. Therefore against new population											
		The full L_{Aeq} contours v	will be c	quantified a	s part of ou	r Stage 3	3 Full Opti	ons Apprais	al if this o	option is	taken for	ward.	
		Noise Abatement Pro A change to the existin			required to	accomm	odate the	offset depa	rtures ar	nd turns.			
		Noise Mitigation The option offers a res there is further sharing increase in the overall are decreases in the requested by stakeho quantitative analysis a	of nois populat frequen lders ar	e by splittir ion and noi icy of overf nd formed	ng the NOR se sensitive flight where part of the	BO depa sites ov the frec design p	artures interesting rerflown he quency of principles.	o two routes owever the in overflight is	. Our ove mpacts o currentl	erflight ai f noise a y high.	nd L _{aMax} o re now sh This is so	data has nared an omething	shown an d so there that was
	Air Quality	This option has a chan in their totality, there w tracks are moving awa decreases in the cond straight ahead departu flightpaths. However, i local air quality.	ill be a c y from t centration re route	change in tl the standar ons below e (known a	he location of d 'straight a these flight s 'offset de	of emissi ahead' de paths. W partures'	ons below eparture th /here late) there ma	/ 1,000ft whi nat aircraft fo ral tracks a ay be slight	ch could blow belo re newly increase	affect loo ow 1,000 overflyir s in the o	cal air qua ft today th ng areas concentra	ality. Wh here ma to the s ations be	ere lateral y be slight ide of the low these
	Greenhouse gas impact	Our fuel burn assessm the baseline. We there further detail in the Sta	fore ex	pect to see	a correspo	onding im	proveme	nt to greenh					
		This option sees the S will be able to depart ir is expected to reduce seen particularly in fut	n interva ground	als 1 minute holding wh	es apart (su iich in turn v	bject to s vill reduc	safety cas ce ground	e and NERL	ability to	o accept	1 minute	separati	ons). This
	Capacity / resilience ³⁵	The ability for 2 NORB demand during the off				on would	l further h	elp to meet	demand	however	it does n	ot cater	for similar
		The introduction of PI provides resilience. Th Modernisation prograr VORs. Introduction of I	nis equij mme. T	pment is du here is cur	ue to be dec rently no lo	commiss ong term ^a	ioned as ³⁶ resilien	part of a NE	RL UK w jow's SIE	/ide prog Ds when	namme u NERL de	inder the ecommis	e Airspace ssions the
		Table 73 shows data of Glasgow's existing SIE			areas of tra	anquillity	based on	the NTK ve	ctoring b	aseline a	and if airc	craft were	e to follow
		Table 73 Easterly depart	ure – Tra	anquil areas	overflown O	ption G							
		System	N	NSA area	NSA cou		tional s count	National Parks area	DQA	count	DQA are	ea	
	Tranquillity	RWY 05 Baseline- Vectoring (NTK dat		0	0		0	0		4	0.66		
		RWY 05 Baseline (Centreline Optioneering tool		0	0		0	0	2	2	0.38		
Wider Society		Runway 05 Option	G	2.91	1		1	14.3	ŧ	5	2.28		
,		The data shows that the appendix A contains a tranquil sites also show	a map v										
		Table 74 shows data of Glasgow's existing SIE			biodiverse a	areas up	to 7000ft	based on th	e NTK h	eatmap a	and if airc	craft wer	e to follow
		Table 74 Biodiversity a	reas ove	erflown Optic	on G								
		System	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	Nationa park area	NSA count	NSA area	
	Biodiversity	RWY 05 Baseline Vectoring (NTK data)	0	0	24	10.46	11	6.37	0	0	0	0	
	Diodiversity	RWY 05 Baseline (Centreline – Optioneering tool)	0	0	10	3.31	0	0	0	0	0	0	
		RWY 05 Option G	0.46	1	28	15.22	9	8.14	1	14.3	1	2.91	
		Below 2000ft no overfl and Sites of Special S								tional Pa	arks, Natio	onal Sce	enic Areas
		Lower slower aircraft, Marise Burn and Mugo majority of aircraft will	lock Wo	ood SSSIs	below 2000	ft. Given	the low o	verall % of a	aircraft ex	pected t	o fly the	SIDs, an	d the vast

 ³⁵ Summary colour corrected
 ³⁶ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

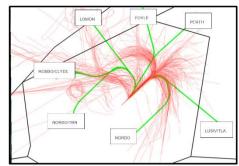
General Aviation	Access	Stage 3. The des offers po would no (togethe containe routes a We creat combine to reduc	ign option may otential to reduc ot quite be cont r with creation ed within CAS w re leaving CAS ted an "illustrati ed to help stakel e the total volur	require cha e the total v ained withir of the "illus" hich is unlil anyway, the ve CAS volu- nolder enga ne of CAS.	anges to the exi rolume of CAS. In ScTMA 7 in ac trative CAS volu- kely to happen i erefore offering ume" which was gement on pote The total volume	sting CAS bounds The Northbound S cordance with the ime") assumed th n reality because more protection th a single volume of ntial impacts. We e of the "illustrative ts. The Glasgow C	aries to accor DS on this op CAA CAS co e northbound 7000ft does r nan today is p CAS required have also use e" airspace vo	nmodate Perio otion with the 7 ntainment poli SIDs terminat ot exist in Airs otentially not p to contain ALI of this volume to	d 2 SIDs to the % climb gradier cy. However, th e at 7000ft and pace Design te roportionate.	at as illustrated is assessment are all wholly rms and these parture options there is scope
	Economic impact from increased effective capacity	air traffic	c compared with	the baselir	ne do nothing ea	I in the section abo asterly departure b liver the biggest e	baseline. How	ever the mergi		
		mileage CLYDE day. The in track	This option sh routes. There a reduction in the miles is outweig	nows reduction re small inco NORBO S hed by the	tions in track m reases to the Pl IDs means that decreases elsev	aseline nominal of ileage for the TR ERTH and LOMO when considered a where. 5 Easterly Departure	N, NORBO S N routes. The against the ov	UNUK, NORE LUSIV remain	BO LAKEY, TLA	A, FOYLE and me as current
				Baseline	(Centreline)				G	
General		RWY 05	5	nm	% Weighting	s Score	nm P1	nm P2	Average	Score
General Aviation /			TRN	50.00	0.81	40.50	49.20	49.70	49.45	40.05
Commer cial			NORBO SUBUK	112.00	5.75	644.00	97.30	103.15	100.23	576.29
airlines	Fuel burn		NORBO	112.00	7.03	787.36	96.50	96.00	96.25	676.64
			LAKEY LUSIV-DCS	88.80	2.34	207.79	88.80	88.80	88.80	207.79
		DEPS	TLA	49.20	0.09	4.43	48.20	48.20	48.20	4.34
			PERTH	50.30	0.27	13.58	50.50	52.20	51.35	13.86
			FOYLE	19.10	0.18	3.44	18.50	17.60	18.05	3.25
				20.00	0.45	9.00	20.30	20.30	20.30	9.14
			CLYDE ROBBO	25.00 33.50	0.63 0.45	15.75 15.08	28.80 34.60	19.10 23.30	23.95 28.95	15.09 13.03
		Total		00.00	0.40	1740.92	04.00	20.00	20.00	1559.48
Commer cial	Training costs	Full Opti Flight pr procedu	ions Appraisal a ocedures are u	t Stage 3 w pdated or i and undert	ve will investigate	is anticipated tha e track mileage in wide as part of a equired. This east	further detail. n AIRAC cycl	e. As part of th	nis cycle, airline	s update their
airlines	Other costs	No other	r airline costs a	e foreseen.						
	Infrastructure	noise in resident assistan	sulation schem ial properties wi ce to be offere	es for sens thin the 660 d towards	sitive buildings, dB L _{Aeq,16h} conto the noise insula	n scheme for resid such as schools ur area. The UK G ation of residentia	and hospitals Sovernment's	, within the 63 current aviation the 63dB L _A	BdB L _{Aeq,16h} con n policy now rec _{eq,16h} noise cont	tour area and juires financial
Airport / Air	costs	types sit within th adjustme	uated within the e 63dB L _{Aeq,16h}	63dB conto area as a ed in Glasg	our area. The L _{Ae} result of this opt	g a new Noise Insi ng modelling in Sta tions as a result o ission, there will b	ge 3 will deter of the track ad	mine if there ar	e any increases departure. If it c	aried property in households loes and track
Air navigatio		types sit within th adjustme Noise In	uated within the le 63dB L _{Aeq,16h} ents are propos sultation Schen	63dB conto area as a ed in Glasg ne.	our area. The L _{Ac} result of this opt ow's ACP subm	eq modelling in Stations as a result o	ge 3 will detern of the track ad e an increase	mine if there ar justments on o d cost for Glas	e any increases departure. If it c gow with regard	varied property in households loes and track
Air		types sit within th adjustme Noise In The initia This airs removes	uated within the le 63dB L _{Aeq,16h} ents are propos sultation Schen al deployment p pace change pl s Glasgow's dep	63dB conto area as a ed in Glasg ne. hase of the roposal is no pendency or	our area. The L _{Ac} result of this opt ow's ACP subm ACP may requi	re some ATC sys change airport or round based navig	ge 3 will deter of the track ad e an increase tem engineeri ANSP operati	mine if there ar justments on o d cost for Glas ng amendmen onal costs. The	e any increases departure. If it o gow with regard ts. e implementatio	raried property in households loes and track is funding their n of PBN SIDs
Air navigatio n service	costs Operational	types sit within th adjustme Noise In The initia This airs removes in NERL This opt Glasgow when we interdep	uated within the le 63dB L _{Aeq,16h} ents are propos sultation Schen al deployment p pace change pl s Glasgow's dep 's operational c ion is expected v Airport. The sc e are appraising endencies with	63dB conto area as a f ed in Glasg hase of the poposal is no poposal is no poposal is no posts as it en to require a cale and na g our short Edinburgh	ACP may required an anticipated to anticipated to anticipated to an anticipated to a conventional grables VOR ratio air traffic controll ture of this trainities of options an	are modelling in Stations as a result of ission, there will be the some ATC system of the some airport or round based navigonalisation ³⁷ ; are training for the ng requires further in respite configurat	ge 3 will deter of the track ad e an increase tem engineeri ANSP operati gation equipm controllers an er exploration a formation is l	mine if there ar justments on o d cost for Glas ng amendmen onal costs. The ent (VORs), w d assistants lo as part of the S known about th	e any increases departure. If it o gow with regard ts. e implementatio hich contributes ocated at NATS Stage 3 Full Opt he network abo	raried property in households loes and track s funding their n of PBN SIDs to a reduction Prestwick and ions Appraisal ve 7000ft and
Air navigatio n service	costs Operational costs Deployment	types sit within th adjustme Noise In The initia This airs removes in NERL This opt Glasgow when we interdep compare This opt departm turn befor validatio More de left turn	uated within the le 63dB L _{Aeq,16h} ents are propos sultation Schen al deployment p pace change pro- s Glasgow's dep 's operational c ion is expected v Airport. The so e are appraising endencies with ed to other optic ion requires a T ent wanted a no pre the end of t n to ensure the tailed IFP invest departures whi	63dB conto area as a ed in Glasg ne. hase of the roposal is no bendency or osts as it er to require a cale and na g our short Edinburgh ns that form rack Adjust to below 500 he runway. WP is acce tigation sug ch is consid	ACP may required anticipated to anticipated to anticipated to another anticipated to a conventional grables VOR rational ture of this training to the first of options and another anticipated to the another anticipated to an conventional grables VOR rational ture of this training to the another and the structure of the structure	are modelling in Stations as a result of ission, there will be the some ATC system of the some airport or round based navigonalisation ³⁷ ; are training for the ng requires further in respite configurat	ge 3 will deter of the track ad e an increase tem engineeri ANSP operati gation equipm controllers an er exploration a formation is l ion, there ma ssible within P colared End of Additional as er turn shortly of 5.7% climb of Glasgow tr	mine if there ar justments on o d cost for Glas ng amendmen onal costs. The ent (VORs), w d assistants lo as part of the S known about the by be more tra ANS OPS but Runway (DER surances will b after the DER gradient is req	e any increases departure. If it of gow with regard ts. e implementatio hich contributes ocated at NATS Stage 3 Full Opt he network abo aining required in a recent ACF) to ensure the a be required durin uired up to 1400	raried property in households loes and track is funding their n of PBN SIDs to a reduction Prestwick and ions Appraisal ve 7000ft and for this option P, the CAA IFP aircraft doesn't ng IFP ground
Air navigatio n service provider	costs Operational costs Deployment costs	types sit within the adjustme Noise In The initia This airs removes in NERL This opt Glasgow when we interdep compare This opt departme turn befor validatio More de left turn Otter air There is NORBO	uated within the le 63dB L _{Aeq,16h} ents are propos sultation Schen al deployment p pace change pro- s Glasgow's dep 's operational c ion is expected v Airport. The sc e are appraising endencies with ed to other optic ion requires a T ent wanted a no ore the end of t n to ensure the tailed IFP invess departures whi craft for which a a lack of global against the la	63dB conto area as a f ed in Glasg ne. hase of the roposal is no pendency or osts as it er to require a cale and na g our short Edinburgh ns that form rack Adjust ot below 500 he runway. WP is acce tigation sug ch is conside alternative ta /UK PBN R ter turn RC	ACP may required achievable of this option of this option of this option of anticipated to a conventional grables VOR rational strategy of the traffic controll ture of this training to the apart of this training to the apart of this IO/ ment on depart of this IO/ ment on depart of this IO/ parts of options and the apart of this IO/ ment on depart of the apart of the special operation of the achievable, especial operation of the achievable achievable achievable achievable achievable of BBO/CLYDE d	are modelling in Stations as a result of ission, there will be the some ATC system of the some ATC system of the some arround based navigonalisation ³⁷ ; are training for the ng requires further ind once further in respite configurate A. These are possitioned at the Desn't require this. Illy following another mode for the majority of the majority o	ge 3 will deter of the track ad e an increase tem engineeri ANSP operati gation equipm controllers an er exploration is li- ion, there ma ssible within P clared End of Additional as er turn shortly of 5.7% climb of Glasgow tr iired. of the interact strations crea	mine if there ar justments on o d cost for Glas ng amendmen onal costs. The ent (VORs), w d assistants lo as part of the S known about the y be more tra ANS OPS but Runway (DER surances will b after the DER gradient is req affic with the e tions in this op ted so far hav	e any increases departure. If it of gow with regard ts. e implementatio hich contributes ocated at NATS Stage 3 Full Opt he network abo aining required in a recent ACF) to ensure the a be required durin uired up to 1400 exception perhal tion. Namely the ye at least 6nm	aried property in households loes and track s funding their n of PBN SIDs to a reduction Prestwick and ions Appraisal ve 7000ft and for this option P, the CAA IFP aircraft doesn't ng IFP ground Oft on the early ps of the Twin

³⁷ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		that perhaps a much more subtle change to a SID structure can be safely accommodated, ATC advised that an option where a SID utilisation would change significantly from a left turn to a right turn (or vice-versa) immediately after departure introduces hazards to the operation which at this stage cannot considered to be mitigated without introducing other issues*. Such hazards are not just associated with aircraft inadvertently flying (or being issued) the wrong SIDs and the wrong time of day but also HF issues associated with ATC confusion. *As an example, mitigations identified for SIDs switching to fundamental different directions after departure were SIDs with completely different names. However flight planning and ATM issues previously identified by NERL requires SIDs going to the same places in the network are required to terminate at the same point which in turn would mean similar SID names to match the SID termination point.
AII	Interdepende ncies, conflicts and tradeoffs	There are no interdependencies, conflicts or trade offs with routes to/from other airports with Easterly departures below 7000ft however Easterly departures are sometimes required to be 'stepped up' underneath Edinburgh's GOSAM departures. Having a slightly earlier turn to the West on NORBO departures reduces this interaction. Conversely the CLYDE/ROBBO traffic routing further to the East may increase this interaction, albeit above 7000ft. This option is not expected to be possible within the existing network as it could require a move of the LANAK hold and a SID structure which changes would not fit with the existing operation. In their Stage 2A feedback NERL questioned the requirement for both a LUSIV/TLA SID in the future. If this option is progressed, we will explore the ability to remove one of these SIDs in Stage 3. The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
AII	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would support the modernisation of the airspace. The option would be expected to generate significant CO ₂ reductions, provide some respite from noise to those most frequently overflown by Glasgow arrivals and departures but a single NORBO departure route for the majority of the day does not meet future demand and therefore offer the most economic benefit. It would concentrate noise from the busiest departure route over the same, newly overflown and densely populated communities to the south of the airport for the majority of the day. This option could be expected to result in reductions in the volume of Glasgow's CAS.

4.15. Runway 05 Easterly Departure Option H

Runway 05 Easterly Departures – Option H



This option was generated as a result of Community and ATC feedback in our engagement. They proposed that ROBBO/CLYDE/LOMON SIDs could also turn left immediately, together with the left turn NORBO SID. Predictable respite is not a feature.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

4	////	
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see the NORBO departures split between two routes. These would be operated throughout the day and therefore they would not be used in a respite configuration, however they would help to share the noise betweer communities. Unlike other options, the ROBBO/CLYDE/LOMON SIDS follow the same initial offset and turn as the left turn NORBO route. There is a mixtures of offset departures and departures that fly straight ahead, therefore there is limited relie for communities living under final approach however there are opportunities to share the noise. The NORBO route accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route is split into two. One NORBO SID offsets left and turns at 1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap in figure 24 shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the route, which would account for around 6.5% of overall departures, largely avoids the overfligh of populated areas with the exception of Milton and western parts of Bowling. The other NORBO SID would fly straight ahead and turn at 5nm. This would largely replicate today's NORBO departures and therefore impact similar communities to current day. The only exception is at higher altitudes where the route turns further towards the south-west than the NORBO centreline day. The only exception is at higher altitudes where the route turns further towards the south-west than the NORBO centreline day. The only exception is at higher altitudes where the route turns further towards the south-west than the NORBO centreline day.
		does today. This results in overflight of some areas of Glasgow City centre which, according to the 2019 NTK heatmap, are not currently overflown on a frequent basis by departures. The sharing of the route between the two SIDs means that the frequency of overflight is reduced compared to some other options that use the same NORBO right turn route. Frequency of overflight will be explored in further detail as part of Stage 3.
Communiti es	Noise impact on health and quality of life	<figure></figure>
		The LUSIV/TALLA equivalent SIDs have been combined into one route, which will account for under 3% of overall
		departures, fly straight ahead for 4nm before turning to the southwest. Whilst flying straight ahead, the route follows the same track as today before turning at 4nm rather than 5nm. When reviewed against the heatmap shown in figure 24 this route more closely follows the most concentrated part of today's vectored swathe. The population data shows that when flying straight ahead, aircraft would overfly the same areas as today, with the turn at 4nm occurring north of Bearsden and route in the southwest of the straight ahead aver parts of Milagavia. This route

opportunity to avoid the most dense areas of population in the very centre of Glasgow as aircraft are slightly further north.

routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route

The ROBBO/CLYDE/LOMON departures all offset left before turning at 1nm (The ROBBO/CLYDE has been combined into one route). This means that around 3% of these departures will no longer fly along the final approach resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap shows that the offset left overflies the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently frequently overflown below 7000ft.

The FOYLE/PERTH departures also offset to the left however these departures turn at 6nm. This again shares noise from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie however results in more frequent overflight of other populated areas. The route initially flies over Dumry and the western parts of Drumchapel before also routing over the western parts of Baljaffray and western Milngavie. At higher altitudes, the routes also overfly Blanefield and Strathblane. Figure 24 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a

737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight contours may extend further than what is shown in this IOA. In the case of this option, the NORBO right turn and LUSIV/TALLA contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The technical appendix to this document includes an image which compares the existing SID centrelines and option H. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour and the population overflown increases. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 76 Easterly departures option H overflight data

System	Area (km²)	Population
RWY 05 Baseline Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option H	234.43	248316

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

In our Stage 2A engagement, the Mains Estate Resident" Association (MERA) and Milngavie Community Council highlighted that the proposed PERTH/FOYLE route in this option would overfly the Douglas Music Academy as a noise sensitive building. If this option is carried forward we will investigate to see if overflight of this building can be avoided/mitigated or indeed if there are likely to be any adverse impacts due to aircraft overflight.

60dB and 65dB L_{aMax}

Technical Appendix A includes 60dB and 65dB L_{aMax} contours which compare Option H against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 77 shows an increase in the population within the 60dB L_{aMax} contour and 65dB L_{aMax} contour. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight. Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 77 60dB and 65dB L_{aMax} Data – Rwy05 Dep Option H

	60dI	B L _{aMax}	65dB	L _{aMax}
System	Area (km²)	Population	Area (km²)	Population
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793
RWY 05 Dep Option H	433.3	442907	147.96	158079

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} day time and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located northeast of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces some offset departures with a turn at 1nm as well as straight ahead departures. Owing to the modal split, it is expected that this change will have minimal impact on the shape and size of the overall L_{Aeq} contours. When considering just the easterly departure component, the introduction of some traffic onto the offset departures may result in the contour shortening compared to current day which may benefit parts of Milngavie. The offset departures to the left may result in the component part of the contour extending further to the northwest to reflect the offset paths; this may result in parts of Drumry moving into a higher dB contour. Owing to the modal split, these changes are expected to be very minimal.

Detailed consideration needs to be given to the use of track adjustments on departure as this would re-distribute noise at higher exposures. Therefore the ability to provide relief to those communities under final approach needs to be carefully assessed against new population adversely affected by aircraft noise in the immediate climb out to the north and south of track.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

Noise Mitigations

The option does not offer an alternative respite configuration however it does aim to share the noise by relocating half of the NORBO departures and the ROBBO/CLYDE/LOMON/FOYLE/PERTH departures onto an offset track, rather than climbing straight ahead over the same areas as final approach as they do today. Splitting the NORBO departures into two on a permanent basis also shares the noise for those communities to the south of the centreline which will be overflown by the right turn NORBO route (although they are already overflown today). The L_{aMax} and overflight data has suggested that this configuration may increase the population overflown compared to the baseline centreline data, and therefore further detailed

		data analysis which	consider	s frequency	of overflig	ht, will be	required a	t Stage 3	if this opti	on progr	esses.	
	Air Quality	This option has a ch emissions in their tot Where lateral tracks there may be slight of to the side of the s concentrations below the contribution of ro	ality, the are mov decrease straight a w these f	re will be a c ving away fr s in the con ahead depa lightpaths. I	change in t rom the sta centrations inture route However, i	the location andard 'str s below the e (known	n of emissi aight ahea ese flightp as 'offset	ons below ad' departu aths. Whe departure	/ 1,000ft w ure that a re lateral es') there	vhich cou ircraft foll tracks are may be	ld affect low belov e newly o slight in	local air qu w 1,000ft t overflying a acreases in
	Greenhouse gas impact	Our fuel burn assess to the baseline. We th in further detail in the	herefore	expect to se	ee a corres	ponding in	nprovemer	nt to green				
	Capacity / resilience	This option sees the aircraft will be able separations). This is benefits of this will be Having 2 NORBO ro The introduction of F provides resilience. T Modernisation progra VORs. Introduction programme.	to depai expecte e seen p outes for t PBN SID This equi amme. T	rt in interva d to reduce articularly ir the whole da s also remo pment is du 'here is curr	Is 1 minut ground ho n future sco ay services oves Glasg e to be deo rently no lo	tes apart of blding whice enarios with s future de gow's depe commission ong term ³⁸	(subject to ch in turn v th increase emand to th endency or ned as par resilience	o safety ca vill reduce ed traffic le he greates n conventi rt of a NEF for Glasg	ase and N ground b evels. St extent. fonal grou RL UK wid io''s SIDs	NERL ab ased em nd based e prograr when NE	ility to a issions a d navigat mme unc ERL deco	ccept 1 m and delays tion aids, v ler the Airs ommission
		Table 78 shows data follow Glasgow's exis	sting SIE) centrelines	s between	0-7000ft:	y based o	n the NTK	vectoring	g baselin	e and if	aircraft we
		Table 78 Easterly depa	arture – T	ranquil areas	s overflown	-	tional	National				
	Tranquillity	System RWY 05 Baseline		ISA count	NSA ar	62	s count	Parks are		count	DQA ar	
	Tranquillity	Vectoring (NTK d RWY 05		0	0		0	0		4	0.66	
	Tranquillity	Baseline (Centreli Optioneering to		0	0		0	0		2	0.38	
		Runway 05 Optio	on H	1	2.91		1	13.93		4	1.2	
		Table 79 shows data follow Glasgow's exis	sting SIE							(noutria		anorari we
		Table 79 Biodiversity	- areas ov SAC	verflown Optio	on H SSSI	SSSI	SPA	SPA	National		I NSA	NSA
	Biodiversity	System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline –				SSSI area 10.46 3.31	SPA count 11	SPA area 6.37 0	National Park count 0	Nationa park area 0	NSA count 0	NSA area 0
	Biodiversity	System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline Optioneering tool)	SAC area 0	SAC count 0	SSSI count 24 10	area 10.46 3.31	count 11 0	area 6.37 0	Park count 0	park area 0	0 0	area 0 0
	Biodiversity	System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline – Optioneering	SAC area 0 0	SAC count 0 0 0 Special Prot	SSSI count 24 10 27 tection Are	area 10.46 3.31 13.66 as, Specia	count1109al Areas of	area 6.37 0 8.14 Conservat	Park count 0 0 1 tion, Natio	park area 0 0 13.93	0 0 1	area 0 0 2.91
	Biodiversity	System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline - Optioneering tool) RWY 05 Option H Below 2000ft no over and Sites of Special Lower slower aircraft Marise Burn and Mu vast majority of aircraft	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	SAC count 0 0 0 Special Prot c Interests is g at below a /ood SSSIs mb above 2	24 24 10 27 tection Are s expected a 6% climb below 200 000ft befor	area 10.46 3.31 13.66 as, Specia for the va o gradient 00ft. Giver re overflyin	count 11 0 9 al Areas of ast majority on the CL on the low on the clus on the sites	area 6.37 0 8.14 Conservat of aircraf YDE/LOM verall % o s, it is expe	Park count 0 0 1 tion, Natic t. ION/FOYL f aircraft e ected that	park area 0 13.93 onal Parks _E/PERT expected any impa	0 0 1 s, Nation H SIDs, to fly the acts will b	area 0 2.91 al Scenic A may overf e SIDs, an be very min
	Biodiversity	System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline - Optioneering tool) RWY 05 Option H Below 2000ft no over and Sites of Special Lower slower aircraft Marise Burn and Mu vast majority of aircraft We will fully quantify at Stage 3.	SAC area 0 0 0 rflight of s Scientific t, climbin igdock W aft will cli	SAC count 0 0 0 Special Prot c Interests is g at below a /ood SSSIs mb above 2 rflight of bio	SSSI count 24 10 27 tection Are s expected a 6% climb below 200 000ft befor odiverse sit	area 10.46 3.31 13.66 as, Specia for the va o gradient Off. Giver re overflyin es using t	count 11 0 9 al Areas of ast majority on the CL on the low on the low on the low on the sites he full Gla	area 6.37 0 8.14 Conservat of aircraf YDE/LOM verall % o s, it is expense sgow fleet	Park count 0 0 1 tion, Natic t. ION/FOYL f aircraft e ected that t mix, as p	park area 0 0 13.93 onal Parks E/PERT expected any impa	0 0 1 s, Nation H SIDs, to fly the acts will b ar Full Op	area 0 2.91 al Scenic / may overf e SIDs, an be very mir otions App
General Aviation	Biodiversity Access	System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline - Optioneering tool) RWY 05 Option H Below 2000ft no over and Sites of Special Lower slower aircraft Marise Burn and Mu vast majority of aircraft	SAC area 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	SAC count 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	24 24 10 27 tection Are s expected a 6% climb below 200 000ft befor odiverse sit a to the exit CAS. The N IA 7 in accor CAS volur happen in	area 10.46 3.31 13.66 as, Specia for the va o gradient 00ft. Given re overflyin es using t isting CAS Northbound ordance w ne") assur reality bed	count 11 0 9 al Areas of ast majority on the CL the low ong the sites he full Gla S boundarid S S boundarid S S S S S S S S S S S S S S S S S S S	area 6.37 0 8.14 Conservat of aircraf YDE/LOM verall % o s, it is expe sgow fleet es to acco this option A CAS con orthbound Off does no	Park count 0 0 1 tion, Natio t. ION/FOYL f aircraft e ected that t mix, as p ommodate n with the tainment SIDs term ot exist in a	park area 0 0 13.93 onal Parks E/PERT expected any impa part of ou e the LOI 7% clim policy. Ho inate at 7 Airspace	0 0 1 s, Nation H SIDs, to fly the acts will b acts will b ur Full Op MON SIE b gradie pwever, t 7000ft ar Design t	area 0 2.91 al Scenic / may overf e SIDs, an be very mir otions App D but still on nt as illust his assess and are all w erms and
		System RWY 05 Baseline Vectoring (NTK data) RWY 05 Baseline (Centreline - Optioneering tool) RWY 05 Option H Below 2000ft no over and Sites of Special Lower slower aircraft Marise Burn and Mu vast majority of aircraft Me will fully quantify at Stage 3. The design option m potential to reduce th would not quite be co (together with creation contained within CAS	SAC area 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	SAC count 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	24 24 10 27 tection Are s expected a 6% climb below 200 000ft befor odiverse sit coooft befor coooft befor odiverse sit coooft befor coooft befor cooft befor coo	area 10.46 3.31 13.66 as, Specia for the val o gradient 00ft. Giver re overflyin es using t isting CAS Northbound ordance w ne") assur reality bed more prote as a single t on poter he total vo	count 11 0 9 al Areas of ast majority on the CL athe low ong the sites he full Gla boundarid S on it S on it	area 6.37 0 8.14 Conservat of aircraf YDE/LOM verall % o s, it is expension sgow fleet es to acco this option CAS con orthbound Oft does no of today is p f CAS req ts. We ha e "illustrat	Park count 0 0 1 tion, Nation t. ION/FOYL f aircraft of ected that t mix, as p ommodate n with the tainment SIDs term of exist in a potentially uired to c ve also u ive" airsp	park area 0 0 13.93 0 13.93 0 13.93 0 13.93 0 13.93 0 13.93 0 0 13.93 0 13.93 0 0 13.93 0 14.111	0 0 1 3 5, Nation 7 4 SIDs, to fly the acts will b acts will b b gradie b gradie	area 0 0 2.91 al Scenic A may overf e SIDs, an be very mir otions App D but still of nt as illust his assess are all w erms and f e. I and depate ared to ex

³⁸ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

mileage. This option shows reductions in track mileage for the TRN, NORBO SUNUK, NORBO LAKEY, TLA, FOYLE, LOMON, CLYDE and ROBBO routes. There are increases to the LUSIV and PERTH routes. The reduction mainly in the NORBO SIDs but also in the other routes means that when considered against the overall % movements at Glasgow, any increase in track miles is outweighed by the decreases elsewhere.

Table 80 Track Length Calculations-- Fuel Burn RWY 05 Easterly Departure Option H

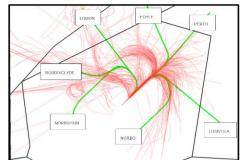
				Baseline	(Centreline)				
		RWY 05		nm	% Weighting	Score	nm	Score	
			TRN	50.00	0.81	40.50	49.20	39.85	
			NORBO SUBUK	112.00	5.75	644.00	103.60	595.70	
			NORBO LAKEY	112.00	7.03	787.36	96.50	678.40	
			LUSIV-DCS	88.80	2.34	207.79	96.50	225.81	
		DEPS	TLA	49.20	0.09	4.43	48.20	4.34	
			PERTH	50.30	0.27	13.58	50.50	13.64	
			FOYLE	19.10	0.18	3.44	18.50	3.33	
			LOMON	20.00	0.45	9.00	14.60	6.57	
			CLYDE	25.00	0.63	15.75	18.40	11.59	
			ROBBO	33.50	0.45	15.08	22.80	10.26	
		Total				1740.92		1589.48	
Commerc al airlines	Training costs Other costs	procedur training c		and underta s.	ntroduced worldwide ake training if requir				
Airport / Air navigatio n service	Infrastructure costs	and resid financial above. T varied pr increase departure	dential properti assistance to b herefore, Glas operty types s s in household e. If it does and	es within the pe offered to gow Airpor ituated with Is within the d track adju	sensitive buildings, e 66dB L _{Aeq,16h} cont owards the noise in t are currently deve in the 63dB contou e 63dB L _{Aeq,16h} are stments are propos	our area. The sulation of resi eloping a new r area. The L _A a as a result c	UK Governme dential proper Noise Insulati _{eq} modelling in f this options	ent's current aviation ties in the 63dB L on Policy for 2022 on Stage 3 will deter as a result of the	on policy now requ _{Aeq,16h} noise contou 2, which will cover ermine if there are e track adjustments
nrovider			I deployment p	hase of the	Noise Insultation S	some ATC sys	em engineerii	ng amendments.	
provider	Operational costs	This airs SIDs ren	I deployment p pace change p noves Glasgow	phase of the roposal is r 's depende		some ATC syst ange airport o I ground based	tem engineerii r ANSP opera d navigation e	ng amendments. tional costs. The in	mplementation of F
provider		This airs SIDs ren reductior This opti and Glas Appraisa	Il deployment p pace change p noves Glasgow n in NERL's op on is expected gow Airport. T	phase of the roposal is r i's depende erational co to require a he scale ar appraising	ACP may require s not anticipated to ch ncy on conventiona sts as it enables VC air traffic controller nd nature of this tra our shortlist of opt	some ATC syst ange airport o Il ground based DR rationalisati training for the ining requires	tem engineerin r ANSP opera d navigation e on ³⁹ ; controllers ar further explora	ng amendments. tional costs. The in quipment (VORs), nd assistants locat ation as part of the	mplementation of F which contributes ed at NATS Prestv e Stage 3 Full Opti
provider	Deployment	This airs SIDs ren reduction This opti and Glas Appraisa 7000ft ar This opti IFP depa doesn't to	Il deployment p pace change p noves Glasgow in NERL's op on is expected gow Airport. T I when we are nd interdepend on requires a T irtment wanted urn before the o	phase of the roposal is r 's depende erational co to require a he scale ar appraising encies with rack Adjust a not below end of the ru	ACP may require s not anticipated to ch ncy on conventiona sts as it enables VC air traffic controller nd nature of this tra our shortlist of opt	some ATC system ange airport o al ground based DR rationalisati training for the ining requires ons and once These are pos- positioned at the doesn't require	tem engineerin r ANSP opera d navigation e on ³⁹ ; controllers ar further explora further inform ssible within F e Declared En e this. Addition	ng amendments. tional costs. The in quipment (VORs), and assistants locat ation as part of the ation is known ab PANS OPS but in a d of Runway (DER al assurances will	mplementation of F which contributes ed at NATS Prestv e Stage 3 Full Opti out the network ab a recent ACP, the C to ensure the airc be required during
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	Costs Deployment costs	This airs SIDs ren reduction This opti and Glas Appraisa 7000ft ar This opti IFP depa doesn't tr ground v More def early left Twin Otto There ar 7000ft ho Having	Il deployment p pace change p noves Glasgow in NERL's ope on is expected gow Airport. T I when we are nd interdepend on requires a T artment wanted urn before the o alidation to ens tailed IFP inves turn departure er aircraft for w e no interdepend a slightly ear	phase of the roposal is r 's depende erational co to require a he scale ar appraising encies with rack Adjust a not below end of the rus sure the WF stigation sup s which is c hich alterna indencies, o departures lier turn t	ACP may require s not anticipated to ch ncy on conventiona sts as it enables VC air traffic controller nd nature of this tra our shortlist of opt Edinburgh. tment on departure v 500ft flyover WP p unway. PANS OPS o is acceptable, esp ggests a minimum onsidered achievab	some ATC syst ange airport o I ground based DR rationalisati training for the ining requires ons and once These are por ositioned at the doesn't require ecially followin climb gradient le for the majo ements may be fs with routes juired to be 'ste NORBO depa	tem engineerin r ANSP opera d navigation e on ³⁹ ; controllers ar further explora further inform ssible within F e Declared En e this. Addition g another turn of 5.7% climb rity of Glasgov e required. to/from other epped up' under tures reduce	ng amendments. tional costs. The in quipment (VORs), nd assistants locat ation as part of the ation is known ab PANS OPS but in a d of Runway (DER al assurances will shortly after the D gradient is requir v traffic with the ex airports with East erneath Edinburgh es this interactio	mplementation of F which contributes red at NATS Prestw e Stage 3 Full Opti out the network ab a recent ACP, the C b to ensure the airc be required during DER. ed up to 1400ft on ception perhaps of terly departures be 's GOSAM departu n. Also keeping
	Costs Deployment costs	This airs SIDs ren reduction This opti and Glas Appraisa 7000ft ar This opti IFP depa doesn't to ground v More def early left Twin Otto Having CLYDE/I This opti having 2 feedback	I deployment p pace change p noves Glasgow in NERL's ope on is expected gow Airport. T I when we are nd interdepend on requires a T artment wanted urn before the o alidation to ens turn departures a sightly ear ROBBO/LUSIV on is not expe NORBO SIDs to NERL question	whase of the roposal is r i's depende erational co to require a he scale ar appraising encies with rack Adjust a not below end of the ru sure the WF stigation sure s which is c hich alterna indencies, of departures lier turn t /TLA traffic cted to be maximises oned the re	ACP may require a not anticipated to ch ncy on conventional sts as it enables VC air traffic controller nd nature of this tra our shortlist of opt Edinburgh. tment on departure v 500ft flyover WP p unway. PANS OPS P is acceptable, esp ggests a minimum onsidered achievate ative tactical arrange conflicts or trade of s are sometimes reco o the West on	some ATC syst ange airport o al ground based DR rationalisati training for the ining requires ons and once These are por ositioned at the doesn't require ecially followin climb gradient le for the majo ements may be fs with routes puired to be 'ste NORBO depa ed to existing tr existing netwo NERL's propos a LUSIV/TLA	tem engineerin r ANSP opera d navigation e on ³⁹ ; controllers ar further explora further inform ssible within F e Declared En e this. Addition g another turn of 5.7% climb rity of Glasgov e required. to/from other exped up' under tures reduce affic patterns in rk as it could ed dual south	ng amendments. tional costs. The in quipment (VORs), nd assistants locat ation as part of the ation is known ab ANS OPS but in a d of Runway (DEF al assurances will shortly after the D gradient is requir v traffic with the ex airports with East erneath Edinburgh as this interactio minimises this inter require a move o bound route struc	mplementation of F which contributes ed at NATS Prestw e Stage 3 Full Opti out the network ab a recent ACP, the C to ensure the airco be required during DER. ed up to 1400ft on ception perhaps of terly departures be 's GOSAM departu n. Also keeping raction f the LANAK hold a

		The cumulative effect on other airspace users as a result to CAS dimensions at Glasgow, Edinburgh and the ScTMA need to be co-ordinated and considered.
		CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
All	AMS	This option would support the modernisation of the airspace by accommodating future demand in an efficient manner. The option would be expected to generate significant CO ₂ reductions, provide some relief from noise to those most frequently overflown by Glasgow arrivals and departures and a dual NORBO track structure would mitigate the impacts on those newly overflown by reducing the frequency of overflight (compared to if under a single NORBO SID structure). This option could be expected to result in reductions in the volume of Glasgow's CAS.

³⁹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.16. Runway 05 Easterly Departure Option I

Runway 05 Easterly Departures – Option I



This option is the same as Option H except that track adjustments do not feature. This is due to a concern that a track adjustment followed by an immediate left 180° turn for the NORBO/ROBBO/CLYDE/LOMON departure could be too technically challenging. This has a knock-on impact in that the PERTH/FOYLE would also not feature a track adjustment.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see the NORBO departures split between two routes. These would be operated throughout the day and therefore they would not be used in a respite configuration, however they would help to share the noise betweer communities. Unlike other options, the ROBBO/CLYDE/LOMON SIDS follow the same initial turn as the left turn NORBO route. All departures fly straight ahead, therefore there is no relief for communities living under immediate final approach although the NORBO Left, ROBBO/CLYDE, LOMON and FOYLE do turn shortly after departure.
		The NORBO route accounts for around 13% of overall departure movements from Glasgow airport. In this option, the NORBO route is split into two. One NORBO SID turns at 1nm, which means that some noise is relocated from communities under the westerly final approach such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. I would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the overflight contours and population data show that the left turn overflies the populated areas of Drumm and Faifley. Beyond this point the route, which would account for around 6.5% of overall departures, largely avoids the overflight of populated areas with the exception of Milton and western parts of Bowling. The other NORBO SID would fill straight ahead and turn at 5nm. This would largely replicate today's NORBO departures and therefore impact similar communities to current day. The only exception is at higher altitudes where the route turns further towards the south-west than the NORBO centreline does today. This results in overflight of some areas of Glasgow City centre which, according to the 2019 NTK heatmap shown in Figure 22, are not currently overflown on a frequent basis by departures. The sharing ot the route between the two SIDs means that the frequency of overflight is reduced compared to some other options that use the same NORBO right turn route. Frequency of overflight will be explored in further detail as part of Stage 3.
Communiti es	Noise impact on health and quality of life	Open definition of the sector of the sect
		Figure 25 Easterly Option I Overflight and 2019 baseline NTK data
		<i>Figure 25 Easterly Option I Overflight and 2019 baseline NTK data</i> The LUSIV/TALLA equivalent SIDs have been combined into one route, which will account for under 3% of departures, fly straight ahead for 4nm before turning to the southwest. Whilst flying straight ahead, the route follo same track as today before turning at 4nm rather than 5nm. When reviewed against the heatmap shown in figure route more closely follows the most concentrated part of today's vectored swathe. The population data shows that flying straight ahead, aircraft would ever further are accounted on the southwest with the turn at 4nm concentrated part of today's vectored swathe.

opportunity to avoid the most dense areas of population in the very centre of Glasgow as aircraft are slightly further north.

flying straight ahead, aircraft would overfly the same areas as today, with the turn at 4nm occurring north of Bearsden and routeing over less densely populated areas compared to continuing to fly straight ahead over parts of Milngavie. This route

The ROBBO/CLYDE/LOMON departures all turn at 1nm (The ROBBO/CLYDE has been combined into one route). This means that around 3% of these departures will no longer fly along the final approach up to 5nm resulting in a small amount of noise sharing for communities in areas such as Old Drum chapel, Bearsden, Burnbrae and the eastern parts of Milngavie. It would however mean that areas that are not currently overflown frequently by departures will now be overflown on a more frequent basis; the heatmap data shows that these departures turning left overfly the populated areas of Drumry and Faifley. Beyond this point the routes, largely avoid the overflight of populated areas although the equivalent ROBBO/CLYDE SID does overfly the southern parts of Dumbarton, Langbank and Milton. The heatmap shows that the removal of the requirement to fly to 5nm before turning results in aircraft taking a more direct routing and therefore climbing to 7000ft over areas that are not currently overflown below 7000ft.

The FOYLE/PERTH fly straight ahead and turn at 6nm. These routes therefore overfly the same areas as final approach and largely follow the same tracks as departures today, particularly from take off to 5nm. Beyond 6nm, at higher altitudes, the routes overfly Blanefield and Strathblane. Figure 25 shows that the latter parts of these routes fly over areas not currently overflown today however these largely avoid dense areas of population.

It's important to note that at this stage, the overflight contours have been generated using the continuous climb profile of a 737-800. Glasgow Airport's fleet mix includes some 'lower and slower' aircraft, particularly those that fly to the highlands and islands. This means that when we fully quantify overflight as part of the Full Options Appraisal at Stage 3, the overflight

contours may extend further than what is shown in this IOA. In the case of this option, the NORBO right turn and LUSIV/TALLA contour may extend slightly over additional areas of dense population within the city of Glasgow. The ROBBO/CLYDE SID may also extend towards Boglestone.

The technical appendix to this document includes an image which compares the existing SID centrelines and option I. The vectoring data is not modelled in the same way as the overflight contours, however it does provide a preliminary means of comparison between this baseline, the airspace change options and data for if aircraft were to follow the centreline of the current published SID.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the existing SID centreline data, the area of the contour and the population overflown increases. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow; further analysis into frequency of overflight will be undertaken at Stage 3 should this option progress.

Table 81 Easterly departures option I overflight data

System	Area (km²)	Population
RWY 05 Baseline Vectoring (NTK data)	246.99	364763
RWY 05 Baseline (Centreline – Optioneering tool)	186.52	173213
RWY 05 Option I	217.71	235019

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows an increase in the number of hospitals, care homes, schools and places of worship being overflown compared to the centreline baseline data. Compared to the vectoring baseline data, there is a decrease in noise sensitive buildings overflown, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction in number of buildings overflown, those that are overflown will likely be at a higher frequency than today. This is something that will be explored further as part of the Stage 3 full options appraisal analysis should this option progress. The full data tables and counts of noise sensitive buildings such as hospitals and schools, are detailed in technical appendix A.

60dB and 65dB LaMax

Technical Appendix A includes 60dB and 65dB L_{aMax} contours which compare Option I against the centreline baseline. These 60dB and 65dB L_{Amax} contours are an indicator of the N60/N65 metrics which will be quantified at the Stage 3 Full Options Appraisal. The data in table 82 shows an increase in the population within the 60dB L_{aMax} contour and 65dB L_{aMax} contour. This can be attributed to the overall increase in contour area created by splitting the NORBO route into two and the right NORBO turn over the centre of Glasgow and at Stage 3 we will explore potential benefits and impacts in terms of frequency of overflight. Also, the centreline baseline data is modelled on aircraft flying the SID centrelines rather than vectored as they are today and therefore we will explore this further at Stage 3.

Table 82 60dB and 65dB LaMax Data – Rwy05 Dep Option I

	60dE	3 L _{aMax}	65dB L _{aMax}		
System	Area (km²)	Population	Area (km²)	Population	
RWY05 Baseline (Centreline – Optioneering tool)	356.82	382113	114	120793	
RWY 05 Dep Option I	411.04	433493	132.97	147678	

L_{Aeq}

The easterly departures make up a component of the overall L_{Aeq} day time and night time contours. We have used the overall L_{Aeq} contours from 2017, as an indicative contour for 2025. Glasgow airport operates on easterlies 18% of the year and therefore the easterly departures will have a smaller influence on the overall parts of the L_{Aeq} contours that are located north-east of the airport.

Most aircraft today fly straight ahead for 5nm before turning; this option introduces straight ahead departures with some turns earlier than today however the largest percentage of flights follow a very similar route to today in the areas within the scope of the IAeq contours. When we consider this, and the modal split, it is expected that this option would have minimal impact on the shape and size of the overall L_{Aeq} contours.

The full LAeq contours will be quantified as part of our Stage 3 Full Options Appraisal if this option is taken forward.

Noise Abatement Procedures

A change to the existing NAPs would be required to accommodate the offset departures and turns.

		Noise Mitigation The option does not offer an alternative respite configuration however it does aim to share the noise by splitting the NORBO departures into two on a permanent basis. This shares the noise for those communities to the south of the centreline which will be overflown by the right turn NORBO route (although they are already overflown today). The L _{aMax} and overflight data has suggested that this configuration may increase the population overflown compared to the centreline data, and therefore further detailed data analysis which considers frequency of overflight, will be required at Stage 3 if this option progresses.
	Air Quality	This option has the potential to change to how a small number of aircraft will fly laterally below 1,000ft. Whilst there are likely to be no increase in emissions in their totality, there will be a change in the location of emissions below 1,000ft which could affect local air quality. Where lateral tracks are moving away from the standard 'straight ahead' departure that aircraft follow below 1,000ft today there may be slight decreases in the concentrations below these flightpaths. Where lateral tracks are newly overflying areas to the side of the straight ahead departure route (known as 'offset departures') there may be slight increases in the concentrations below these flightpaths. However, it should be noted that these changes are likely to be small compared to the contribution of road traffic to local air quality.
Wider Society	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated that Option I will have an overall improvement in fuel burn compared to the baseline. We therefore expect to see a corresponding improvement to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.

	Capacity / resilience	aircraft v separatio benefits Having 2 The intro provides Modernis VORs. In program		o depart xpected seen pa tes for th BN SIDs is equip nme. Th f PBN S	in interval to reduce inticularly in ne whole da also remo ment is dua ere is curro SIDs is ab	Is 1 minute ground hol n future sce ay services ves Glasgo e to be dec ently no lor solutely es	es apart (ding whic narios with future de ow's depe ommission og term ⁴⁰ n sential fo	subject to h in turn w th increase mand to th ndency on ned as part resilience f or the Glas	safety cas ill reduce g ed traffic le ne greates convention t of a NERI for Glasgov sgow oper	se and N ground ba vels. t extent. nal grour UK wide w's SIDs ration foll	ERL abil ased emis of based program when NE lowing N	navigati me unde RL deco ER''s V(ccept 1 m nd delays on aids, v er the Airs mmissior DR withd	hinute s. The which space hs the Irawal
		follow GI	shows data asgow's exist <i>Easterly depar</i> t	ing SID	centrelines	S:		based on	the NTK	vectoring	l baseline	e and if a	aircraft we	ere to
							Na	tional	National		count	DQA ar		
		RWY	System 05 Baseline-		SA count	NSA are	Park		Parks are	a			ea	
	Tranquillity	Vector	ring (NTK dat RWY 05	ta)	0	0		0	0		4	0.66		
		Optio	ne (Centrelin oneering tool vay 05 Optior	l)	0	0 1.62		0	0 12.7		2	0.38		
		The data data. Te	a shows that t chnical appe e contour, wit	there is ndix A d	an increas contains a	e in NSAs map whic			nd DQAs c			ectoring		
		follow GI	shows data asgow's exist Biodiversity–- a	ing SID	centrelines	S.	e areas up	o to 7000ft	based on	the NTK	heatmap	o and if a	aircraft we	ere to
			stem	SAC area	SAC count	SSSI count	SSSI area	SPA count	SPA area	National Park count	National park area	NSA count	NSA area	
	Biodiversity	Base Vector d	VY 05 eline ing (NTK ata) VY 05	0	0	24	10.46	11	6.37	0	0	0	0	
		(Cent Optio	seline rreline – neering ool)	0	0	10	3.31	0	0	0	0	0	0	
		Below 20	5 Option I											
General Aviation	Access	The desi potential would no assessm are all wi terms ar proportio We creat options o	Areas and Sites of Special Scientific Interests is expected which would offer some small benefits compared to the baseline. The design option may require changes to the existing CAS boundaries to accommodate the LOMON SID but still offers potential to reduce the total volume of CAS. The Northbound SIDs on this option with the 7% climb gradient as illustrated would not quite be contained within ScTMA 7 in accordance with the CAA CAS containment policy. However, this assessment (together with creation of the "illustrative CAS volume") assumed the northbound SIDs terminate at 7000ft and are all wholly contained within CAS which is unlikely to happen in reality because 7000ft does not exist in Airspace Design terms and these routes are leaving CAS anyway, therefore offering more protection than today is potentially not proportionate. We created an "illustrative CAS volume" which was a single volume of CAS required to contain ALL arrival and departure options combined to help stakeholder engagement on potential impacts. We have also used this volume to understand if there is scope to reduce the total volume of CAS. The total volume of the "illustrative" airspace volume compared to existing											
	Economic impact from increased effective capacity	We expe	ect the increas nercial air traff	ed effec	tive capac	ity detailed	in the sec	tion above	e will result	in the gr	eatest po			npact
General		mileage. LOMON, NORBO increase	nate that Opti This option s CLYDE and SIDs but also in track miles	shows re ROBBC o in the c s is outw	eductions D routes. T other route eighed by	in track mi here are ir s means th the decrea	leage for creases t at when c ses elsew	the TRN, o the LUS considered here.	NORBO S IV and FC against th	SUNUK, YLE rout	NORBO tes. The	LAKEY, reduction	TLA, PE n mainly i	RTH, in the
Aviation / Commerci		Table 85	Track Length C				Easterly L	Departure O	ption I					
al airlines	Fuel burn	RWY 05		Base nm	eline (Cent %	treline) Weighting	Sco	re	nm	Scor	e			
			TRN NORBO	50.00 112.0	0.8	31	40.5 644	0	49.10 103.90	39.77 597.4	7			
		DEPS	SUBUK NORBO	112.0			787.		96.50	678.4				
		DEPS	LAKEY LUSIV-DCS				207.		96.50 96.50	225.8				

⁴⁰ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		FOYLE	19.10	0.18	3.44	20.30	3.65	
		LOMON	20.00	0.45	9.00	14.80	6.66	
		CLYDE	25.00	0.63	15.75	19.00	11.97	
		ROBBO	33.50	0.45	15.08	23.00	10.35	•
		Total			1740.92		1591.93	_
		the NATS NERL ACI burn. In the Full Optic	P for the airs	pace above 70 at Stage 3 we	000ft), it is anticipate will investigate track	ed that this op mileage in fu	otion would see an urther detail.	east 6000ft (subject to n improvement in fuel
Commerci al airlines	Training costs		gly and unde	ertake training				e, airlines update their ipated to require any
	Other costs	No other airline costs	are foreseer	۱.				
	Infrastructure	The initial deploymer there are not expecte						however beyond this
Airport /	costs	Unlike options that pro L _{Aeq,16h} noise contour						ations within the 63dB
Air navigation service provider	Operational costs		w's depende	ency on conven	tional ground based	navigation ed		nplementation of PBN which contributes to a
provider	Deployment costs	and Glasgow Airport.	The scale and the scale and the scale appraising	nd nature of thi	is training requires for	urther explora	ation as part of the	ed at NATS Prestwick Stage 3 Full Options out the network above
All	Safety		ires which is	considered ac	hievable for the maje	ority of Glasg	ow traffic with the	ed up to 1400ft on the exception perhaps of
		The lack of a track a each other means thi						at do not wrap around
		7000ft however Eas	terly departu slightly earl	ures are some ier turn to the	etimes required to West on NORBO d	be 'stepped epartures rec	up' underneath duces this interact	erly departures below Edinburgh's GOSAM ion. Also keeping the traction
AII	Interdependenci es, conflicts and tradeoffs	having 2 NORBO SI	Ds maximises stioned the re	the benefits frequirement for	om NERL's propose both a LUSIV/TLA S	ed dual south	bound route struct	the LANAK hold and ure. In their Stage 2A is progressed, we will
		The cumulative effect to be co-ordinated an			a result to CAS dim	ensions at Gl	asgow, Edinburgh	and the ScTMA need
		CAP1711 describes t	he objective	as:				
		Deliver quicker, quiet airspace.	er and clean	er journeys and	d more capacity for	the benefit of	those who use ar	nd are affected by UK
All	AMS	option would be expe	cted to gene arrivals and	rate significant departures and	CO ₂ reductions, pro	ovide some re k structure w	elief from noise to ould mitigate the in	efficient manner. The those most frequently npacts on those newly re).
		This option could be	expected to r	esult in reduction	ons in the volume of	Glasgow's C	AS.	

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⁴¹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.17. Runway 23 Westerly Arrivals Baseline

Runway 23 W	esterly Arrivals Bas	eline		
		The majority of aircraft are vectored to join fina however they are allowed to join final approach a join final approach inside 6nm are likely performin For more information on our do nothing scenario Portal.	as close as 2000ft/6nm when usin ng a visual approach.	g the ILS. The tracks shown which
Group	Impact	Qualitative Assessment		
Group	Noise impact on health and quality of life	Qualitative Assessment Due to wind direction, westerly operations on rugulitative assessment has considered this mode Aircraft arriving at Glasgow are tactically control with the extended runway centreline. Aircraft to although when undertaking an ILS approaches closer than 6nm. The NTK data shown in figure 26, demonstrates that there are wide areas that are overflown be Glasgow, Inverkip, Helensburgh, Cardross, Bog Cumbernauld, Kilsyth, Airdrie, Wishaw, Carluke eastern parts of the city centre of Glasgow. There before aircraft join the final approach which overfli Muirhead, eastern parts of Kirkintilloch, Milton of Figure 26 Runway 23 Artival Vectoring Swathe 2019 The technical appendix to this document include to note that this data is not modelled in the same means of comparison between this baseline and The technical appendix also includes a baseline in the technical appendix to this document therefor NTK data for 2019 and analysing the arrivals concentreline has then been processed through the run optioneering tool for if aircraft were to follow one Table 86 below includes data based on the NT optioneering tool for if aircraft were to follow one Table 86 below includes data based on the NT optioneering tool for if aircraft were to follow one Table 86 below includes data based on the NT optioneering tool for if aircraft were to follow one Table 86 Westerly arrivals Baseline - Vectoring INTK data from these tables will be used to compare In additin to population overflown, we also hav hospitals and	al split with daily movements avera led (vectored) by ATC before joining pically join final approach between they can be as close as 6nm. A the large swathe of overflight creat tween 1-10 times per day on aver glestone, Birdgend, Greenock, Du e, Udston, Blantyre, East Kilbride, e is some concentration which occ ies Larkhall, Motherwell, Belishill, C Campsie, and Lennoxtown: s a larger version of this map alone way as the overflight contours, ho the airspace change options. arrivals centreline contour and assi- ore this centreline has been gener oncentration which occurred acros optioneering tool in order to output K heat map as shown in figure 26 centreline arrival:	ged across the year. ing final approach which is aligned en 7nm and 13nm before landing iteraft may also undertake visual ated by today's vectoring. It shows rage including Weymess Bay, Fort mbarton, Bonhill, Balloch, Balfron, Newton Mearns, Clarkstone, and urs from a south-easterly direction, boatbridge, Gartcosh, Moddlesburn, 2019 baseline average swathe: 1 9 9 9 9 9 9 9 9 9 9 9 9 9

		Table 87 Westerly arrivals baselin	e L _{AMax} data	1					
				60dB L	AMax				
		System	Area	(km²)	Population				
		RWY23 Arrivals Baseline (Centreline – optioneering tool)	57.	86	68289				
		The data from these tables will	be used to	compare the	westerly arriva	als options aga	ainst the 'do no	othing' baseline	۱ <u>ـ</u>
		L _{Aeq} Westerly arrivals make up a co contours from 2017, as an indi							
		Noise Abatement Procedures As this baseline reflects curren		e would be no	changes to NA	APs as a result	t of this option		
		Noise Mitigation The option doesn't see the use The option doesn't contain mee				vever routine v	vectoring does	disperse the tr	raffic.
		Impacts to air quality are consi have a significant impact on loc			v around 1000f	t (200m). Aircr	aft flying abov	e this are unlike	ely to
	Air Quality	Aircraft arriving at Glasgow fly This is when they are very clos lateral changes below 1000ft h	se to landir	ng. It's therefo	ore highly unlike	ely that any of	our arrival's o		
		Emissions of greenhouse gase linked to track length, we have assessment is therefore linked	initially lool	ked at the trac	ck length for the	baseline wes	terly arrivals.		
	Greenhouse gas impact	We will estimate the difference advantages/disadvantages of the than a typical flight today. As qualitatively describe anticipat technical appendix a.	he option. 7 CO2 emiss	This estimation sions are link	n will consider we differ	vhether the air ence in aviati	craft tracks wil on fuel burnt,	be longer or sh this will allow	norter us to
	Capacity / resilience	In future, increased forecast movements across the Scottish TMA are anticipated to result in capacity and resilience disbenefits. Although vectoring of arrivals is expected to be able to meet the forecast demand, we anticipate changes to the vectoring practices may be required to facilitate the wider changes to CAS, the network and the departures. In addition to this, no change to the airspace around Glasgow may also inhibit the wider FASI programme of change and AMS benefits associated with the programme.							
		For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. Although ILS approaches will remain available, the decommissioning of VORs results in reduced resilience for Glasgow Airport in the event on an ILS outage.							
		CAP1616 outlines the consider of Outstanding Natural Beauty we've therefore included overfl Tranquillity assessment. At this and whether this has the poten	/ (AONB). light data a s stage of th	In Scotland, t round these, I ne ACP we wil	he equivalent on National Parks National Parks	of AONB are and designate ssess whether	National Scen ed quiet areas the option diff	ic Areas (NSA) (DQA) as part c) and of our
Wider Society		Table 88 shows data on the overflight of these areas, based on the NTK vectoring baseline and the centreline baseline. The data from this table will be used to compare the westerly arrivals to the baseline.							
	Tranquillity	Table 88 Westerly arrival baseline	e – Tranquilli	ty overflown 0-3					
			SA count	NSA area	National Parks count	National Parks area	DQA count	DQA area	
		RWY 23 Arrival Baseline - Vectoring (NTK data)	1	17.51	5	79.21	8	2.29	
		RWY23 Arrival Baseline (Centreline – optioneering tool)	1	23.63	1	34.52	0	0	
	Biodiversity	The effects of airspace change on ecology or biodiversity are expected to be minimal. CAA guidance states the general, airspace change proposals are unlikely to have an impact upon biodiversity because they do not in ground-based infrastructure. As such they are unlikely to have a direct impact that would engage the Birds or Ha legislation." Though there is limited research available on the effects of aircraft noise on wildlife, there is some evid that disturbance effects associated with aircraft can occur during take-off and landing where aircraft are below a 500m (~1,640ft). Consideration will therefore be given to the effects on ecology and biodiversity where aircraft or Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas and Sites of S Scientific Interest, particularly at altitudes below 2,000ft. Aircraft arriving at Glasgow fly a standard 3.0 degree approach and are aligned with the runway centreline at 7 this typically occurs at around 5nm (9-10km) from landing. The NTK vectoring baseline shows some low free overflight of Mugdock Wood and Manse Burn SSSIs below 2000ft (Both are located north of the extended r centerline). It's highly unlikely that any of our arrival's options will have any lateral changes between 5nm and lateral changes betw							volve bitats dence round verfly becial 640ft; uency inway
General Aviation	Access	however we will compare this b This baseline scenario would n today. The options will be quali	not offer any	y change from	n the existing C		bace (CAS) ar	rangements in p	place

Aviation Image: Commercial systems Fuel burn Table 89 Westerly Arrival Track Mileage Detummercial systems Fuel burn Track Mileage Track Mileage Option Track miles (nm) 58.2 2380.6 Arroraft arriving at Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traffic in the airspace. We will qualitatively estimate the differences between this baseline and the option, to understand if there are any arriteipated advantages/davan						
Several Lines with the volume closes to the aipport gaing down to ground level. This is the Glasgov CTR shown in red outline. As to in the gain can be seen. Current and Alfront Provides (1 Home) to the east of Glasgov aipport which state is under the data of the CAS structures to support Clasgov Alprot's operation are out of data and the CTR itself can likely be reduced in size. While the existing baseline scenario will not result in the requirement tor more airspace. While the existing baseline scenario will not result in the requirement tor more airspace. This option of the spontantify to airspace boundaries or node to the sale of CAS where its option files no opportunity to the same of the data and the CTR itself can likely be reduced in size. While the existing baseline scenario will not result the differencement for more airspace. This option off result to current and and the glding community. Commit: impact Forometic impact There will be no increase to effective capacity by doing nothing with Westerly arrivals (in isolation to the rest of the westerly arrivals. View and the impact As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline scenario, will be modelled in further of the approach. This means that track length westerly arrivals. View and the track milling of Glasgow, aircraft are vectored by ATC before joining the final approach. This means that track length westerly arrivals are used to anothing the track wells well			Figure 27 Glasgow Airport C Within c.35nm of Glasg Airspace (CAS) volumes	Control Zone and Control Area C gow airports are Edinburgh s. In addition to this, the Sco	hart (See eAIP for full details) and Glasgow Prestwick Airport each with	the airports' airspace
Seried CAS structures to support Glasgow Aiport's operation are out of date and the CTR lister can likely be reduced in size. While the existing baseline scenario will not requirement for more airspace, this option offers no opportunity to implify the assigned boundaries or reduce the size of CAS which is something Glasgow has been specifically working to the Editohugh-Glasgow Gap and the associated Gliding Corridor with a base of 3000th. The ability to raise parts of CTA+ vocul driver fargificant benefit to Cumbernaud and the gliding community. Remove: There will be no increase to effective capacity by doing nothing with Westerly arrivals (in isolation to the rest of the system). Seriend There will be no increases to effective capacity by doing nothing with Westerly arrivals (in isolation to the rest of the system). Seriend As the combustion of aviation fuel is linked to track length, we have initially looked at the track length for the baseline westerly arrivals. Seriend Wehen arriving at Glasgow, aircraft are vectored by ATC before joining the final approach. This means that track length is used for mitight in fight. For the purposes of companing our vestering and rub born we have used the NTK vectoring baseline data and information from ATC to estimate. Seriend Fuel burn Table 89 Westerly Arrival. Fuel burn Table 89 Westerly Arrival. Track miles ('m) track miles ('m) track miles ('weighter data. Seriend Table and Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traftic in the airo			limits with the volume clo Also, in this figure can outside CAS where the l	osest to the airport going dov be seen Cumbernauld Airpo base of the CTA is 3000ft. Th	n to ground level. This is the Glasgow CTI rt approximately 15nm to the east of Glas is is indicated with a yellow dot.	R shown in red outline. gow airport which sits
from increased effective capacity system). General Visition As the combustion of aviation fuel is linked to track length, we have initially locked at the track length for the baseline westerly arrivals. As the combustion of aviation fuel is linked to track length, we have initially locked at the track length is varied from flight of light. For the purposes of comparing our westerly arrival options against the baseline scenario, we have used the NTK vectoring baseline data and information from ATC to estimate an arrival scenario aveighting based on arrival can and information from ATC to estimate an arrival scenario. General Visition / Fuel burn Track Mileage Track Mileage Track Mileage Track Mileage Option Track Mileage Yeighted 58.2 Option Track Mileage Yeighted 58.2 Option Track Mileage Track Mileage Option Track Mileage Yeighted 58.4 (South) 13.48 (North) based on 2019 modal split) Baseline (centreline) 58.2 2380.6 Aircraft arriving at Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traffic in the arrspace. We will qualitatively estimate the differences between this baseline. As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our			CAS structures to support Whilst the existing baseling to simplify the airspace b with GA stakeholders to to the Edinburgh-Glasgo	ort Glasgow Airport's operation ne scenario will not result in to oundaries or reduce the size try to achieve. The most promow Gap and the associated C	n are out of date and the CTR itself can like he requirement for more airspace, this optic of CAS which is something Glasgow has be ninent feature of Westerly arrivals in relation Gliding Corridor with a base of 3000ft. The	ely be reduced in size. on offers no opportunity een specifically working to CAS is with regards
Series Image: series </td <td></td> <td>from increased</td> <td></td> <td>se to effective capacity by de</td> <td>ping nothing with Westerly arrivals (in isola</td> <td>ation to the rest of the</td>		from increased		se to effective capacity by de	ping nothing with Westerly arrivals (in isola	ation to the rest of the
Commercial airlines Fuel burn Track Mileage Option Track miles (nm) Track miles (Weighted baseline (centreline) Baseline (centreline) 58.2 2380.6 Aircraft arriving at Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traffic in the airspace. We will qualitatively estimate the differences between this baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option against current day. This estimation will consider whether the aircraft tracks will be longer or shorter than a typical flight today and will also consider the opportunity for continuous descent from 7000ft. Commercial airlines Training costs As this option is aircady in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air navigation service provider As this option is aiready in operation, there are no operational this baseline. As this option is aiready in operation, there are no orpotions and this baseline. As this option is aiready in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. As this option is aiready in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. As this option is aiready in operation, there are no operational costs antic	General Aviation /		When arriving at Glasgo is varied from flight to fli we have used the NTK then used the track milea a weighting based on arr appraisal track length ar	ght. For the purposes of comvectoring baseline data and age from this centreline as an rival direction to provide an or ad fuel burn will be modelled	paring our westerly arrival options against information from ATC to estimate an arriva initial indication of 'do nothing' track length verall total track mileage for the system. At	the baseline scenario, als centreline; we have . We have then applied
Airport / Air navigation provider Track miles (nm) Track miles (Neighted 69% (South), 13% (North) based on 2019 modal split) Baseline (centreline) 58.2 2380.6 Aircraft arriving at Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traffic in the airspace. We will qualitatively estimate the differences between this baseline and the option, to understand if there are any anticipated advantages/disadvatages of the option against current day. This estimation will consider whether the aircraft tracks will be longer or shorter than a typical flight today and will also consider the opportunity for continuous descent from 7000ft. Commercial airlines Training costs As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air navigation service provider As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. As this option is already in operation, there are no infrastructure costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air navigation service provider Operational costs For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigatin	Commercial					
Baseline (centreline) 58.2 2380.6 Aircraft arriving at Glasgow are sometimes prevented from continuously descending due to the tactical coordination with other traffic in the airspace. We will qualitatively estimate the differences between this baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option against current day. This estimation will consider whether the aircraft tracks will be longer or shorter than a typical flight today and will also consider the opportunity for continuous descent from 7000ft. Commercia fraining costs As this option is already in operation, there are no training costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. At this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. As this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air navigation As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air navigation As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air navigation As this	annes	Fuel burn		Track miles (nm)	69% (South), 13% (North)	
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Airport / Air navigation service providerAs this option is already in operation, there are no options and this baseline.As this option is already in operation, there are no options and this baseline.Airport / Air navigation serviceOperational costsAs this option is already in operation, there are no options and this baseline.Airport / Air navigationOperational costsAs this option is already in operation, there are no other costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.Airport / Air navigation serviceAs this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.Airport / Air navigation serviceAs this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.Airport / Air navigation service providerAs this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.Airport / Air navigation service providerAs this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.Airport / Air navigation service providerAs this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference					d from continuously descending due to th	e tactical coordination
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Airport / Air As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. Airport / Air Operational costs As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is considered an interim measure and failure to implement a long term solution may result in additional operational costs. Deployment costs As this option is already in operation, there are no deployment costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. All Safety At current traffic levels, there are no safety concerns with the current arrangements at Glasgow. Future traffic growth could however result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic levels within the Scottish TMA being capped, on increased aircraft holding in order to maintain safety.	airlines	Other costs				nange; later in this IOA
Airport / Air navigation service providerOperational costsIOA we will estimate the difference between our options and this baseline.Airport / Air navigation service providerOperational costsFor some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is considered an interim measure and failure to implement a long term solution may result in additional operational costs.Deployment costsAs this option is already in operation, there are no deployment costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.AIISafetyAt current traffic levels, there are no safety concerns with the current arrangements at Glasgow. Future traffic growth could however result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic levels within the Scottish TMA being capped, on increased aircraft holding in order to maintain safety.		Infrastructure costs				be no change; later in
Deproyment costs IOA we will estimate the difference between our options and this baseline. All Safety At current traffic levels, there are no safety concerns with the current arrangements at Glasgow. Future traffic growth could however result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic levels within the Scottish TMA being capped, on increased aircraft holding in order to maintain safety.	Airport / Air navigation service provider	Operational costs	IOA we will estimate the For some approaches, which are currently under substitution to mitigate	difference between our option Glasgow Airport is depende ergoing a rationalisation prog /OR rationalisation however	ons and this baseline. nt on conventional ground based navigati ramme by NATS NERL. Glasgow is curren this is considered an interim measure and	on equipment (VORs) tly investigating RNAV
All Safety could however result in increased complexity and workload for Air Traffic Controllers and pilots, which may lead to traffic levels within the Scottish TMA being capped, on increased aircraft holding in order to maintain safety.		Deployment costs				no change; later in this
All Interdependencies As detailed in our Stage 2A documentation on the CAA airspace change portal there are currently interdependencies	All	Safety	could however result in in	ncreased complexity and wor	kload for Air Traffic Controllers and pilots, w	hich may lead to traffic
	All	Interdependencies	As detailed in our Stage	2A documentation on the C	AA airspace change portal there are curre	ntly interdependencies

	, conflicts and tradeoffs	between Westerly arrivals to Glasgow and Easterly arrivals to Edinburgh. Doing nothing will not reduce those dependencies however in all options, we expect some dependencies and airspace buffer arrangement will continue to be required based on the geography of the airports and runways.
		CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.
All	AMS	Whilst vectoring of arrivals is a perfectly reasonable options in a future operating environment, doing nothing with Westerly departures will not align with the AMS as it would constrain other options. Limiting our options to one which sees no change to vectoring practices could also reduce the ability to change CAS boundaries and improve CDA performance.

4.18. Runway 23 Arrival Option C

Runway 23 W	esterly Arrivals Option	on C
		PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 8nm.
		For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 12nm from the runway, and be used by around 13% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 8nm, and would be used by around 69% of overall arrivals.
		Option Overflight Contours (Black outline) with estimated % of overall arrivals
		Figure 28 Westerly Arrivals Option C Overflight and 2019 baseline NTK data
Communitie s	Noise impact on health and quality of life	Route from the North This route would see aircraft continuously descending from 7000ft over areas of relatively low population. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map suggests these areas are not heavily populated and by relocating the arrival route to the north, populated areas such as Dryman and Balfron can be avoided. On the base-leg, (as aircraft turn to the south-east), the route continues to avoid overflight of populated areas with the exception of Buchlyvie before turning to join final approach. The NTK data shown in figure 28 suggests that this turn takes place in around the same areas as some concentration occurs today, although this could be more concentrated in future. Aircraft then join the final approach and overfly the same areas as they do today.
		Route from the South The route from the south would see aircraft start a continuous descent at 7000ft from around the Larkhall area. When reviewed against the NTK data in figure 28, the route then tracks north-west following the same areas where there is concentration in arrivals today. This occurs over the populated areas of Motherwell, Bellshill, Cuparhead, Gartcosh, and East Kirkintillock amongst others. Aircraft then turn to join the final approach at 8nm from the threshold, over Milton on Campsie and Lennoxtown. Reviewed against the NTK data shown in figure 28, this is area where concentration of arrivals traffic is also seen today. Aircraft then join the final approach and overfly the same areas as they do today. Overflight Data

in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

The technical appendix to this document includes a baseline image which shows a PBN centreline created using

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is a small decrease in the area of the contours and the number of population and noise sensitive sites overflown.

Note that a Centreline for the baseline does not actually exist in reality, we created one based on the areas most frequently overflown by RWY 23 arrivals in today's airspace arrangement. Compared to the other options, Option C overflies the highest number of population compared between 0-4000ft and 0-7000ft. *Table 90 Westerly arrivals option C overflight data*

System	Area (km²)	Population	
RWY 23 Baseline (Vectoring)	1659.74	1250066	
RWY23 Baseline (Centreline)	184.13	139113	
RWY23 Option C	180.49	129769	
Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, and places of worship overflown compared to the centreline baseline data. Hospital remained the same. There is a significant decrease compared to the vectoring data in all areas, but it's important to			

		note that at this stage none will result in a reduction in it than today. This is somethi this option progress. The fe detailed in technical append 60dB and 65dB L _{AMax} Technical Appendix A inclu are an indicator of the N60 in table 85 shows a decreas the same between the base <i>Table 91 60dB L</i> _{AMax} <i>Data - R</i> System RWY23 Baseline (Centreline Optioneering tool) RWY 23 Dep Option C	number of bui ng that will be ull data tables dix A. des 60dB wh metrics which se in the area eline and this <i>wy23 Arrival Op</i> Area – 57	ildings overflov explored furth and counts o ich compare C will be quanti and population option.	wn, those that a ner as part of the f noise sensitive Option C against ified at the Stag n within the 60dE	re overflown v e Stage 3 full e buildings su t the centrelin e 3 Full Option	vill likely be at options appra ich as hospita e baseline. Th ns Appraisal.	a higher frequency isal analysis should ils and schools, are nese 60dB contours The data, as shown
	Air Quality	The north-east component northerly arrival component the shape/size of the L _{Aeq} of that this may influence the with the contour shape adju This option has no change changes to local air quality	t of option C jo contour. The s shape of the o usting slightly to how aircra	oins the final ap outherly arriva outer most 51d south-east to r ft fly below 1,0	pproach at 12nr al component joi dB contour altho reflect the turn to 000ft compared	n and therefor ins at 8nm an ugh we would o join final app to the baselin	re we do not e d therefore the l expect this to proach. e and so there	expect this to impact ere is the possibility be relatively minor
	Greenhouse gas impact	Our fuel burn assessment (to the baseline. We theref explored in further detail in	(see below) has ore expect to	as anticipated see a corres	that Option C w	rill have a sma se to greenho	all increase in ouse gas emis	
	Capacity / resilience	explored in further detail in Use of PBN transitions alor less accurate final approac The introduction of PBN ap part of a NERL UK wide precision approach and ND	he is likely to i h spacing me proaches will programme u	educe capacit aning lower rui improve Glasg inder the Airsp	y as airborne ar nway utilisation. gow's resilience, pace Modernisa	as following t	ding would inc	sion of the VORs as
Wider Society		Table 92 shows data on the baseline. <i>Table 92 Westerly arrival optic</i> System RWY 23 Baseline - Vectoring (NTK data) RWY 23 Baseline (Centreline – Optioneering tool)	Ū.		n 0-7000ft National	the NTK vector National Parks area 79.21 34.52	DQA count 8 0	DQA area 2.29 0
		Runway 23 Option C00126.2900The data shows that there is a reduction in NSAs, National Parks and DQAs overflown. Technical appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour, with tranquil sites also shown.						
	Biodiversity	The routes that form part o typically associated with ch before landing, this option i	anges below	1640ft, which v	when flying a sta	andard 3 degre		
General Aviation	Access	Use of a pure PBN solution expected to significantly rec	duce the volu	me of CAS req	uired and would	d enable a rais	se to the base	of CTA-1
	Economic impact from increased effective capacity	Use of PBN transitions alor less accurate final approac We estimate that Option C track mileage.	h spacing me	aning lower rui	nway utilisation.	There would	be a negative	economic effect.
		Track Mileage Option Track miles (nm) (South), 13% (Nor 2019 modal split)			3% (North)			
General Aviation / Commercial airlines	Fuel burn	Baseline (centreline) C This increase in driven lar compared to today in order A. The southern route is a arrivals.	to avoid nois	orthern arrival	es. This can be	seen in the m	aps shown in	technical appendix
		All arrival options have been airspace above 7000ft). As part of Stage 3, should review whether we can ball to understand the impacts of CO_2 and noise.	this option pr ance noise ar	rogress, we wi nd CO2 on the	Il look to refine northern route.	this in further We will also	detail and as quantify fuel b	part of this we will burn in further detail

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly arrival option is not anticipated to require any additional training costs for airlines.			
	Other costs	No other airline costs are foreseen.			
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.			
Airport / Air navigation service provider	vigation vice				
P	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.			
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding. The use of a PBN arrival to RWY 23 may deliver safety enhancements through enabling a reduction in false GPWS alerts due to high ground under final approach/base-leg. This option would require a re-design of the ILS to move the FAF closer or move the PBN path slightly further east.			
All	Interdependencies , conflicts and tradeoffs	As this PBN arrival remains clear of the existing Glasgow-Edinburgh buffer, so long as future Edinbugh GOSAM departures can ensure CCO to be above MSL there should not be any dependences with Edinburgh below 7000ft. There would not be any dependencies with the network design with this option assuming LANAK stays where it is however that stack may require re-alignment to enable some RWY 05 departure options which could affect the upper portions of this PBN arrival option.			
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects of a pure PBN arrival solution at Glasgow include increased delay, reduced economic benefit, increased CO ₂ emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.			

⁴² Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.19. Runway 23 Arrival Option D

Runway 23 We	esterly Arrivals Option	on D
		PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 9nm. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 12nm from the runway, and be used by around 13% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 9nm, and would be used by 69% of overall arrivals.
		13% Contours (Black outline) with estimated % of overall arrivals
		Summer day overflight swather:
Communitie s	Noise impact on health and quality of life	Route from the North This route would see aircraft continuously descending from 7000ft over areas of relatively low population. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map suggests these areas are not heavily populated and by relocating the arrival route to the north, populated areas such as Dryman and Balfron can be avoided. On the base-leg, (as aircraft turn to the south-east), the route continues to avoid overflight of populated areas with the exception of Buchlyvie before turning to join final approach. The NTK data shown in figure 29 suggests that this turn takes place in around the same areas as some concentration occurs today, although this could be more concentrated in future. Aircraft then join the final approach and overfly the same areas as they do today. Route from the South The route from the south would see aircraft start a continuous descent at 7000ft from around the northern part of the Larkhall area. When reviewed against the NTK data in figure 29, the route then tracks north/north-west tracking slightly north-east of where the heat map shows the main concentration occurring today. This part of the route flies over the populated areas of Motherwell, Bellshill, Cuparhead, Coatbridge, Croftfoot, and east of Moodiesburn. Aircraft then turn to join final approach at around 9nm from the threshold. The NTK data in figure 29 shows that this happens north-east of today's arrival concentration however this avoids the densely populated area of Kirkintilloch and Milton on Campsie and largely routes over areas with relatively low population density. Aircraft then join the final approach and overfly the same areas as they do today.

Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 93 Westerly arrivals option D overflight data

System	Area (km²)	Population
RWY 23 Baseline (Vectoring)	1659.74	1250066
RWY23 Baseline (Centreline)	184.13	139113
RWY23 Option D	178.24	118103

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, and places of worship overflown compared to the centreline baseline data. There is an increase in hospitals. There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths

		will result in a reduction in nu than today. This is something this option progress. The full detailed in technical appendix	that will be data tables	explored furtl	her as part of the	e Stage 3 full	options appra	isal analysis shoul	
		60dB and 65dB L_{AMax} Technical Appendix A include are an indicator of the N60 m in table 94 shows a decrease the same between the baseli	etrics which in the area a	will be quant nd populatior	ified at the Stag	e 3 Full Optio	ns Appraisal.	The data, as show	
		Table 94 60dB L _{AMax} Data - Rwy	23 Arrival Opt	tion D					
				60dB L	-AMax				
		System	Area	(km²)	Population				
		RWY23 Baseline (Centreline Optioneering tool)	57.	86	68289				
		RWY 23 Dep Option D	54.	55	54040				
		L _{Aeq} The north-east component of Option D sees a turn onto fin shape or size of the L _{Aeq} cont	nal approach						
	Air Quality	This option has no change to changes to local air quality (p						e are no anticipate	
	Greenhouse gas impact	Our fuel burn assessment (se to the baseline. We therefor explored in further detail in th	e expect to	see a corres	sponding increa	se to greenh	ouse gas emi		
	Capacity /	Use of PBN transitions alone less accurate final approach					ding would inc	crease as a result o	
	resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.							
		Table 95 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:							
		Table 95 Westerly arrival Option D – Tranquil areas overflown 0-7000ft							
Wider Society		System N	ISA count	NSA area	National Parks count	National Parks area	DQA count	DQA area	
	Tranquillity	RWY 23 Baseline - Vectoring (NTK data) RWY 23	1	17.51	5	79.21	8	2.29	
		Baseline (Centreline – Optioneering tool)	1	23.63	1	34.52	0	0	
		Runway 23 Option D000000The data shows that there is a reduction in NSAs, National Parks and DQAs overflown; all are avoided. Technical appendix A contains a map which shows the overflight contour of this option alongside the baseline centreline contour,							
	Biodiversity	with tranquil sites also shown The routes that form part of <i>A</i> typically associated with char before landing, this option is	Arrival Option nges below 1	640ft, which w	when flying a sta	ndard 3 degr	ee approach c	occur at around 5ni	
General	Access	Use of a pure PBN solution	for arrivals,	with a final a	approach joining	g point in the	same vicinity	as today could b	
Aviation	Economic impact from increased	expected to significantly redu Use of PBN transitions alone less accurate final approach	is likely to re	educe capacit	ty as airborne ar	nd ground hol	ding would ind	crease as a result of	
	effective capacity	We estimate that Option D, w track mileage.	vhen compa	red to baselir	ne nominal cent	relines, will re	esult in a smal	l overall increase	
		Track Mileage							
		Option	Trac	k miles (nm)			3% (North)		
General		Baseline (centreline)	58.2			2019 moda 2380.6	al split)		
Aviation / Commercial		D This is seen in deiver land	63.9		l navita vubiala t	2589.1		inin final annuar	
airlines Fuel burn		This increase in driven large compared to today in order to A. The southern route also ta typically join today.	o avoid noise	e sensitive sit	es. This can be	seen in the n	haps shown in	technical appendi	
		All arrival options have been airspace above 7000ft).	designed to	continuously	descend from 7	7000ft (subjec	t to the NATS	S NERL ACP for th	
		As part of Stage 3, should this will review whether we can be to understand the impacts of CO_2 and noise.	lance noise	and CO ₂ on tl	he northern rout	e. We will also	o quantify fuel	burn in further deta	
Commercial	Training costs	Flight procedures are update	d or introduc		as part of an Al equired. This we			ycle, airlines updat	

		any additional training costs for airlines.			
	Other costs	No other airline costs are foreseen.			
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.			
Airport / Air navigation service provider	avigation ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs				
p. e	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.			
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.			
		The use of a PBN arrival to RWY 23 may deliver safety enhancements through enabling a reduction in false GPWS alerts due to high ground under final approach/base-leg.			
	1	This option would require a re-design of the ILS to move the FAF closer or move the PBN path slightly further east.			
All	Interdependencies , conflicts and tradeoffs	As this PBN arrival remains clear of the existing Glasgow-Edinburgh buffer, so long as future Edinburgh GOSAM departures can ensure CCO to be above MSL there should not be any dependences with Edinburgh below 7000ft. There would not be any dependencies with the network design with this option assuming LANAK stays where it is however that stack may require re-alignment to enable some RWY 05 departure options which could affect the upper portions of this PBN arrival option.			
All	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace.			
		This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.			

⁴³ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.20. Runway 23 Arrival Option E

Runway 23 Wes	terly Arrivals Option E	
		PBN arrivals from the north joining final approach at approximately 12nm from the runway and from the south at approximately 10nm.
		For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 12nm from the runway, and be used by around 13% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 10nm, and would be used by 69% of overall arrivals.
		Option Overflight Contours (Black outline with estimated % of overall arrivals
		2019 baseline average summer day overflight summer day overflight
Communities	Noise impact on health and quality of life	<i>Figure 30 Westerly Arrivals Option E Overflight and 2019 baseline NTK data</i> Route from the North This route would see aircraft continuously descending from 7000ft over areas of relatively low population. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map suggests these areas are not heavily populated and by relocating the arrival route to the north, populated areas such as Dryman and Balfron can be avoided. On the base-leg, (as aircraft turn to the south-east), the route continues to avoid overflight of populated areas with the exception of Buchlyvie before turning to join final approach. The NTK data shown in figure 30 suggests that this turn takes place in around the same areas as some concentration occurs today, although this could be more concentrated in future. Aircraft then join the final approach and overfly the same areas as they do today.
		Route from the South The route from the south would see aircraft start a continuous descent from 7000ft, from around south of Motherwell. When reviewed against the NTK data in figure 30, the route then tracks north/north-west flying north- east of where the heat map shows the main concentration of arrivals occurring today. This part of the route flies over the populated areas of Motherwell, Bellshill, New Stevenson, Coatbridge, Glenboig, and Croftfoot. Aircraft then turn to join final approach at around 10nm from the threshold. The NTK data in figure 30 shows that this happens north-east of today's arrival concentration however this avoids the densely populated area of Kirkintilloch, Milton on Campsie and Moodiesburn nd largely routes over areas with relatively low population density with the exception of the small areas of Twechar and southern parts of Queenzieburn. Aircraft then join the final approach and overfly the same areas as they do today.

the final approach and overfly the same areas as they do today.

Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 96 Westerly arrivals option E overflight data

System	Area (km²)	Population	
RWY 23 Baseline (Vectoring)	1659.74	1250066	
RWY23 Baseline (Centreline)	184.13	139113	
RWY23 Option E	175.89	115858	
Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, and places of worship overflown compared to the centreline baseline data.			

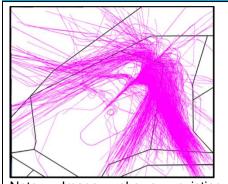
		There is an increase in hospi it's important to note that concentrated PBN flight path will likely be at a higher frequ 3 full options appraisal analy buildings such as hospitals a 60dB and 65dB L _{AMax} Technical Appendix A inclue contours are an indicator of data, as shown in table 97 sh L _{AMax} contours remain the sa	at this stage as will result in uency than to ysis should th and schools, a des 60dB wh the N60 metr nows a decrea	e none of the n a reduction in day. This is so his option prog are detailed in hich compare rics which will ase in the area	e data conside n number of bu omething that w gress. The full n technical app Option E aga be quantified a a and populatio	ers the frequent ildings overflow vill be explored data tables and endix A. inst the centre at the Stage 3 on within the 60	ncy of overflig vn, those that a further as part d counts of nc line baseline. Full Options A	ht; although are overflown of the Stage ise sensitive These 60dB ppraisal. The	
		Table 97 60dB L _{AMax} Data - Rw							
				60dB L	AMax				
		System	Area	(km²)	Populatior	n			
		RWY23 Baseline (Centreline	- 57	.86	68289				
		Optioneering tool) RWY 23 Dep Option E	53	.19	53821				
		L _{Aeq} The north-east component of Arrival Option E sees a turn alter the shape or size of the	onto final app	proach at 9nm					
	Air Quality	This option has no change anticipated changes to local							
	Greenhouse gas impact	Our fuel burn assessment (compared to the baseline. W This will be explored in furthe	(see below) h Ve therefore e	has anticipate expect to see	d that Option a correspondir	E will have a gincrease to g	small increase greenhouse ga	in fuel burn s emissions.	
	Capacity / resilience	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result of less accurate final approach spacing meaning lower runway utilisation. The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only							
Wider Society		Table 98 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline: Table 98 Westerly arrival Option E – Tranquil areas overflown 0-7000ft Sustem NSA count NSA count National National							
	-	RWY 23 Baseline -	NSA count	NSA area 17.51	Parks count	Parks area 79.21	DQA count 8	DQA area	
	Tranquillity	Vectoring (NTK data) RWY 23 Baseline (Centreline –	1	23.63	1	34.52	0	0	
		Optioneering tool) Runway 23 Option E	0	0	1	26.29	0	0	
		The data shows that there is and DQAs which are now av		in the overflig	ht of National I	Parks and ther	e is also reduc	tion in NSAs	
	Biodiversity	The routes that form part of <i>A</i> are typically associated with around 5nm before landing, from the baseline.	changes be	ow 1640ft, wh	hich when flyin	g a standard 3	degree appro	ach occur at	
General Aviation	Access	Use of a pure PBN solution f expected to significantly redu							
	Economic impact from increased effective capacity	Use of PBN transitions alon result of less accurate final economic effect.							
		We estimate that Option E, when compared to baseline nominal centrelines, will result in an overall increase in track mileage.							
		Track Mileage				Track m	iles (Weight	ed 69%	
		Option		k miles (nm)		(South), 1 2019 moda	3% (North)		
General Aviation / Commercial		Baseline (centreline) E	58.2 <mark>72.8</mark>			2380.6 3203.2			
airlines	Fuel burn	This increase in driven by compared to today in order appendix A. The southern ro most arrivals typically join to All arrival options have been	to avoid noi oute also tak day.	se sensitive s es a longer pa	ites. This can ath as it joins f	be seen in the inal approach	e maps showr at 10nm which	in technical further than	
		the airspace above 7000ft). As part of Stage 3, should the this we will review whether we in further detail to understand order to try to balance CO_2 and the the try to balance CO_2 and the try to balance to try to try to balance to try to balance to try	his option pro ve can baland d the impacts	ogress, we wil ce noise and C	I look to refine CO ₂ on the nor	this option in t	further detail a e will also quar	nd as part of htify fuel burn	

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This westerly arrival option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁴⁴ .
Deployment costs		This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
		The use of a PBN arrival to RWY 23 may deliver safety enhancements through enabling a reduction in false GPWS alerts due to high ground under final approach/base-leg. This option would require a re-design of the ILS to move the FAF closer or move the PBN path slightly further east.
All	Interdependencies, conflicts and tradeoffs	As this PBN arrival remains clear of the existing Glasgow-Edinburgh buffer, so long as future Edinburgh GOSAM departures can ensure CCO to be above MSL there should not be any dependences with Edinburgh below 7000ft. There would not be any dependencies with the network design with this option assuming LANAK stays where it is however that stack may require re-alignment to enable some RWY 05 departure options which could affect the upper portions of this PBN arrival option.
All	AMS	 CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

⁴⁴ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.21. Runway 23 Arrival Vectors only

Runway 23 Westerly Arrivals Vectors only



Note: Image shows existing vectoring swathe. Visualisation of option to be developed at Stage 3 once further information around airspace above 7000ft is known alongside more information about departures and CAS arrangements.

Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. The former, because it is difficult for ATC to deliver accurate final approach spacing to varying runway spacing requirements using PBN only and they can often require more Controlled Airspace than is required by vectoring. The latter because they can often result in longer final approach joining points than vectoring caters for and, in the case of Glasgow would see c.85% of all Westerly arrivals on a single path. Communities can sometimes favour the 'spreading' of arrivals to mitigate against potential adverse effects of concentration as seen in Design Principle 6.

This option would see all arrivals continuing to be vectored with no PBN paths available for routine use.

Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet, so there is not an illustration for this option.

For the Design Principle Evaluation and this Initial Options Appraisal, we will assume similar impacts as the baseline however for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft.

For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		In this vectoring option, aircraft arriving at Glasgow would continue to be tactically controlled (vectored) by ATC before joining final approach. Today aircraft typically join the runway 23 final approach between 7nm and 13nm before landing although when undertaking an ILS approach they can be as close as 6nm. This option would continue to see aircraft joining the final approach at these distances, although there is a small possibility that this could be influenced by changes to the airspace above 7000ft and departures – this will be explored in further detail at Stage 3 should this option progress.
		Unlike PBN routes, tactical controlling of aircraft typically leads to higher levels of dispersion of flights and therefore sharing of the noise. The NTK data shown in figure 31, demonstrates the large swathe of overflight created by today's vectoring. It shows that there are wide areas that are overflown between 1-10 times per day on average including Weymess Bay, Fort Glasgow, Inverkip, Helensburgh, Cardross, Boglestone, Birdgend, Greenock, Dumbarton, Bonhill, Balloch, Balfron, Cumbernauld, Kilsyth, Airdrie, Wishaw, Carluke, Udston, Blantyre, East Kilbride, Newton Mearns, Clarkstone, and eastern parts of the city centre of Glasgow. There is some concentration which occurs from a southeasterly direction, before aircraft join the final approach which overflies Larkhall, Motherwell, Belishill, Coatbridge, Gartcosh, Moddlesburn, Muirhead, eastern parts of Kirkintilloch, Milton of Campsie, and Lennoxtown.
Communities	Noise impact on health and quality of life	<figure></figure>

are known about where aircraft will enter at 7000ft, where and how the departures might be operated, and the shape and size of the CAS volume.

For the purposes of this IOA, we will use the baseline data as the closest representative data for this option. The technical appendix includes NTK and centreline data for the baseline. It's important to note that the NTK data is not modelled in the same way as the other data, however it does provide a preliminary means of comparison between this baseline and the airspace change options.

Table 99 below includes data based on the NTK heat map as shown in figure 33 above:

Table 99 Westerly arrivals baseline overflight data 0-7000ft

System	Area (km²)	Population
RWY 23 Arrivals Baseline - Vectoring (NTK data)	1659.74	1250066

In addition to population overflown, we also have data on the overflight of noise sensitive buildings such as schools, hospitals and places of worship:

		System		Schools count	Hospitals c	ount Care	homes count	Place	s of worshi
		RWY 23 (Vectoring)	Baseline	399	23	3	206	count	695
		Although the da	uency of o	higher number o verflight will be lov at Stage 3.					
		and the options. the baseline, ho centreline data. to equivalent PB	ndix A inclue Similar to t wever this It also does N routes. V	des 60dB L _{AMax} con the overflight data data does not cur s not articulate the Ve will explore this long the extended	above, the po rently take int frequency of in further deta	pulation within t o account the fu overflight which ail a Stage 3 sho	he 60dB LAMax of Ill vectored swath would be lower fo ould the option pro	contours e, as it is or some a ogress. T	is highest wit s modelled fr areas compa he 65dB LAN
		Table 100 Wester	ly arrivals ba	aseline L _{AMax} data					
					60dB L _{AMax}				
		System		Area (km	²) I	Population			
		RWY23 Arrival Baseline (Ce Optioneering te	entreline	- 57.86		68289			
		option is expected option to alter the	ed to see ai e shape or	of the existing L _{Ad} ircraft continue to size of the L _{Aeq} co e fully quantified.	join final appre	bach as they do	today and theref	ore we do	o not expect
	Air Quality			to how aircraft fly (positive or negati				there ar	e no anticipa
	Greenhouse gas impact	compared to the	e baseline.	see below) has ar We therefore ex the Stage 3 Full C	bect neutral b	enefit/impact to	greenhouse gas		
	Capacity / resilience	This option would be expected to cope with future demand. The peak hourly landing rate already experienced in today's airspace through vectoring could be expected to be delivered through vectoring in the future subject to some potential changes to the vectoring patterns as a result of the changes to surrounding structures.							
		a NERL UK wid	le programi	nprove Glasgow A me under the Airs ual non precision a	pace Modern	isation program			
Vider Society		Table 101 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline. For the purposes of this IOA we have assumed the vectoring swathe to be similar today however, should this option progress, at Stage 3 we will refine it further and undertake further analysis on the impacts to tranquillity.							
		Table 101 Westerly vectors only – Tranquil areas overflown 0-7000ft							
	Tranquillity	Systen	n I	NSA count NSA	area	nal Parks Nat ount	ional Parks area	A count	DQA area
		RWY 23 Bas (Vectorin RWY2	ng)	1 17	51	5	79.21	8	2.29
		Baseline (Cer	ntreline)	1 23		1	34.52	0	0
	Biodiversity	This option is unlikely to change where aircraft join the final approach compared to today. As impacts to biodiversit are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at aroun 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline							
General Aviation	Access			e to a reduction ir opportunity to rec			cause this option	can be o	contained wit
	Economic impact from increased effective capacity	today's airspace	through ve	ected to cope with ectoring could be e ctoring patterns as	expected to be	e delivered throu	igh vectoring in th	e future	
General Aviation /		vectoring swath	e to be sim	e centreline data f hilar today howeve on the benefits and	er, should this	option progres			
Commercial irlines		Table 102 Wester	ly Arrival Tra	ack Mileage					
	Fuel burn	Track Mileage			Π	rack miles	(Weighted		
		Option		Track miles (nr	n) 6	9% (South), 1: based on 2019 n	3% (North)		
		Baseline (centre		58.2		380.6			
Commercial airlines	Training costs		accordingl	ted or introduced v y and undertake tr s for airlines.					
	Other costs	No other airline	costs are fo	preseen.					
Airport / Air	Infrastructure costs			se of the ACP may to be any change				dments h	nowever beyo
navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables							

		VOR rationalisation ⁴⁵ ;
	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	No safety concerns have been identified at this stage.
All	Interdependencies, conflicts and tradeoffs	As detailed in our Stage 2A documentation on the CAA airspace change portal there are currently interdependencies between Westerly arrivals to Glasgow and Easterly arrivals to Edinburgh. We expect some dependencies and airspace buffer arrangement will continue to be required based on the geography of the airports and runways. Any changes to vectoring practices would only be as a result to changes to surrounding airspace and route structures enabled by other options.
All	AMS	 CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. Vectoring of arrivals in the future would not deliver a PBN arrival solution, nor reduce the numbers of people overflown / affected by noise from Glasgow's arrivals. However it is unlikely to change the adverse effects which would be measured within the LOAEL which would not extend out to the final approach joining point. This option would meet future demand however it may not be the best future-proofed option should technological enhancements become available in the future to better rely on a pure PBN arrival solution for Glasgow.

⁴⁵ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.22. Runway 23 Arrival Vectors and PBN hybrid

Runway 23 We	esterly Arrivals Vect	tors and PBN hybrid
(B)		Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. There are however the benefits of PBN for arrivals.
		This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.
		The PBN arrival(s) would likely be the 'best performing' of Options C-E above which are then optimised in Stage 3 to balance CO ₂ , noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation.
overflight conto Visualisation developed at s shortlist is kn	the alongside the ours for Options C-E. of option to be Stage 3 once PBN own and there is ormation around	For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, westerly operations on runway 23 occur approximately 82% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing.
		The PBN arrival component could be any of the PBN options already assessed; the option taken forward will depend on the shortlisting as part of this IOA and the outcome of the Stage 3 Full Options Appraisal.
		Below provide links to the four assessments for the PBN Options: <u>Initial Options Appraisal – Runway 23 Arrival Option C</u> <u>Initial Options Appraisal – Runway 23 Arrival Option D</u> <u>Initial Options Appraisal – Runway 23 Arrival Option E</u>
		The PBN option assessments linked above have shown that there is the potential for PBN routes to reduce the number of people and noise sensitive sites overflown, however due to the concentration created by PBN routes, areas overflown would likely be at a higher frequency than today.
		By combining with vectoring, some of this concentration from PBN routes could be mitigated, as some aircraft would continue to be tactically controlled and would therefore see the dispersion that occurs today. This dispersion has been described in the vectoring option linked below: Initial Options Appraisal – Runway 23 Arrival Vectors only
		As described in the Vectoring assessment, the shape/size of the vectoring swathe will be dependent on a number of factors which are yet to be determined including the airspace above 7000ft, the departure options, and the CAS arrangements. We will explore this further at Stage 3.
		For this IOA, we have included an image which shows all of the potential PBN options alongside the vectoring swathe. In Stage 3 we will refine this in further detail as described above and we will also quantify when we would expect to see the PBN and vectoring used.
Communitie s	Noise impact on health and quality of life	PBN Options Overflight Contours (Black outline) with estimated % of overall arrivals
		2019 baseline average summer day overflight swathe:

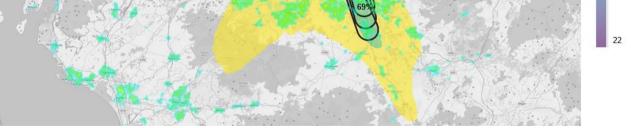


Figure 32 Runway 23 PBN (All potential options) and Vectoring. Note only one PBN option would be proposed alongside vectoring.

Overflight Data The individual sections of the PBN Options linked above provide more detailed information on the areas overflown and overflight data. Table 103 below shows the comparison between the baseline NTK vectoring data and the different options. Although the NTK vectoring data is not modelled in the same way as the centreline data, it does provide a preliminary means of comparison between the baseline and the airspace change options.

		System	Area	Population	Schools count	Hospitals count	Carehomes count	Places o worship count		
		RWY23_BASE (Vectoring NTK data)	⁹ 1659.74	1250066	399	23	206	695		
		RWY23_BASE (Centreline)	184.13	139113	66	0	22	83		
		RWY23_C	180.49	129769	58	0	20	82		
		RWY23_D	178.24	118103	51	1	18	79		
		RWY23_E	175.89	115858	50	1	15	80		
		Overall, the data suggests that vectoring baseline however the articulated in the data tables a	ese options	s will result in so						
		This suggests that the combinative would mitigate some of the im routes would mean that when will be explored in further details.	pacts of co traffic allow	ncentration for the	nose communi umber of peop	ties living unde	er the PBN routes	s, and the PBN		
		60dB and 65dB L_{AMax} Technical Appendix A includes At this stage we do not have L data shows that the PBN arri although at this stage, this da Similar to the overflight assess mitigate the impacts of PBN w this will be explored further in	AMax data fo vals routes ata does no sment abov vith some o	or the vectoring o result in a redu ot take into acco ve, by offering a l f the benefits of v	r overall N60 r rction in area unt the freque hybrid PBN/ve vectoring whic	metrics - we wi and population ency of overflic ctoring option, h may result in	Il quantify these and within the 60dE wht which would l there would be of favourable LAMax	at Stage 3. The 3 L _{AMax} contou ikely increase opportunities to		
		L _{Aeq} The north-east component of t of the PBN Options and the V the LAeq contour and therefor	ectors only e this hybri	option have sug d option is also u	gested that th Inlikely to sign	ere will be no ificantly impac	impact to the sha t the shape or siz	pe and size o e.		
	Air Quality	This option has no change to changes to local air quality (po		•	•			no anticipated		
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated this option will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.								
	Capacity /	Option is expected to enhance Glasgow's operational performance in the future. This is because ATC can use the PBN arrivals when traffic levels are low-medium and this will also facilitate the use of combined Tower and Approach services (Radar In Tower) offering additional resilience to ATC resource.								
Wider Society	resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
wider society	Tranquillity	This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has shown that there are benefits to areas of tranquillity for all runway 23 PBN options. For the purposes of this IOA we have assumed the vectoring swathe to be similar today and therefore this component of a hybrid option would offer neutral benefits/impacts to areas of tranquillity. Overall, at this stage, the IOA suggests there may therefore be some benefits to the overall hybrid option owing to the use of the PBN routes. We will explore this tranquillity assessment further in Stage 3 should this option progress.								
	Biodiversity	This option is unlikely to change where aircraft join the final approach compared to today. The PBN options also all join the final approach from at 10 or 11nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.								
General Aviation	Access	Option is likely to contribute t existing CAS whilst offering so					option can be co	ontained within		
General	Economic impact from increased effective capacity	ed airspace through vectoring could be expected to be delivered through vectoring in the future and the feature of the solution would best future-proof Glasgow in the case of technological enhancements that may allow for great						ature of PBN i		
Aviation / Commercial airlines	Fuel burn	This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has shown that there may be increases in track mileage and fuel burn as a result of the PBN options. For the purposes of this IOA we have assumed the vectoring swathe to be similar today and therefore this component of a hybrid option would offer neutral benefits/impacts to fuel burn. Overall, at this stage, the IOA suggests there may therefore be some impacts to fuel burn as a result of a hybrid option although these will be less than operating purely PBN arrivals alone.								
Commercial airlines	Training costs	Flight procedures are updated their procedures accordingly a any additional training costs for	nd underta							
	Other costs	No other airline costs are fores	seen.							
	Infrastructure costs	The initial deployment phase this there are not expected to						wever beyon		
Airport / Air navigation service provider	Operational costs	This airspace change proposa PBN approaches provides an is the potential for the existing ground based navigation equi VOR rationalisation ⁴⁶ ;	al is not ant alternative VOR appro	icipated to chang approach proced baches to be rem	ge airport or A lure alongside oved which re	NSP operation the current ILS duces Glasgov	al costs. The imp approaches. Th v's dependency c	is means ther		
	Deployment costs	This option is expected to re Prestwick and Glasgow Airpor								

⁴⁶ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

		Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
AII	Safety	Use of a PBN solution to RWY 23 may reduce the number of false GPWS alerts occasionally experienced by some arrivals. No other safety issues identified with this option.
AII	Interdependencies , conflicts and tradeoffs Solong as future Edinburgh GOSAM departures can ensure CCO to be above MSL there option assuming LANAK stays where it is however that stack may require re-alignment to en- departure options which could affect the upper portions of this hybrid-PBN arrival option.	
AII	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option is considered to best meet the requirements of the AMS for Westerly arrivals. It introduces a PBN arrival solution without being reliant on it which ensures that demand can be met but allowing improved CDA for arrivals using the PBN structure. The feature of PBN in the solution would best future-proof Glasgow in the case of technological enhancements that may allow for greater use of PBN, if desired by Glasgow and its stakeholders. It would help to reduce the number of people overflown by Glasgow's arrivals without concentrating all arrivals permanently onto 2 routes.

4.23. Runway 05 Easterly Arrivals Baseline

Runway 05 Easterly Arrivals Baseline						
	The how join For Port					

The majority of aircraft are vectored to join final approach between approximately 8nm and 11nm from touchdown however they are allowed to join final approach as close as 2000ft/6nm when using the ILS. The tracks shown which join final approach inside 6nm are likely performing a visual approach.

For more information on our do nothing scenario, please see our Stage 2A document on the CAA's Airspace Change Portal.

Group	Impact	Qualitative Assessment						
		Due to wind direction, easterly operations on	runway 05 occur approximately 18% of th	ne year. The noise data and				
		qualitative assessment has considered this mo	dal split with daily movements averaged ac	cross the year.				
		Aircraft arriving at Glasgow are tactically controlled (vectored) by ATC before joining final approach which is aligned with the extended runway centreline. Aircraft typically join the runway 05 final approach between 8nm and 11nm before landing although when undertaking an ILS approach they can be as close as 6nm. Aircraft may also undertake visual approaches closer than 6nm.						
		The NTK data shown in figure 33, demonstrate that there are wide areas to the south of the airp Darvel, Newmilns, Galston, Kilmarnock, Kilmau which occurs from a south-easterly direction, be and Beith:	port that are overflown between 1-10 times rs, Dunlop, Kilwinning, Dalry, and Kilbirnie.	per day on average including There is some concentration				
Communitie s	Noise impact on health and quality of life	Figure 33 Runway 05 Arrivals Vectoring Swathe 2017The technical appendix to this document include to note that this data is not modelled in the same means of comparison between this baseline and The technical appendix also includes a baseline not have any published PBN arrivals and there NTK data for 2019 and analysing the arrivals	des a larger version of this map along with ne way as the overflight contours, however nd the airspace change options. e arrivals centreline contour and associated efore this centreline has been generated b	it does provide a preliminary d data. Glasgow Airport does by reviewing 92 day summer				
		Table 104 below includes data based on the I optioneering tool for if aircraft were to follow on	e optioneering tool in order to output the da NTK heat map as shown in figure 33 abov	ata tables and contours.				
		Table 104 Easterly arrivals baseline overflight data (
		System	Area (km²)	Population				
		RWY 05 Arrivals Baseline - Vectoring (NTK	691.95	140596				
		data) RWY 05 Arrivals Baseline (Centreline –	182.63	51256				
		optioneering tool)						
		The data from these tables will be used to com In addition to population overflown, we also ha hospitals and places of worship; the full data ar will provide a qualitative statement around this 60dB and 65dB L AMax	ave data on the overflight of noise sensitive ound these is shown in technical appendix	e buildings such as schools,				
		Technical Appendix A includes 60dB L _{AMax} cont and the options. Although we have shown a 6 options as the scope of the contour is only on the N60/N65 metrics which will be quantified at the	55dB L _{AMax} contour in the appendix, this do he final approach. 60dB and 65dB L _{Amax} co	pes not change between the				

				60dB L	AMax				
		System	Area	(km²)	Population				
		RWY 05 Arrivals Baseline (Centreline optioneering tool)	- 56	.96	34798				
		The data from these tables	will be used t	o compare the	e easterly arrival	s options aga	ainst the 'do no	thing' baseline.	
		L _{Aeq} Easterly arrivals make up a contours from 2017, as an i							
		Impacts to air quality are co have a significant impact or			v around 1000ft	(200m). Aircı	raft flying abov	e this are unlike	
	Air Quality	Aircraft arriving at Glasgow This is when they are very lateral changes below 1000	close to landi	ng. It's therefo	ore highly unlike	ly that any of	four arrival's c		
		Emissions of greenhouse g linked to track length, we ha assessment is therefore link	ave initially loc	oked at the tra	ck length for the	baseline eas	sterly arrivals.		
	Greenhouse gas impact	We will estimate the differences between the baseline and the option, to understand if there are any anticipated advantages/disadvantages of the option. This estimation will consider whether the aircraft tracks will be longer or shorte than a typical flight today. As CO ₂ emissions are linked to the difference in aviation fuel burnt, this will allow us to qualitatively describe anticipated greenhouse gas impacts as a result of the option. Full data tables are shown in technical appendix a.							
	Capacity /	In future, increased forecast movements across the Scottish TMA are anticipated to result in capacity and resilience disbenefits. Although vectoring of arrivals is expected to be able to meet the forecast demand, we anticipate change to the vectoring practices may be required to facilitate the wider changes to CAS, the network and the departures. I addition to this, no change to the airspace around Glasgow may also inhibit the wider FASI programme of change and AMS benefits associated with the programme.							
	resilience	For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. This equipment is due to be decommissioned as part of a NERL UK wide programme under the Airspace Modernisation programme. Although ILS approaches will remain available, the decommissioning of VORs results in reduced resilience for Glasgow Airport in the event on an ILS outage.							
		CAP1616 outlines the consideration of impacts upon tranquillity is with specific reference to National Parks and Areas of Outstanding Natural Beauty (AONB). In Scotland, the equivalent of AONB are National Scenic Areas (NSA) and we've therefore included overflight data around these, National Parks and designated quiet areas (DQA) as part of our Tranquillity assessment. At this stage of the ACP we will qualitatively assess whether the option differs from current day and whether this has the potential to impact tranquillity with regards to noise and AONB.							
Wider Society		Table 106 shows data on Glasgow's existing SID cent							
	Tranquillity	Table 106 Easterly arrival base	eline – Tranqui	llity overflown 0-					
		System	NSA count	NSA area	National Parks count	National Parks area	DQA count	DQA area	
		RWY 05 Arrival Baseline - Vectoring (NTK data) RWY05 Arrival	0	0	0	0	0	0	
		Baseline (Centreline – optioneering tool)	0	0	0	0	0	0	
	Biodiversity Biodiversity Biodiversity are expected to be minimal. CAA guidance of the term of the effects of airspace change proposals are unlikely to have an impact upon biodiversity because the ground-based infrastructure. As such they are unlikely to have a direct impact that would engage the legislation." Though there is limited research available on the effects of aircraft noise on wildlife, there i that disturbance effects associated with aircraft can occur during take-off and landing where aircraft a 500m (~1,640ft). Consideration will therefore be given to the effects on ecology and biodiversity when Special Protection Areas, Special Areas of Conservation, National Parks, National Scenic Areas and Scientific Interest, particularly at altitudes below 2,000ft.							they do not inv the Birds or Hab re is some evide aft are below are where aircraft ov	
		Aircraft arriving at Glasgow this typically occurs at arou overflight of Castle Semple	und 5nm (9-1	0km) from lan	ding. The NTK	vectoring ba	seline shows	some low frequ	

		overflight of Castle Semple and Barr Lochs SSSI below 2000ft (Located north of the extended runway centerline). It's highly unlikely that any of our arrival's options will have any lateral changes between 5nm and landing however we will compare this baseline against each option.
General Aviation	Access	This baseline scenario would not offer any change from the existing Controlled Airspace (CAS) arrangements in place today. The options will be qualitatively compared against this existing scenario. Within c.35nm of Glasgow airports are Edinburgh and Glasgow Prestwick Airport each with their own Controlled Airspace (CAS) volumes. In addition to this, the Scottish TMA airspace sits above and around the airports' airspace
Aviation		which generates the volumes shown in Figure 34. The controlled airspace at Glasgow has varying lower and upper limits with the volume closest to the airport going down to ground level. This is the Glasgow CTR shown in red outline. Also, in this figure can be seen Cumbernauld Airport approximately 15nm to the east of Glasgow airport which sits outside CAS where the base of the CTA is 3000ft. This is indicated with a yellow dot.

			Control Zone and Control Area C				
		CAS structures to support Whilst the existing base arrivals would constrain reduce the size of CAS	ort Glasgow Airport's operation eline scenario will not result in departure options and there	on are out of date and the n the requirement for m fore offers less opportun	e CTR itself can likely be reduced in siz ore airspace, doing nothing with easte ity to simplify the airspace boundaries v working with GA stakeholders to try		
	Economic impact from increased effective capacity		ase to effective capacity by d ing would constrain the ability		rly arrivals (in isolation to the rest of t artures.		
		As the combustion of a easterly arrivals.	viation fuel is linked to track I	ength, we have initially h	ooked at the track length for the baseli		
General		When arriving at Glasgow, aircraft are vectored by ATC before joining the final approach. This means that track length is varied from flight to flight. For the purposes of comparing our easterly arrival options against the baseline scenario, we have used the NTK vectoring baseline data and information from ATC to estimate an arrivals centreline; we have then used the track mileage from this centreline as an initial indication of 'do nothing' track length. We have then applied a weighting based on arrival direction to provide an overall total track mileage for the system. At the Stage 3 full options appraisal track length and fuel burn will be modelled in further detail.					
Aviation / Commercial		Table 107 Easterly Arrival Track Mileage					
airlines	Fuel burn	Track Mileage Track miles (Weighted					
		Option	Track miles (nm)	69% (South), 13% based on 2019 mo	6 (North)		
		Baseline (centreline)	50	428.4			
		with other traffic in the a We will qualitatively es anticipated advantages	airspace. stimate the differences betwe s/disadvantages of the optior	en this baseline and th against current day. T	scending due to the tactical coordination e option, to understand if there are a his estimation will consider whether the consider the opportunity for continuo		
Commercial	Training costs		in operation, there are no tra erence between our options a		s there will be no change; later in this IC		
airlines	Other costs		y in operation, there are no o erence between our options a		there will be no change; later in this IC		
	Infrastructure costs				pated as there will be no change; later e.		
Airport / Air navigation service provider	Operational costs	As this option is already IOA we will estimate the For some approaches, which are currently und substitution to mitigate	this IOA we will estimate the difference between our options and this baseline. As this option is already in operation, there are no operational costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline. For some approaches, Glasgow Airport is dependent on conventional ground based navigation equipment (VORs) which are currently undergoing a rationalisation programme by NATS NERL. Glasgow is currently investigating RNAV substitution to mitigate VOR rationalisation however this is considered an interim measure and failure to implement a long term solution may result in additional operational costs.				
	Deployment costs	As this option is already in operation, there are no deployment costs anticipated as there will be no change; later in this IOA we will estimate the difference between our options and this baseline.					
All	Safety	could however result in		kload for Air Traffic Cont	ements at Glasgow. Future traffic grow rollers and pilots, which may lead to traf order to maintain safety.		
All	Interdependencie s, conflicts and tradeoffs		t in constraining some of Glas relocation of the LANAK hold		otions as well as some of NERL's optio		
All	AMS	CAP1711 describes the Deliver quicker, quieter UK airspace.		ore capacity for the ben	efit of those who use and are affected		
	AIVIO						

4.24. Runway 05 Arrival Option A

Runway 05 Ea	asterly Arrivals Optic	n A
		PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would route from the south, which would also join the final approach at around 11nm, and would be used by 15% of overall arrivals.
		the stimated % of overall arrivals 2019 baseline average summer day overflight overall arrivals 2019 baseline average summer day overall arrivals 2019 baseline average summer day overall arrivals 2019 baseline average summer day overall arrivals
Communitie s	Noise impact on health and quality of life	 Figure 35 Easterly Arrivals Option A Overflight and 2019 baseline NTK data Route from the North This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map shows these areas are not heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would ther turn and fly south-east; this part of the route again overflies new areas however these are not heavily populated with the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would then join the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach over the same areas as they do today. Route from the South The route from the south would see aircraft start a continuous descent from 7000ft starting from around Whiteleer Forest. Aircraft would then joining the final approach at around 11nm. This largely avoids dense areas of population with the exception of the southern parts of Fenwick. The NTK heatmap in figure 35 shows that this route remains south of the existing areas of concentration however by doing so, it avoids the densely populated area of Stewarton. Aircraft hen join the final approach at around 11nm. This join occurs earlier than the NTK data shows the majority of aircraft join today, but in doing so, aircraft are aligned on final approach when overflying Beith, whereas at present, there is a concentration of aircraft that route over Beith when joining final approach. Be

areas as they do today.

Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 108 Easterly arrivals option A overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option A	174.72	21006

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline data.

		There is a significant decr none of the data considers in number of buildings ov something that will be expl The full data tables and c appendix A.	the frequ verflown, t ored furth	ency of overfligh hose that are over er as part of the S	t; although conce verflown will like Stage 3 full option	entrated PBN ly be at a hig ns appraisal a	flight paths v gher frequen nalysis shou	vill result in a reducy cy than today. T Id this option proc	luction This is gress
		60dB and 65dB L_{AMax} Technical Appendix A inclu These 60dB contours are a The data, as shown in tabl L _{AMax} contours remain the	an indicato e 109 sho	or of the N60 met ws a decrease in	rics which will be the area and po	e quantified at pulation within	the Stage 3	Full Options App	raisal
		Table 109 60dB L _{AMax} Data –	Rwy05 Ar	rival Option A					
				60dB	L _{AMax}				
		System		Area (km²)	Populatio	n			
		RWY05 Baseline (Centreline Optioneering tool)	-	56.96	34798				
		RWY 05 Arr Option A		52.74	27292				
		L _{Aeq} The south-west componer Option A sees turns onto t of the L _{Aeq} contours.							
	Air Quality	This option has no change to how aircraft fly below 1,000ft compared to the baseline and so there are no antic changes to local air quality (positive or negative) as a result of this airspace design option.							ipate
	Greenhouse gas impact	Our fuel burn assessment to the baseline. We there explored in further detail in	fore expe	ct to see a corr	esponding incre	ase to green	house gas e		
		Use of PBN transitions alc less accurate final approa			-	-	olding would	increase as a res	sult o
	Capacity / resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will o precision approach and NDB and visual non precision approaches available.							
		Table 110 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:							
		Table 110 Easterly arrival A – Tranquil areas overflown 0-7000ft							
Wider Society		System	NSA cou	Int NSA area	National	National	DQA coun	t DQA area	
	Tranquillity	RWY 05 Baseline Vectoring (NTK data)	0	0	Parks count 0	Parks area 0	0	0	
		RWY 05 Baseline (Centreline - Optioneering tool)	0	0	0	0	0	0	
		Runway 05 Option A	0	0	0	0	0	0	
		The data shows that there will be no change in areas of tranquillity overflown – all areas will be avoided as they are today.							
	Biodiversity	The routes that form part of Arrival Option A join the final approach at 11nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.							
General Aviation	Access	The design option may red contained within ScTMA 5 the route closer to final ap PBN route in its existing p	in accord proach in	ance with the CA	A CAS containm	ent policy. Th	is could be n	nitigated by positi	ionin
	Economic impact from increased effective capacity	Use of PBN transitions alcord less accurate final approace							
		We estimate that Option A when compared to baseline nominal centrelines, will result in a small overall increase in track mileage.							
		Track Mileage				Track r	niloo (Moi	abtod 15%	
		Option		Track miles (nn	n)	(South), 2019 mod	3% (North	ghted 15%) based on	
General Aviation /		Baseline (centreline) Runway 05 Arrival Op	tion A	50 57.5		428.4 492.9	428.4 492.9		
Commercial airlines	Fuel burn	This increase in driven la compared to today in orde A. The southern route also approach at around 11nm	er to avoid o takes a	noise sensitive slonger path to av	sites. This can b oid some popula	e seen in the ated areas an	maps shown	in technical app	bendi
		All arrival options have be airspace above 7000ft).	en design	ed to continuous	ly descend from	7000ft (subje	ect to the NA	TS NERL ACP fo	or th
		As part of Stage 3, should review whether we can ba to understand the impacts CO_2 and noise.	lance nois	se and CO2 on the	he northern rout	e. We will also	o quantify fu	el burn in further	deta

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This easterly arrival option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁴⁷ .
provider	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and trade-offs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

⁴⁷ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.25. Runway 05 Arrival Option B

Runway 05 Ea	sterly Arrivals Optio	n B	
		PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the so approximately 10nm. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.	outh at
Group	Impact	Qualitative Assessment	
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise dat qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final appro around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would rout the south, which would join the final approach at around 10nm, and would be used by 15% of overall arrivals.	bach at
		Option Overfi Contours (Bla with estimate overall arriva	ack outline ed % of
		<figure></figure>	
Communitie s	Noise impact on health and quality of life	Figure 36 Easterly Arrivals Option B Overflight and 2019 baseline NTK data Foute from the North This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part route overflies areas not typically overflown by arrivals today. The population heat map shows these areas a heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would turn and fly south-east; this part of the route again overflies new areas however these are not heavily populate the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approver the same areas as they do today.	are not Id then ed with en join
		Route from the South The route from the south would see aircraft start a continuous descent from 7000ft starting from around WI Forest. Aircraft would then route slightly west, overflying Fenwick and Waterside but largely avoiding Kilmarnov Stewarton, before turning to the north-west, avoiding Dalry, and then joining the final approach at around 10nr NTK heatmap in figure 36 shows that this route remains south of most of the existing areas of concentration ho by doing so, it avoids the densely populated area of Stewarton. Aircraft then join the final approach at around This join occurs slightly earlier than the NTK data shows the majority of aircraft join today, but in doing so, aircr aligned on final approach when overflying Beith, whereas at present, there is a concentration of aircraft that rout Beith when joining final approach. Beyond this point, aircraft overfly the same areas as they do today.	ck and m. The owever 10nm. raft are

Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 111 Easterly arrivals option B overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option B	176.02	21242

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline data. There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction

		in number of buildings overfl	own, those that are o	verflown will likely	be at a hink	ner frequency	than today. This i		
		something that will be explored The full data tables and coun appendix A.	d further as part of the	Stage 3 full options	appraisal an	alysis should t	his option progress		
		60dB and 65dB L_{AMax} Technical Appendix A includes These 60dB contours are an in The data, as shown in table 17 L _{AMax} contours remain the sam	ndicator of the N60 me 12 shows a decrease ir	trics which will be on the area and pop	quantified at t	he Stage 3 Fu	II Options Appraisa		
		Table 112 60dB L _{AMax} Data - Rwy							
			60dI	B L _{AMax}					
		System	Area (km²)	Population					
		RWY05 Baseline (Centreline – Optioneering tool)	56.96	34798					
		RWY 05 Arr Option B	53.79	27446					
		L_{Aeq} The south-west component of Option B sees turns onto fina shape or size of the L_{Aeq} conto	al approach at 11nm a						
	Air Quality	This option has no change to changes to local air quality (po					e are no anticipate		
	Greenhouse gas impact	Our fuel burn assessment (se to the baseline. We therefore explored in further detail in the	e expect to see a cor	responding increa	se to greenh	ouse gas emi			
	Canacity	Use of PBN transitions alone less accurate final approach s				lding would ind	crease as a result o		
	Capacity / resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.							
	Tranquillity	Table 113 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:							
Vider		Table 113 Easterly arrival B – Tranquil areas overflown 0-7000ft							
Society		System N	SA count NSA are	a National Parks count	National Parks area	DQA count	DQA area		
		RWY 05 Baseline - Vectoring (NTK data) RWY 05	0 0	0	0	0	0		
		Baseline (Centreline – Optioneering tool)	0 0	0	0	0	0		
		Runway 05 Option B	0 0	0	0	0	0		
		The data shows that there will be no change in areas of tranquillity overflown – all areas will be avoided as they are today.							
	Biodiversity	The routes that form part of Arrival Option B join the final approach at 11nm and 10nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before landing, this option is not expected to have an impact on biodiversity or present a change from the baseline.							
General Aviation	Access	The design option may require quite be contained within ScT positioning the route slightly cl people than the PBN route in	MA 5 in accordance work of the final approach in the final approac	vith the CAA CAS	containment	policy. This co	ould be mitigated b		
	Economic impact from increased effective capacity	Use of PBN transitions alone less accurate final approach s							
		We estimate that Option B when compared to baseline nominal centrelines, will result in a small overall increase in track mileage.							
		Track Mileage			Track m	iles (Weigh	ted 15%		
		Option	Track miles (n	m)		3% (North)			
Seneral Aviation /		Baseline (centreline) Runway 05 arrival option	50 B <mark>56.3</mark>		428.4 474.9				
Commercial airlines	Fuel burn	Runway 05 arrival option B 56.3 474.9 This increase in driven largely by the northern arrival route, which takes a less direct route to join final approach compared to today in order to avoid noise sensitive sites. This can be seen in the maps shown in technical appendix A. The southern route also takes a longer path to avoid some populated areas and noise sensitive sites; it joins final approach at around 10nm which is further than most arrivals typically join today.							
		All arrival options have been a airspace above 7000ft).	designed to continuou	sly descend from 7	7000ft (subjed	ct to the NATS	S NERL ACP for th		
		As part of Stage 3, should this review whether we can balance to understand the impacts of the CO_2 and noise.	ce noise and CO2 on t	the northern route.	We will also	quantify fuel b	ourn in further deta		

airlines		their procedures accordingly and undertake training if required. This easterly arrival option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁴⁸ ;
p. e nuel	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and tradeoffs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

⁴⁸ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.26. Runway 05 Arrival Option C

Runway 05 Ea	sterly Arrivals Optio	n C	
		PBN arrivals from the north and south both joining final approach at approximately 11nm from the runway. Slig different track to Option A above 5000ft. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.	jhtly
Group	Impact	Qualitative Assessment	
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data a qualitative assessment has considered this modal split with daily movements averaged across the year. This option would see two PBN arrival routes. The first would route from the north, which would join final approach around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would route first would have be used by around 11nm, and would be used by 15% of overall arrivals. Southerly route option differs slightly from option A above 5000ft.	h at from
		Contrast (Black or versit) is the stimated of versities of the stimated of	outline) of erage
Communitie s	Noise impact on health and quality of life	 Figure 37 Easterly Arrivals Option C Overflight and 2019 baseline NTK data Foute from the North This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part of route overflies areas not typically overflown by arrivals today. The population heat map shows these areas are heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would the turn and fly south-east; this part of the route again overflies new areas however these are not heavily populated to the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would then the final approach at 11nm avoiding all but the very southern part of Kilibirinie. Aircraft would then fly the final approach at 11nm avoiding Kilmarnock and Stewarton, before turning to the north-west, avoiding Da and then joining the final approach at around 11nm. This avoids dense areas of population with the exception Fenwick. The NTK heatmap in figure 37 shows that this route remains south of the existing areas of concentra however by doing so, it avoids the densely populated area of Stewarton. Aircraft then join the final approach at around 11nm. This avoids dense areas as they do today. Overflight Data 	Hill. alry, n of ation bund t are

Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 114 Easterly arrivals option C overflight data

System	Area (km²)	Population
RWY 05 Baseline (Vectoring)	691.95	140596
RWY 05 Baseline (Centreline)	182.63	51256
RWY 05 Option C	174.44	21211

Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in the number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline data. There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this stage none of the data considers the frequency of overflight; although concentrated PBN flight paths will result in a reduction

		in number of buildings ove something that will be explo The full data tables and co	red further as	part of the Sta	age 3 full option	s appraisal ar	nalysis should	this option progress	
		60dB and 65dB L_{AMax} Technical Appendix A includ These 60dB contours are an The data, as shown in table L _{AMax} contours remain the si	des 60dB and n indicator of t 115 shows a	65dB L _{AMax} co he N60 metric decrease in th	ntours which co cs which will be ne area and pop	mpare Option	n C against the the Stage 3 Fu	centreline baseline Il Options Appraisal	
		Table 115 60dB L _{AMax} Data – F							
				60dB L					
		System	Area		Population				
		RWY05 Baseline (Centreline Optioneering tool)		.96	34798				
		RWY 05 Dep Option C	52	.74	27292				
		L _{Aeq} The south-west component Option C sees turns onto fir of the L _{Aeq} contours.							
	Air Quality	This option has no change changes to local air quality						e are no anticipated	
	Greenhouse gas impact	Our fuel burn assessment (to the baseline. We therefore explored in further detail in	see below) ha	see a corres	that Option C w	vill have a sm se to greenh	all increase in ouse gas emi		
	Capacity /	Use of PBN transitions alor less accurate final approact					Iding would inc	crease as a result o	
	resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the N part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only h precision approach and NDB and visual non precision approaches available.							
		Table 116 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and the centreline baseline:							
Wider	Tranquillity	Table 116 Easterly arrival C – Tranquil areas overflown 0-7000ft							
Society			NSA count	NSA area	National Parks count	National Parks area	DQA count	DQA area	
		RWY 05 Baseline - Vectoring (NTK data)	0	0	0	0	0	0	
		RWY 05 Baseline (Centreline – Optioneering tool)	0	0	0	0	0	0	
		Runway 05 Option C	0 will be no cha	0 Inge in areas	0 of tranguillity ov	0 /erflown – all	0 areas will be	0 avoided as they are	
	Biodiversity	The data shows that there will be no change in areas of tranquillity overflown – all areas will be avoided as they are today. The routes that form part of Arrival Option C join the final approach at 11nm. As impacts to biodiversity are typically associated with changes below 1640ft, which when flying a standard 3 degree approach occur at around 5nm before							
		landing, this option is not ex The design option may requ	uire changes t	o the existing	CAS boundarie	s. The arriva	l routes as illus	strated would not be	
General Aviation	Access	contained within ScTMA 5 in the route closer to final app PBN route in its existing po	oroach in line v						
	Economic impact from increased effective capacity	Use of PBN transitions alon less accurate final approact							
		We estimate that Option C track mileage.	when compa	red to baselin	e nominal cent	relines, will re	esult in a smal	l overall increase ir	
		Track Mileage				Track m	Track miles (Weighted 15%		
		Option	Trac	k miles (nm)		(South), 2019 mod	3% (North) al split)	based on	
General		Baseline (centreline) C	50 57.8			428.4 497.4			
Aviation / Commercial airlines	Fuel burn	C57.8497.4This increase in largely driven by the northern arrival route, which takes a less direct route to join final approach compared to today in order to avoid noise sensitive sites. This can be seen in the maps shown in technical appendix A. The southern route also takes a longer path to avoid some populated areas and noise sensitive sites; it joins final approach at around 11nm which is further than most arrivals typically join today. Compared to Option A, which also joins at 11nm, this route is slightly longer when considering connectivity with the network, due to the positioning of the 7000ft point.							
		All arrival options have bee airspace above 7000ft).	n designed to	continuously	descend from	7000ft (subje	ct to the NATS	S NERL ACP for the	
		As part of Stage 3, should review whether we can bala to understand the impacts of CO_2 and noise.	ance noise an	d CO2 on the	northern route	We will also	quantify fuel l	ourn in further detai	

Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This easterly arrival option is not anticipated to require any additional training costs for airlines.
	Other costs	No other airline costs are foreseen.
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁴⁹ ;
provider	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and tradeoffs have been identified with other sponsors' ACPs below 7000ft.
All	AMS	CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative effects include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of all arrivals into just 2 arrival routes to each runway.

⁴⁹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.27. Runway 05 Arrival Option D

Runway 05 Ea	sterly Arrivals Optic	on D
		PBN arrivals from the north joining final approach at approximately 11nm from the runway and from the south at approximately 10nm. Slightly different track to Option B above 5000ft For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Croup	Impost	
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year.
		This option would see two PBN arrival routes. The first would route from the north, which would join final approach at around 11nm from the runway, and be used by around 3% of overall arrivals at Glasgow. The second would route from the south, which would join the final approach at around 10nm, and would be used by 15% of overall arrivals.
		Option Overflight Contours (Black outline with estimated % of overall arrivals
		219 baseline average summer day overflight soarthe: 1 22
		Figure 38 Easterly Arrivals Option D Overflight and 2019 baseline NTK data
Communitie s	Noise impact on health and quality of life	Route from the North This route would see aircraft continuously descending from 7000ft starting from around Levan. The initial part of the route overflies areas not typically overflown by arrivals today. The population heat map shows these areas are not heavily populated however there is some overflight at higher altitudes of Inverkip and Wemyss Bay. Aircraft would then turn and fly south-east; this part of the route again overflies new areas however these are not heavily populated with the exception of the north eastern part of Largs which is just captured by the overflight contour. Aircraft would then join the final approach at 11nm avoiding all but the very southern part of Kilbirinie. Aircraft would then fly the final approach over the same areas as they do today.
		Route from the South The route from the south would see aircraft start a continuous descent from 7000ft starting from around Whitelee Forest. Aircraft would then route west, overflying Fenwick and Waterside and the very southern parts of Stewaton, but avoiding Kilmarnock, before turning to the north-west, avoiding Dalry, and then joining the final approach at around 10nm. The NTK heatmap in figure 38 shows that the initial part of this route aligns with some existing concentration however then heads slightly further west than the concentration seen today. In doing so, the route avoids the densely populated area of Stewarton. Aircraft then join the final approach at around 10nm. This join occurs slightly earlier than the NTK data shows the majority of aircraft join today, but in doing so, aircraft are aligned on final approach when overflying Beith, whereas at present, there is a concentration of aircraft that route over Beith when joining final

Overflight Data

The technical appendix to this document includes a baseline image which shows a PBN centreline created using concentration information from the NTK data. There is also data based on the NTK data which, although is not modelled in the same way as the centreline data, does provide a preliminary means of comparison between the baseline and the airspace change options.

overflying Beith, whereas at present, there is a concentration of aircraft that route over Beith when joining final

Against the NTK baseline vectoring data, there is a decrease in population overflown between 0-7000ft however the option will result in some population being overflown more frequently, which is not articulated in the data tables at this stage of the process. When comparing against the baseline centreline data, there is also a decrease in the area of the contours and the number of population overflown.

Table 117 Easterly arrivals option D overflight data

System	Area (km²)	Population	
RWY 05 Baseline (Vectoring)	691.95	140596	
RWY 05 Baseline (Centreline)	182.63	51256	
RWY 05 Option D	176.01	21379	
Data on the number of noise sensitive buildings (schools, hospitals and places of worship) shows a decrease in t number of schools, care homes, hospitals and places of worship overflown compared to the centreline baseline da There is a significant decrease compared to the vectoring data in all areas, but it's important to note that at this sta			

approach. Beyond this point, aircraft overfly the same areas as they do today.

		none of the data considers in number of buildings ov something that will be expl The full data tables and co appendix A.	erflown, the ored further	ose that are over as part of the Sta	rflown will likely age 3 full options	be at a higl appraisal an	ner frequency alysis should t	than today. This his option progres	
		60dB and 65dB L _{AMax} Technical Appendix A includes 60dB and 65dB L _{AMax} contours which compare Option D against the centreline These 60dB contours are an indicator of the N60 metrics which will be quantified at the Stage 3 Full Options A The data, as shown in table 118 shows a decrease in the area and population within the 60dB L _{AMax} contour. T L _{AMax} contours remain the same between the baseline and this option.							
		Table 118 60dB L _{AMax} Data –	Rwy05 Arriv	al Option D					
				60dB L	AMax				
		System	Ar	ea (km²)	Population				
		RWY05 Baseline (Centreline Optioneering tool)	-	56.96	34798				
		RWY 05 Dep Option D		53.88	27446				
		L _{Aeq} The south-west componer Option D sees turns onto shape or size of the L _{Aeq} co	final approa						
	Air Quality	This option has no change changes to local air quality						e are no anticipat	
	Greenhouse gas impact	Our fuel burn assessment to the baseline. We there explored in further detail in	fore expect	to see a corres	ponding increas	e to greenh	ouse gas emi		
	Capacity / resilience	Use of PBN transitions alone is likely to reduce capacity as airborne and ground holding would increase as a result of less accurate final approach spacing meaning lower runway utilisation. The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS							
		precision approach and NDB and visual non precision approaches available. Table 119 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and centrel baseline.							
Wider		Table 119 Easterly arrival D – Tranquil areas overflown 0-7000ft							
Society	Tranquillity	System RWY 05 Baseline -	NSA cou			National Parks area	DQA count	DQA area	
		Vectoring (NTK data) RWY 05	0	0	0	0	0	0	
		Baseline (Centreline – Optioneering tool) Runway 05 Option D	0	0	0	0	0	0	
		The data shows that there will be no change in areas of tranquillity overflown – all areas would be avoided today.							
	Biodiversity	The routes that form part of typically associated with che before landing, this option	nanges belo	w 1640ft, which w	when flying a star	ndard 3 degr	ee approach c	occur at around 5n	
General Aviation	Access	The design option may re quite be contained within s positioning the route slight people than the PBN route	ScTMA 5 in y closer to f	accordance with nal approach in li	the CAA CAS o	ontainment	policy. This co	ould be mitigated	
	Economic impact from increased effective capacity	Use of PBN transitions alo less accurate final approact							
		We estimate that Option E track mileage.) when com	pared to baselin	e nominal centre	elines, will re	esult in a smal	overall increase	
		Track Mileage				b er			
		Option	т	rack miles (nm)			iles (Weigh 3% (North) ∣ al split)		
General Aviation /		Baseline (centreline) D	5 5	0 6.5		428.4 477.9			
Commercial airlines	Fuel burn	This increase in largely d compared to today in orde A. The southern route also approach at around 10nm joins at 10nm, this route is 7000ft point.	r to avoid n takes a lo which is fu	oise sensitive siten nger path to avoin rther than most a	es. This can be s d some populate arrivals typically j	seen in the r d areas and oin today. C	naps shown in I noise sensitiv Compared to C	technical append ve sites; it joins fin option B, which als	
		All arrival options have be airspace above 7000ft).	en designed	d to continuously	descend from 7	000ft (subjed	ct to the NATS	NERL ACP for th	
		As part of Stage 3, should review whether we can ba to understand the impacts	lance noise	and CO2 on the	northern route.	We will also	quantify fuel b	ourn in further det	

		CO ₂ and noise.				
Commercial airlines	Training costs	Flight procedures are updated or introduced worldwide as part of an AIRAC cycle. As part of this cycle, airlines update their procedures accordingly and undertake training if required. This easterly arrival option is not anticipated to require any additional training costs for airlines.				
	Other costs	No other airline costs are foreseen.				
	Infrastructure costs	The initial deployment phase of the ACP may require some ATC system engineering amendments however beyond this there are not expected to be any changes to infrastructure for the airport or the ANSP.				
Airport / Air navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables VOR rationalisation ⁵⁰ ;				
P . .	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.				
All	Safety	There is nothing unsafe with PBN arrival transitions to final approach and it would be preferable from an airline perspective owing to lower pilot workload and improved CDA performance. However, industry currently lacks the ability to deliver accurate final approach spacing using PBN alone in an environment, such as Glasgow, with a varied fleet mix and variable runway spacing requirements. As a result it would lead to increased delays and increased workload for pilots and crews to manage routine stack holding.				
All	Interdependencies , conflicts and tradeoffs	No interdependencies, conflicts and tradeoffs have been identified with other sponsors' ACPs below 7000ft.				
All	AMS CAP1711 describes the objective as: This option would modernise the airspace by introducing PBN as required by the AMS. However the negative of include increased delay, reduced economic benefit, increased CO2 emissions and increased concentration of arrivals into just 2 arrival routes to each runway.					

⁵⁰ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

4.28. Runway 05 Arrival Vectors only

Runway 05 Easterly Arrivals Vecto	ors only
Note: Image shows existing vectoring swathe. Visualisation of option to be developed at Stage 3 once further information around airspace above 7000ft is known alongside more information about departures and CAS arrangements.	 Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. The former, because it is difficult for ATC to deliver accurate final approach spacing to varying runway spacing requirements using PBN only and they can often require more Controlled Airspace than is required by vectoring. The latter because they can often result in longer final approach joining points than vectoring caters for and, in the case of Glasgow would see c.85% of all Easterly arrivals on a single path. Communities can sometimes favour the 'spreading' of arrivals through vectoring to mitigate against potential adverse effects of concentration. This option would see all arrivals continuing to be vectored with no PBN paths available for routine use. Any change to the departures, controlled airspace arrangements and ScTMA network design is likely to result in a change to vectoring practices therefore this option is currently different to a 'Do Nothing' option for arrivals. However, what that change is not possible to determine yet so there is not an illustration for this option. For the Design Principle Evaluation and Initial Options Appraisal we will assume similar impacts as the baseline however, for the Full Options Appraisal in Stage 3 we will need to determine what these changes would result in and analyse the impacts. It is more likely that the differences between this option and the baseline options will be at altitudes of c.5-7000ft with more negligible changes below c.5000ft. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group Impact	Qualitative Assessment
	Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. In this vectoring option, aircraft arriving at Glasgow would continue to be tactically controlled (vectored) by ATC before joining final approach. Today aircraft typically join the runway 05 final approach between 8nm and 11nm before landing although when undertaking an ILS approach they can be as close as 6nm. This option would continue to see aircraft joining the final approach at these distances, although there is a possibility that this could be influenced by changes to the airspace above 7000ft and departures – this will be explored in further detail at Stage 3 should this option progress. Unlike PBN routes, tactical controlling of aircraft typically leads to higher levels of dispersion of flights and therefore sharing of the noise. The NTK data shown in figure 39, demonstrates the large swathe of overflight created by today's vectoring. It shows that there are wide areas to the south of the airport , and some areas to the north, that are overflown between 1-10 times per day on average including Darvel, Newmilns, Galston, Kilmarnock, Kilmaurs, Dunlop, Kilwinning, Dalry, and Kilbirnie. There is some concentration which occurs from a south-easterly direction, before aircraft join the final approach which overflies Fenwick, Stewarton and Beith:
Communities Noise impact on health and quality of life	Figure 39 Runway 05 Arrival Vectoring Swathe 2019 The vectoring swathe as seen in Figure 39 is influenced by how aircraft arrive from the airspace above 7000ft, how

For the purposes of this IOA, we will use the baseline data as the closest representative data for this option. The technical appendix includes NTK and centreline data for the baseline. It's important to note that the NTK data is not

modelled in the same way as the other data, however it does provide a preliminary means of comparison between this baseline and the airspace change options.

Table 120 below includes data based on the NTK heat map as shown in figure 39 above:

Table 120 Easterly arrivals baseline overflight data 0-7000ft

System	System				Population		
RWY 05 Arrivals Baseline - Vectoring (NTK data)			691.95	95 140596			
In addition to po hospitals and pla System	aces of wors		ave data on the overflig Hospitals count			Places of worshi	
RWY 05 (Vectoring)	Baseline		0	32		count 77	
Although the da			noise sensitive building er owing to the dispers				

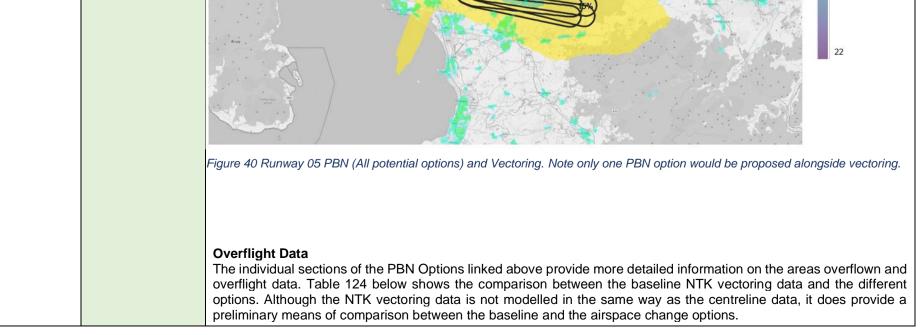
		will explore in further detail at	Stage 3.						
		60dB and 65dB L _{AMax} Technical Appendix A includes 60dB L _{AMax} contours and data for the baseline, to aid comparison between the and the options. Similar to the overflight data above, the population within the 60dB LAMax contours is high the baseline, however this data does not currently take into account the full vectored swathe, as it is mode centreline data. It also does not articulate the frequency of overflight which would be lower for some areas of to equivalent PBN routes. We will explore this in further detail a Stage 3 should the option progress. The 65d contours extend partially along the extended runway centreline and are expected to remain the same be options.							
		Table 121 Easterly arrivals base	line L _{AMax} data	1					
			60dB L _{AMax}						
		System	Area ((km²)	Population				
		RWY 05 Arrivals Baseline (Centreline · Optioneering tool)	- 56.5	96	34798				
		L _{Aeq} The south-west component of option is expected to see airc We therefore do not expect th	raft continue	to join final a	pproach as they	do today whi	ch typically or		
	Air Quality	This option has no change to changes to local air quality (p						e are no anticipated	
	Greenhouse gas impact	Our fuel burn assessment (se compared to the baseline. V explored in further detail in th	Ve therefore	expect neut	ral benefit/impac	t to greenho	use gas emis		
	Capacity /	This option would be expect today's airspace through vect potential changes to the vector	toring could I	be expected	to be delivered th	nrough vecto	ring in the futu		
	resilience	Vectoring only would not improve Glasgow Airport's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.							
Wider Society		Table 122 shows data on the overflight of areas of tranquillity based on the NTK vectoring baseline and t baseline. For the purposes of this IOA we have assumed the vectoring swathe to be similar today how this option progress, at Stage 3 we will refine it further and undertake further analysis on the impacts to t							
	Tranquillity	Table 122 Easterly arrival vectors only – Tranquil areas overflown 0-7000ft							
		System N	ISA count	NSA area	National Parks count	National Parks area	DQA count	DQA area	
		RWY 05 Baseline - Vectoring (NTK data) Runway 05 Baseline	0	0	0	0	0	0	
		Centreline	0	0	0	0	0	0	
	Biodiversity	This option is unlikely to char are typically associated with o 5nm before landing, this optio	changes belo	ow 1640ft, wh	nich when flying a	standard 3 o	degree approa	ach occur at around	
General Aviation	Access	This option can be contained result of enabling changes the				tunity to redu	ice the total v	olume of CAS as a	
	Economic impact from increased effective capacity	This option would be expect today's airspace through vect potential changes to the vector	toring could I	be expected	to be delivered th	nrough vecto	ring in the futu		
General Aviation /		Table 123 provides baseline centreline data for easterly arrivals. For the purposes of this IOA we have assumed the vectoring swathe to be similar today however, should this option progress, at Stage 3 we will refine it further and undertake further analysis on the benefits and impacts to fuel burn.							
Commercial airlines	Fuel burn	Table 123 Easterly Arrival Track	Mileage						
	rueibuin	Track Mileage Option	Track miles	(nm)	Track mile 69% (South)				
			50	()	based on 20 428.4				
Commercial	Training costs	Flight procedures are updated their procedures accordingly any additional training costs f	and undertak						
airlines	Other costs	any additional training costs for airlines. No other airline costs are foreseen.							
	Infrastructure costs	The initial deployment phase this there are not expected to						ts however beyond	
Airport / Air navigation service provider	Operational costs	This airspace change propos PBN approaches provides an is the potential for the existing ground based navigation equ VOR rationalisation ⁵¹ ;	alternative a VOR approa	pproach proc aches to be re	cedure alongside emoved which rec	the current II duces Glasgo	S approache	s. This means there ncy on conventiona	
PIOTINEI	Deployment costs	This option is expected to re Prestwick and Glasgow Airpo 3 Full Options Appraisal when the network above 7000ft and	ort. The scale n we are app	e and nature or aising our s	of this training re shortlist of options	quires furthe	r exploration a	as part of the Stage	

⁵¹ Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

All	SafetyATC advised that with any option which sees a RWY 05 wrap around SID that needs to outclimb arrivals to R a PBN waypoint to direct RWY 05 arrivals to would be preferable to help them ensure separation. This would available in a vectoring only option. No other safety concerns have been identified at this stage.			
All	Interdependencies, conflicts and tradeoffs	To accommodate a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05 may also require a relocation of the LANAK hold in the network. This could slightly change the vectoring swathe to Runway 05 but most likely above 5/6000ft. There are not expected to be tradeoffs between arrivals below 7000ft and NERL or Edinburgh's options.		
AII	AMS	CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. Vectoring of arrivals in the future would not deliver a PBN arrival solution, nor reduce the numbers of people overflown / affected by noise from Glasgow's arrivals. However it is unlikely to change the adverse effects which would be measured within the LOAEL which would not extend out to the final approach joining point. Conversely a PBN arrival to RWY 05 in the lowest areas of population would require additional CAS to ensure CAS containment therefore a vectoring solution may be preferable from a CAS perspective. This option would meet future demand however it may not be the best future-proofed option should technological enhancements become available in the future to better rely on a pure PBN arrival solution if desired by Glasgow and its stakeholders.		

4.29. Runway 05 Arrival Vectors and PBN hybrid

Runway 05 Ea	asterly Arrivals Vect	ors and PBN hybrid
overflight conto Visualisation developed at shortlist is kr	athe alongside the burs for Options A-D. of option to be Stage 3 once PBN nown and there is prmation around	 Whilst PBN arrivals enable systemisation and enhanced CDA performance, they are not always operationally or environmentally optimal. There are however the benefits of PBN for arrivals. In addition, from an operational perspective for RWY 05, due to the interaction of NORBO departures with arrivals, ATC have advised than the option of PBN for arrivals would be extremely desirable. This is because it would provide a Waypoint for use which, when combined with an altitude restriction, could be used to guarantee separation against NORBO departures. This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing. The PBN arrival(s) would likely be the 'best performing' of Options A-D above which are then optimised in Stage 3 to balance CO2, noise impacts and Controlled Airspace containment requirements. The frequency of usage of the PBN route(s) would need to be determined through stakeholder engagement and consultation. For more information, please see our Stage 2A document on the CAA's Airspace Change Portal.
Group	Impact	Qualitative Assessment
		Due to wind direction, easterly operations on runway 05 occur approximately 18% of the year. The noise data and qualitative assessment has considered this modal split with daily movements averaged across the year. This scenario would see the availability of PBN arrivals but with the ability for ATC to still vector arrivals when required to provide the required final approach sequence and spacing. The PBN arrival component could be any of the PBN options already assessed; the option taken forward will depend on the shortlisting as part of this IOA and the outcome of the Stage 3 Full Options Appraisal. Below provide links to the four assessments for the PBN Options: Initial Options Appraisal – Runway 05 Arrival Option A Initial Options Appraisal – Runway 05 Arrival Option D Initial Options Appraisal – Runway 05 Arrival Option D Initial Options Appraisal – Runway 05 Arrival Option D The PBN option assessments linked above have shown that there is the potential for PBN routes to reduce the number of people and noise sensitive sites overflown, however due to the concentration created by PBN routes, areas overflown would likely be at a higher frequency than today. By combining with vectoring, some of this concentration from PBN routes could be mitigated, as some aircraft would continue to be tactically controlled and would therefore see the dispersion that occurs today. This dispersion has been described in the vectoring assessment, the shape/size of the vectoring swathe will be dependent on a number of factors which are yet to be determined including the airspace above 7000ft, the departure options, and the CAS arrangements. We will refine this in further at Stage 3.
Communitie s	Noise impact on health and quality of life	Contours (Black outline with estimated %, of overall arrivals 2019 baseline average summer day overflight swathe: 1



		System	Area	Population	Schools count	Hospitals count	Carehomes count	Places worship		
		RWY05_BASE (Vectoring	601.05	140506			32	count		
				140596	51	0		77		
		RWY05_BAS (Centreline) RWY05_A	182.63 174.72	51256 21006	19 7	2 0	9 5	26 10		
		RWY05_B	176.02	21242	6	0	5	10		
		RWY05_C	174.44	21211	7	0	5	10		
		RWY05_D	176.01	21379	6	0	6	10		
		Overall, the data suggests that the vectoring however these or articulated in the data tables at	options will	result in some						
		This suggests that the combina would mitigate some of the imp routes would mean that when the will be explored in further detail	pacts of conc raffic allowed	centration for the	bse communition	es living under	the PBN routes,	and the PB		
		60dB and 65dB L _{AMax} Technical Appendix A includes At this stage we do not have L _A data shows that the PBN arriva at this stage, this data does not overflight assessment above, b impacts of PBN with some of t further in Stage 3 when this opt	Max data for Is routes res t take into ac by offering a the benefits	the vectoring or ult in a reduction ccount the freque hybrid PBN/vec of vectoring whi	overall N60 m in area and p ency of overflig ctoring option, ch may result	etrics - we will opulation within opulation within ght which would there would be in favourale L _A	the 60dB L _{AMax} likely increase.	Stage 3. Th contour althoug Similar to th comitigate th		
		L _{Aeq} The south-west component of t of the PBN Options and the Ve the LAeq contour and therefore	ectors only o	ption have sugg	ested that the	re will be no im	pact to the shap	e and size o		
	Air Quality	This option has no change to h changes to local air quality (pos	now aircraft f	ily below 1,000ft	compared to	the baseline an	d so there are r			
	Greenhouse gas impact	Our fuel burn assessment (see below) has anticipated this option will have a small increase in fuel burn compared to the baseline. We therefore expect to see a corresponding increase to greenhouse gas emissions. This will be explored in further detail in the Stage 3 Full Options Appraisal should this option progress.								
	Capacity / Option is expected to enhance Glasgow's operational performance in the future. This is because ATC arrivals when traffic levels are low-medium and this will also facilitate the use of combined Tower and A (Radar In Tower) offering additional resilience to ATC resource.									
Wider Society	resilience	The introduction of PBN approaches will improve Glasgow's resilience, as following the decommission of the VORs as part of a NERL UK wide programme under the Airspace Modernisation programme, Glasgow will only have ILS precision approach and NDB and visual non precision approaches available.								
	Tranquillity	This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has shown that all of the options will continue to avoid NSAs, DQAs and National Parks, as they do today. For the purposes of this IOA we have assumed the vectoring swathe to be similar today and therefore this too avoids these areas. We therefore expect there to be no change to overflight of tranquil areas as a result of a hybrid PBN/vectoring scenario.								
	Biodiversity This option is unlikely to change where aircraft join the final approach compared to today. The PBN of the final approach from at 10 or 11nm. As impacts to biodiversity are typically associated with change which when flying a standard 3 degree approach occur at around 5nm before landing, this option is have an impact on biodiversity or present a change from the baseline.						d with changes	below 1640f		
General Aviation	Access	All of the existing PBN arrival options from the South may require changes to CAS boundaries to protect the PBN arrival in accordance with CAA's policy on CAS containment. This could be avoided by positioning a PBN arrival route furth to the East or in the middle of the existing swathe which would avoid any increase in additional CAS although it would result in more people being overflown compared to any of the existing PBN options. Options B and D would require less adjustment to CAS then Options A and C.						I route furthe		
General	Economic impact from increased effective capacity	This option would be expected to cope with future demand. The peak hourly landing rate already experienced in to airspace through vectoring could be expected to be delivered through vectoring in the future and the feature of Pl the solution would best future-proof Glasgow in the case of technological enhancements that may allow for greate of PBN, if desired by Glasgow and its stakeholders.								
Aviation / Commercial airlines	ation / nmercial This option proposes a hybrid of PBN routes and vectoring. Our assessment of the PBN routes has may be increases in track mileage and fuel burn as a result of all of the PBN options. For the purpos						r the purposes of of a hybrid optic therefore be sor PBN arrivals alo d avoid any inc	of this IOA w n would offerne impacts to one. There rease in CC		
Commercial airlines	Training costs	Flight procedures are updated their procedures accordingly ar any additional training costs for	nd undertake							
-	Other costs	No other airline costs are fores	een.							
	Infrastructure	The initial deployment phase of						vever beyor		
Airport / Air	costs	this there are not expected to b		-	•					
navigation service provider	Operational costs	This airspace change proposal is not anticipated to change airport or ANSP operational costs. The implementation of PBN approaches provides an alternative approach procedure alongside the current ILS approaches. This means there is the potential for the existing VOR approaches to be removed which reduces Glasgow's dependency on conventional ground based navigation equipment (VORs). This contributes to a reduction in NERL's operational costs as it enables								

⁵² Glasgow is currently investigating RNAV Substitution to mitigate VOR rationalisation however this is a temporary solution for the interim period before the deployment of the FASI-S

	Deployment costs	This option is expected to require air traffic controller training for the controllers and assistants located at NATS Prestwick and Glasgow Airport. The scale and nature of this training requires further exploration as part of the Stage 3 Full Options Appraisal when we are appraising our shortlist of options and once further information is known about the network above 7000ft and interdependencies with Edinburgh.
All	Safety	ATC advised that with any option which sees a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05, a PBN waypoint to direct RWY 05 arrivals to would be preferable to help them ensure separation. This would be available with this option. No other safety concerns have been identified at this stage.
All	Interdependencies , conflicts and tradeoffs	To accommodate a RWY 05 wrap around SID that needs to outclimb arrivals to RWY 05 may also require a relocation of the LANAK hold in the network. This could slightly change the position of the upper portion of the PBN arrival options to Runway 05 but most likely above 5/6000ft. There are not expected to be tradeoffs between arrivals below 7000ft and NERL or Edinburgh's options.
AII	AMS	 CAP1711 describes the objective as: Deliver quicker, quieter and cleaner journeys and more capacity for the benefit of those who use and are affected by UK airspace. This option is considered to best meet the requirements of the AMS for Easterly arrivals. It introduces a PBN arrival solution without being reliant on it which ensures that demand can be met but allowing improved CDA for arrivals using the PBN structure. The feature of PBN in the solution would best future-proof Glasgow in the case of technological enhancements that may allow for greater use of PBN, if desired by Glasgow's arrivals without concentrating all arrivals permanently onto 2 routes. However it could require additional CAS to contain the arrival routes in accordance with CAA policy.

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5. IOA Summary and Conclusion

The following sections provide an overview of the outcome of the IOA before explaining whether an option has been progressed into Stage 3 and the rationale around this. Within this document, we have identified that further qualitative assessment is required for some categories; details have been included, where applicable, in the full IOA tables and is also summarised in the 'preferred option' section below.

Discounting Methodology

When discounting or progressing an option, each category within the IOA for each option has been reviewed in detail before being summarised as per the categories shown in table 125 below. The summary tables shown in the following sections for each runway mode provide an overview of this categorisation and show how the option has performed overall as part of the IOA when compared against the baseline 'do nothing' scenario.

Table 125 IOA Summary Table Key

IOA Summary	IOA Summary Key						
	Anticipated overall net impacts/costs; the option may have only impacts (negatives compared to the baseline) or may have a mix of benefits and impacts where the impacts outweigh the benefits						
	Neutral; the option either offers neutral benefit or may have a mix of benefits and impacts (some of which may require quantified assessment at Stage 3 should the option progress).						
	Anticipated overall net benefits/costs; the option may have only benefits (positives compared to the baseline) or may have a mix of benefits and impacts where the benefits outweigh the impacts						

We have used the detailed IOA assessment as well as the summary tables as the basis for determining whether to continue or discount an option. In some cases there may be multiple options that perform well against the baseline and in these cases we have also looked at the comparative performance of each option; details of this are included in the conclusion tables below. Alongside this, we have considered the Design Principles developed with stakeholders at Stage 1 as well as the requirement to meet the Airspace Modernisation Strategy (AMS). The threshold for discounting an option cannot be based on quantitative assessments alone but must also come down to the qualitative appraisals and professional judgment, as there are many factors to balance - many of which will not be quantified until the Full Options Appraisal at Stage 3. Therefore, alongside the summary tables shown in the sections below, we have included the rationale for discounting or progressing an option which explains these qualitative elements.

5.1. Runway 23 Westerly Departures

Group	Impact	Option A	Option B	Option C	Option D	Option E
Communities	Noise impact on health and quality of life					
	Air Quality					
	Greenhouse gas impact					
Wider Society	Capacity / resilience53					
	Tranquillity					
	Biodiversity					
General Aviation	Access					
General Aviation / Commercial	Economic impact from increased effective capacity					
airlines	Fuel burn					
Commercial	Training costs					
airlines	Other costs					
Airport / Air	Infrastructure costs					
navigation service	Operational costs					
provider	Deployment costs					
All	Safety					
All Interdependencies, conflicts and trade-offs						
All	All AMS					
Option progressed to	o Stage 3	\checkmark	X	Х	Х	\checkmark

Today, all of Glasgow's SIDs turn at 5nm however in order to deliver CO2 reductions through reduced track mileage and delays, all of Glasgow design options

require SIDs to turn before 5nm which unavoidably means overflying new communities and more people overall. All the options were generated to explore the pros and cons of various configurations alongside their positive and negative effects. The options being taken forward into Stage 3 are those believed to best balance the range of competing environmental and operational requirements for Glasgow and its stakeholders.

⁵³ Option B, C and D capacity summary colour corrected

Option	ls the option being	Rationale
	progressed	
		This option is progressed on the basis of it (along with Option E) best meeting the needs of the airport, airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route.
		It is not the most optimal in CO_2 reductions owing to one of the NORBO tracks being slightly longer than today but it is still expected to offer significant CO_2 reductions overall. It also does not overfly the fewest people compared to other options but that would have resulted in greater frequency of overflight for communities under a single NORBO route.
		It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3.
Runway 23 Departure Option A	Yes	It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO ₂ emissions and cater for future demand throughout the day. By having 2 NORBO SIDs, Glasgow's busiest departure route is split into two which helps mitigate the adverse noise effects of PBN concentration.
		As articulated within the appraisal, the track adjustments on departure followed by another immediate turn could be too technically challenging to achieve but this will be investigated in more detail in Stage 3. If they are a viable feature, the FOA will then help Glasgow to determine if the track adjustments increase or decrease population numbers within the 63db L _{Aeq, 16hr} contour.
		The positioning of the PBN routes within this option are still subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.
		This option is discontinued as it does not meet future demand and is the poorest performing option in terms of noise.
		It would concentrate the initial portion of Glasgow's busiest departure routes (NORBO) over the same populations who would be newly overflown without any mitigation against the adverse noise impacts of PBN concentration before they split into 2 tracks. It would overfly the fewest people as well as performing well in reducing track miles compared to other options but in turn would lead to greater frequency of overflight for those communities under the initial track of the 2 NORBO routes.
Runway 23 Departure Option B	No	In terms of future demand, the configuration of the option means that although it offers capacity improvements compared to the baseline, the use of a single initial tracks for the main NORBO departure SIDs, rather than splitting this traffic immediately as occurs in some other options, could result in increased ground delay in the future. The option performs well in terms of track mileage and CO ₂ however this constraint on capacity could offset some of those gains in track mileage reductions.
		The IOA noise assessment showed that on balance there were overall negative noise impacts when compared to the baseline. When compared to other runway 23 departure options, this option overall performs poorest in terms of noise (as seen in the summary table above).
		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer some benefits in terms of track miles and CAS, there are impacts in terms of noise and meeting future demand. Compared to other options, there was less potential with this option to meet the whole objectives / parameters of the AMS which is a major driver for this ACP.
		This option is discontinued as detailed appraisal, as part of the IOA, has identified significant safety concerns and as a result the options does not meet future demand, and performs comparatively poorly in the noise assessments compared to some options.
		The IOA offered the opportunity to investigate safety concerns raised in the DPE in further detail and the IOA assessed the SID switching feature as being not operationally viable for safety reasons. This is the primary reason this option has not been progressed to Stage 3.
Runway 23 Departure Option C	No	In addition, the IOA noise assessment outlined that this option would concentrate the initial tracks of Glasgow's busiest departure route over the same populations for the majority of the day who would be newly overflown. We attempted to mitigate the overflying of new communities by introducing a SID switching feature but that would have resulted in the same communities (to the south of final approach) being overflown even more than without the SID switch, albeit to the benefits of other communities. Overall, the IOA concluded that there are a mix of benefits and impacts to noise with this option however when we compare these to the benefits and impacts of other options, other options comparatively perform better.
		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has

		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer benefits in terms of CO ₂ and CAS, there are a mix of impacts with noise, and it is not the most effective at meeting future demand.
Runway 23 Departure Option D	No	This option is discontinued as the detailed IOA has identified significant safety concerns, does not meet future demand, and performs comparatively poorly in the noise assessments compared to some options. The IOA offered the opportunity to investigate safety concerns raised in the DPE in further detail and the IOA assessed the SID switching feature as being not operationally viable for safety reasons. This is the primary reason this option has not been progressed to Stage 3. In addition, the IOA noise assessment outlined that, like with Option C, the single shared NORBO track would overfly the same communities the majority of the day without any mitigation against the adverse noise impacts of PBN concentration. With this option those communities are also under final approach and are therefore overflown the majority of the time. The result is this option overflies the most people below 4000ft compared to Options A-E. With regards to future demand, although this option offers improved capacity compared to the baseline, without permanently splitting the NORBO route which accounts for the largest % of Glasgow departures, it does not as effectively meet future demand as other options.

		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer benefits in terms of CO_2 and CAS, there are a mix of impacts with noise, and it is not the most effective at meeting future demand.
		This option is progressed on the basis of it best meeting the needs of the airport, airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating the majority of departure tracks away from final approach and spreading aircraft noise from Glasgow's busiest departure route across two routes. By having 2 NORBO SIDs, Glasgow's busiest departure route is split into two which helps mitigate the noise impacts of PBN concentration.
		It is the most optimal in CO ₂ reductions. The route positioning means it scored 2 nd best in terms of population overflown below 4000ft whilst still splitting NORBO departures across 2 different routes.
Runway 23 Departure Option E	Yes (preferred option)	It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3.
		It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO_2 emissions and cater for future demand throughout the day. It also mitigates the adverse impacts of PBN concentration. One of these NORBO SIDs would continue to fly down final approach but the option would result in a significant reduction in frequency of overflight for those under final approach (outside 1-2nm) compared to today. This NORBO route would also reduce the frequency of overflight for those communities to the north of final approach who may experience increased overflight (compared to today) from the northbound departures.
		The data suggests that the lack of a track adjustment on departure would result in lower population numbers overflown below 4000ft compared to Option A but more granular analysis is required in the FOA.
		The positioning of the PBN routes within this option are still subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.

5.2. Runway 05 Easterly Departures

Group	Impact	Option A	Option B	Option C	Option D	Option E	Option F	Option G	Option H	Option I
Communities	Noise impact on health and quality of life									
	Air Quality									
	Greenhouse gas impact									
Wider Society	Capacity / resilience54									
Wider Society	Tranquillity									
	Biodiversity									
General Aviation	Access									
General Aviation / Commercial	Economic impact from increased effective capacity									
airlines	Fuel burn									
Commercial	Training costs									
airlines	Other costs									
Airport / Air	Infrastructure costs									
navigation service	Operational costs									
provider	Deployment costs									
All	Safety									
All	Interdependencies, conflicts and tradeoffs									
AMS A qualitative (high-level) assessment of how the Design Options perform against the vision and parameters / strategic objectives of the AMS										
Option progres	Х	Х	X	Х	×	X	X	\checkmark	\checkmark	

Today, all of Glasgow's SIDs turn at 5nm however in order to deliver CO₂ reductions through reduced track mileage and delays, all of Glasgow design options require SIDs to turn before 5nm which unavoidably means overflying new communities and more people overall. All the options were generated to explore the pros and cons of various configurations alongside their positive and negative effects. The options being taken forward into Stage 3 are those believed to best balance the range of competing environmental and operational requirements for Glasgow and its stakeholders.

⁵⁴ Option A-G capacity summary colour corrected

Option	Is the option being progressed	Rationale
		This option is discontinued as it does not meet future demand, performs negatively compared to the baseline when considering noise, and has a mixed performance when considering the parameters of the AMS.
		The IOA noise assessment showed that on balance there were overall negative noise impacts when compared to the baseline. It would concentrate Glasgow's busiest departure route without any mitigation against the noise impacts of PBN concentration. This route would also overfly over the same populations who would be newly overflown without any mitigation, albeit areas of relatively low population compared to under the other SIDs. The Southbound SIDs turn earlier than today, overflying new communities but without offering other benefits.
Runway 05 Departure Option	No	The option would have delivered significant CO_2 savings when making a direct comparison of expected track mileage but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
A		In terms of future demand, the configuration of the option means that although it offers capacity improvements compared to the baseline, the use of a single route for the main departure SID, rather than splitting this traffic as occurs in some other options, could result in increased ground delay in the future. The option performs well in terms of track mileage and CO ₂ however this constraint on capacity could offset some of those gains in track mileage reductions.
		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer some benefits in terms of track miles and CAS, there are impacts in terms of noise and meeting future demand. Compared to other options, there was less potential with this option to meet the whole objectives / parameters of the AMS which is a major driver for this ACP.
		This option is discontinued as it does not meet future demand, performs negatively compared to the baseline when considering noise, and has a mixed performance when considering the parameters of the AMS.
		The IOA noise assessment showed that on balance there were overall negative noise impacts when compared to the baseline. It would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown without any mitigation against the impacts of PBN concentration, albeit over areas of relatively low population compared to under the other SIDs.
Runway 05 Departure Option	No	The option would have delivered significant CO_2 savings when making a direct comparison of expected track mileage, but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
В		In terms of future demand, the configuration of the option means that although it offers capacity improvements compared to the baseline, the use of a single route for the main departure SID, rather than splitting this traffic as occurs in some other options, could result in increased ground delay in the future. The option performs well in terms of track mileage and CO_2 however this constraint on capacity could offset some of those gains in track mileage reductions.
		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer some benefits in terms of track miles and CAS, there are impacts in terms of noise and meeting future demand. Compared to other options, there was less potential with this option to meet the whole objectives / parameters of the AMS which is a major driver for this ACP.
	No	This option is discontinued as it does not meet future demand, performs negatively compared to the baseline when considering noise, and has a mixed performance when considering the parameters of the AMS.
		The IOA noise assessment showed that on balance there were overall negative noise impacts when compared to the baseline. It would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown without any mitigation against the impacts of PBN concentration, albeit areas of relatively low population compared to under the other SIDs. The Southbound SIDs turn earlier than today, overflying new communities but without offering other benefits.
Runway 05 Departure Option		The option would have delivered significant CO_2 savings when making a direct comparison of expected track mileage but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
С		In terms of future demand, the configuration of the option means that although it offers capacity improvements compared to the baseline, the use of a single route for the main departure SID, rather than splitting this traffic as occurs in some other options, could result in increased ground delay in the future. The option performs well in terms of track mileage and CO ₂ however this constraint on capacity could offset some of those gains in track mileage reductions.
		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer some benefits in terms of track miles and CAS, there are impacts in terms of noise and meeting future demand. Compared to other options, there was less potential with this option to meet the whole objectives / parameters of the AMS which is a major driver for this ACP.
		This option is discontinued as it does not meet future demand, performs negatively compared to the baseline when considering noise, and has a mixed performance when considering the parameters of the AMS.
		The IOA noise assessment showed that on balance there were overall negative noise impacts when compared to the baseline. It would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown without any mitigation against the impacts of PBN concentration, albeit over areas of relatively low population compared to under the other SIDs.
Runway 05 Departure Option D	No	The option would have delivered significant CO ₂ savings when making a direct comparison of expected track mileage but Options H and I are expected to be more optimal as this option would have penalised the 'low and slow' departures to the North.
		In terms of future demand, the configuration of the option means that although it offers capacity improvements compared to the baseline, the use of a single route for the main departure SID, rather than splitting this traffic as occurs in some other options, could result in increased ground delay in the future. The option performs well in terms of track mileage and CO_2 however this constraint on capacity could offset some of those gains in track mileage reductions.

		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer some benefits in terms of track miles and CAS, there are impacts in terms of noise and meeting future demand. Compared to other options, there was less potential with this option to meet the whole objectives / parameters of the AMS which is a major driver for this ACP.
Runway 05 Departure Option E	No	 This option is discontinued as it does not meet future demand, performs negatively compared to the baseline when considering noise, performs comparatively poorly for CO₂, and has a mixed performance when considering the parameters of the AMS. The IOA noise assessment showed that on balance there were overall negative noise impacts when compared to the baseline. It would concentrate Glasgow's busiest departure route over the same populations who would be newly overflown and this routes over highly populated areas. As all NORBO departures would use one route, there is no mitigation against the impacts of PBN concentration. When compared to the baseline, the option offered CO₂ savings however compared to the other options it was the least optimal in track mileage reductions and subsequent CO₂ savings. In terms of future demand, the configuration of the option means that although it offers capacity improvements compared to the baseline, the use of a single route for the main departure SID, rather than splitting this traffic as occurs in some other options, could result in increased ground delay in the future. This constraint on capacity could offset some of those gains in track mileage reductions.
		When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that whilst it does offer some benefits in terms of track miles and CAS, there are impacts in terms of noise and meeting future demand. Compared to other options, there was less potential with this option to meet the whole objectives / parameters of the AMS which is a major driver for this ACP.
Runway 05 Departure Option F	No	 This option is discontinued as detailed appraisal as part of the IOA has identified significant safety concerns. The option also does not meet future demand, and performs comparatively poorly in the noise and CO₂ assessments compared to some options. The IOA offered the opportunity to investigate safety concerns raised in the DPE in further detail and the IOA assessed the SID switching feature as being not operationally viable for safety reasons. In addition, the IOA noise assessment showed that this option would concentrate Glasgow's busiest departure route over areas of very high population for ½ of the day. This option performed similarly to Option E in terms of CO₂ emissions from track mileage reductions. Whilst the SID switch is assessed as being not operationally viable for safety reasons articulated in the appraisal, it would have also increased CO₂ performance compared to keeping the Period 1 SID as a permanent arrangement. With regards to future demand, although this option offers improved capacity compared to the baseline, without permanently splitting the NORBO route which accounts for the largest % of Glasgow departures, it does not as effectively meet future demand as other options. When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that there are a mix of benefits and impacts and it is not the most effective at meeting future demand.
Runway 05 Departure Option G	No	 This option is discontinued as detailed appraisal as part of the IOA has identified significant safety concerns and as a result does not meet future demand. The option also performs comparatively poorly in the noise and capacity assessments compared to some options. The IOA offered the opportunity to investigate safety concerns raised in the DPE in further detail and the IOA assessed the SID switching feature as being not operationally viable for safety reasons. This is the primary reason this option has not been progressed to Stage 3. In addition, the IOA noise assessment showed that this option would concentrate Glasgow's busiest departure route over extremely dense population for most of the day with high numbers of newly overflown people. It would have resulted in the highest numbers of population overflown 0-4000ft and 0-7000ft although would have delivered the greatest CO₂ reductions based on track length. With regards to future demand, although this option offers improved capacity compared to the baseline, and in the peak periods it splits the NORBO route which will meet future demand more effectively that Options A-F however for the remainder of the day the NORBO departures would operate on one route which has the potential to limit capacity in future. When considering this options' overall performance against the objective and parameters of the AMS, the IOA has concluded that there are a mix of benefits and impacts and other options meet the requirements of the AMS more effectively.
		This option is progressed on the basis of it best meeting the needs of the airport (along with option I), airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating the majority of departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route.

Runway 05 Departure Option H

Yes

It performs very well in terms of CO₂ reductions. The route positioning means it scored similar to Options A-C in terms of overflight below 4000ft but without overflying new population to the south at low altitude but it still splits NORBO departures (Glasgow's busiest departure) across 2 different routes. By having 2 NORBO SIDs, this helps to mitigate the noise impacts of PBN concentration.

It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation (see assessments of Option F and G). However more subtle SID changes could be a potential feature and can be investigated in Stage 3.

As articulated within the appraisal, the track adjustments on departure followed by another immediate turn could be too technically challenging to achieve but this will be investigated in more detail in Stage 3. If they are a viable feature, the FOA will then help Glasgow to determine if the track adjustments increase or decrease population numbers within the 63db $L_{Aeq, 16hr}$ contour.

It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO₂ emissions and caters for future demand throughout the day. One of these NORBO SIDs would continue to fly down final approach but the option would result in a significant reduction in frequency of overflight for those under final approach (outside 1-2nm) compared to today. Half of the NORBO departures routing South would also reduce the frequency

	of overflight for those communities to the north of final approach who may experience increased overflight (compared to today) from the northbound departures. The positioning of the PBN routes within this option are still subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.
Runway 05 Departure Option I	 This option is progressed on the basis of it best meeting the needs of the airport, airlines and the AMS whilst helping mitigate the negative effects of PBN concentration by relocating the majority of departure tracks away from final approach and spreading of aircraft noise from Glasgow's busiest departure route. It performs very well in terms of CO₂ reductions. The route positioning means it scored similar to Options D in terms of overflight below 4000ft but without overflying new population to the south at low altitude but it still splits NORBO departures across 2 different routes. It does not feature SID structures which switch to provide partly predictable respite (runway direction cannot be wholly predictable) but these are considered to introduce unacceptable hazards to the operation. However more subtle SID changes could be a potential feature and can be investigated in Stage 3. It does feature 2 NORBO SIDs available at all times which will reduce ground delay and associated CO₂ emissions and caters for future demand throughout the day. One of these NORBO SIDs would continue to fly down final approach but the option would result in a significant reduction in frequency of overflight for those under final approach (outside 1-2nm) compared to today. Half of the NORBO departures routing South would also reduce the frequency of overflight for those communities to the north of final approach who may experience increased overflight (compared to today) from the northbound departures. The data suggests that the lack of a track adjustment on departure would result in lower population numbers overflown below 4000ft compared to Option H but more granular analysis is required in the FOA. The positioning of the PBN routes within this option are still subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles,

5.3. Runway 23 Westerly Arrivals

Group	Impact	Runway 23 Arrival Option C	Runway 23 Arrival Option D	Runway 23 Arrival Option E	Runway 23 Arrival Vectors only	Runway 23 Arrival Hybrid Vectors and PBN
Communities	Noise impact on health and quality of life					
	Air Quality					
	Greenhouse gas impact					
Wider Society	Capacity / resilience					
Wider Society	Tranquillity					
	Biodiversity					
General Aviation	Access					
General Aviation /	Economic impact from increased effective capacity					
Commercial airlines	Fuel burn					
Commercial airlines	Training costs					
Commercial airlines	Other costs					
Airport / Air	Infrastructure costs					
navigation service	Operational costs					
provider	Deployment costs					
All	Safety					
All	Interdependencies, conflicts and tradeoffs					
A qualitative (high-level) assessment of how the Design Options perform against the vision and parameters / strategic objectives of the AMS						
Option progressed to	o Stage 3	Х	∕*	Х	\checkmark	\checkmark

*As articulated in our Stage 2A document, use of pure PBN for arrivals into Glasgow does not perform well in the Design Principle Evaluation and is not a viable option for Glasgow going forwards. Therefore, this option was discounted in the DPE. However, the option of a mix of PBN and vectoring does come through very favourable. In this scenario, we would want to use the best performing PBN routes so we will take the PBN arrival options (other than the ones discounted above) into the Full Options Appraisal for further assessment to help inform the Hybrid vectors and PBN options.

Option	Is the option being progressed	Rationale
		Overall, when looking at the IOA summary tables, the three PBN options C, D and E perform similarly when compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybrid scenario, we therefore looked at the performance of each of options C, D and E, within the IOA categories to understand if any performed comparatively better than others.
Runway 23 Arrival	No	It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including the technical waypoint configuration of the route (particularly the Final Approach Fix (FAF) positioning) and consideration of safety elements including the known Campsie line ground proximity warning system (GPWS) issues. When considering these elements with the detail available at this stage, the options (C, D and E) are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.
Option C		Next, we looked at the IOA categories where the comparative performance of the options C, D and E varies; these were the noise and CO ₂ /Fuel burn assessments.
		Although this option was the best performing PBN arrival option in terms of CO_2 , it was the poorest performer in terms of population numbers, overflying more than double the number of people at 4000ft and below compared to Option E and over two thirds more people than Option D. Given the small variations in track length and subsequent CO_2 and Fuel burn impacts between Option C and Option D, we therefore determined that Option D's overall performance achieved a better balance between CO_2 performance and noise and therefore we have chosen to discontinue Option C at this stage.
		Overall, when looking at the IOA summary tables, the three PBN options C, D and E perform similarly when compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybrid scenario, we therefore looked at the performance of each of options C, D and E, within the IOA categories to understand if any performed comparatively better than others.
Runway 23 Arrival Option D	No (preferred for Hybrid Vectors and PBN option)	It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including the technical waypoint configuration of the route (particularly the Final Approach Fix (FAF) positioning) and consideration of safety elements including the know Campsie line ground proximity warning system (GPWS) issues. When considering these elements with the detail available at this stage, the options (C, D and E) are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.
		Beyond the above categories, we've looked at the IOA categories where the comparative performance of the options varies; these were the noise and CO2/Fuel burn assessments.
		Option D overflies considerable fewer population numbers than Option C 0-4000ft and 0-7000ft with much better CO_2 performance compared to Option E. We therefore concluded that it achieved a good compromise between these two elements and would be most appropriate to take forward to be optimised in Stage 3.
	No	Overall, when looking at the IOA summary tables, the three PBN options C, D and E perform similarly when compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybrid scenario, we therefore looked at the performance of each of options C, D and E, within the IOA categories to understand if any performed comparatively better than others.
Runway 23 Arrival		It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including the technical waypoint configuration of the route (particularly the Final Approach Fix (FAF) positioning) and consideration of safety elements including the know Campsie line ground proximity warning system (GPWS) issues. When considering these elements with the detail available at this stage, the options (C, D and E) are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.
Option E		Beyond the above categories, we've looked at the IOA categories where the comparative performance of the options varies; these were the noise and CO2/Fuel burn assessments.
		Although Option E was the best performing PBN arrival option in terms of noise, overflying more than half the numbers of people 4000ft and below than Option C, it was the poorest performer when considering fuel burn and CO_2 . Compared to Option D, Option D offers a relatively small increase in the number of people overflown compared to Option E however it also offers a more significant improvement in track mileage and subsequent fuel burn/ CO_2 emissions. We therefore determined that Option D's overall performance achieved a better balance between CO_2 performance and noise and therefore we have chosen to discontinue Option E at this stage.
Runway 23 Arrival Vectors only	Yes	Vectoring is a proven and ever flexible method of efficiently managing arrivals. The IOA showed that it offered fewer benefits compared to Hybrid Vectors and PBN. It is likely that changes to the network as well as to the rest of Glasgow's route structure will result in a change to vectoring practices and this option is carried forward to accommodate those changes.
Runway 23 Arrival Hybrid Vectors	Yes (preferred)	This is Glasgow's preferred option. In the IOA it offered the most benefits compared to the 'do nothing' baseline, as seen in the summary table above. The availability of PBN arrivals to RWY 23 may be able to address some of the GPWS issues, greatly reduce the numbers of people overflown by avoiding population centers, enhance CDA performance and reduce controller workload to support operation concepts such as Radar In The Tower. By also retaining vectoring, it enables ATC to deliver accurate and variable spacing, mitigates the increase in track miles that a Permanent PBN arrival may require and also ensure some track variation on the ground compared to pure PBN which helps to mitigate adverse effects from PBN concentration.

Vectors	res (preferred)	some track variation on the ground compared to pure PBN which helps to mitigate adverse effects from PBN concentration.		
	and PBN		The positioning of the PBN route within this option is still subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.	

5.4. Runway 05 Easterly Arrivals

Group	Impact	Runway 05 Arrival Option A	Runway 05 Arrival Option B			Runway 23 Arrival Vectors only	Runway 23 Arrival Hybrid Vectors and PBN
Communities	Noise impact on health and quality of life						
	Air Quality						
	Greenhouse gas impact						
Wider Society	Capacity / resilience						
wider Society	Tranquillity ⁵⁵						
	Biodiversity						
General Aviation	Access						
General Aviation / Commercial	Economic impact from increased effective capacity						
airlines	Fuel burn						
Commercial	Training costs						
airlines	Other costs						
Airport / Air	Infrastructure costs						
navigation service	Operational costs						
provider	Deployment costs						
All	Safety						
All	Interdependencies, conflicts and trade-offs						
AMS	Performance against the vision and parameters / strategic objectives of the AMS						
Option progressed to Stage 3		Х	√*	Х	Х	\checkmark	\checkmark

*As articulated in our Stage 2A document, use of pure PBN for arrivals into Glasgow does not perform well in the Design Principle Evaluation and is not a viable option for Glasgow going forwards. Therefore, this option was discounted in the DPE. However, the option of a mix of PBN and vectoring does come through very favourably. In this scenario, we would want to use the best performing PBN routes so we will take the PBN arrival options (other than the ones discounted above) into the Full Options Appraisal for further assessment to help inform the Hybrid vectors and PBN options.

Option	Is the option being progressed	Rationale
Runway 05 Arrival Option A	No	Overall, when looking at the IOA summary tables, the four PBN options A, B, C and D perform similarly when compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybrid scenario, we therefore looked at the performance of each option within the IOA categories to understand if any performed comparatively better than others.
		It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including the technical waypoint configuration of the route (particularly the Final Approach Fix (FAF) positioning). When considering this element with the detail available at this stage, the options are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.
		To determine which options to take through, we've looked at the IOA categories where the comparative performance of options A-D varies; these were the noise, CO ₂ /Fuel burn assessments and Controlled Airspace (CAS)/General Aviation.
		With regards to noise, Options A-D perform very similarly. When looking at the noise data between 0-7000ft, there was a difference of <400 people between Option A (best performing) and Option D (worst performing). Similarly, when looking at the 60dB LAmax data, there is less than 200 population between the best and worst performing options.
		When considering track mileage, CO_2 and fuel burn, there are only very small differences between the four options A-D. Of the four options, Option A is the second worst performing for track miles.
		Option A would require additional CAS and this is expected to be a greater volume than options B and D. Given the very small differences between Option A and Options B-D in the other areas outlined above, it is on basis of CAS that Option A is discontinued at this stage.
Runway 05 Arrival Option B	No (preferred for Hybrid Vectors and PBN option)	Overall, when looking at the IOA summary tables, the four PBN options A, B, C and D perform similarly when compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybrid scenario, we therefore looked at the performance of each option within the IOA categories to understand if any performed comparatively better than others.
		It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN' option depends on a variety of factors including the technical waypoint configuration of the route (particularly the Final Approach Fix (FAF) positioning). When considering this element with the detail available at this stage, the options are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.

⁵⁵ All options avoid overflight of tranquil areas which is the same as the vectoring and centreline baseline.

Runway 05 Arrival Hybrid Vectors and PBN	Yes	avoid the need for any additional CAS through alternative mitigation. By also retaining vectoring, it enables ATC to deliver accurate and variable spacing, mitigates the increase in track miles that a Permanent PBN arrival may require but also ensure some track variation on the ground compared to pure PBN which has some noise benefits. The availability of a PBN waypoint to ensure separation between RWY 05 arrivals and departures is currently considered to be a requirement in the final solution. The positioning of the PBN route within this option is still subject to change throughout the airspace change process as options are matured in detail and refined in accordance with safety requirements, our design principles, our appraisals and stakeholder engagement and consultation.
		This is Glasgow's preferred option. In the IOA it offered the most benefits compared to the 'do nothing' baseline, a seen in the summary table above. The availability of PBN arrivals to RWY 05 may be able to reduce the numbers of people overflown by avoiding population centres, enhance CDA performance and reduce controller workload to support operation concepts such as Radar In The Tower. However, all of options A-D could require additional CAS to contain the routes in accordance with CAA policy. This CAS requirement will be investigated in Stage 3 to try and the route of the route of the routes in accordance with CAA policy.
Runway 05 Arrival Vectors only	Yes	Vectoring is a proven and ever flexible method of efficiently managing arrivals. The IOA showed that it offered fewer benefits compared to the Hybrid Vectors and PBN option. It is likely that changes to the network as well as to the rest of Glasgow's route structure will result in a change to vectoring practices and this option is carried forward to accommodate those changes.
		On balance, Option D and Option B are very similar however Option B performs slightly better in terms of population overflown, and CO_2 and is expected to require a similar volume of CAS to Option B. We have therefore chosen to take forward Option B and discontinue Option D at this stage.
	No	Option D would require additional CAS unless moved slightly further East however this is expected to be less of a move than would be required for Options A and C.
		When considering track mileage, CO_2 and fuel burn, there are only very small differences between the four option A-D. Of the four options, Option D is the second best performing for track miles.
Runway 05 Arrival Option D		With regards to noise, Options A-D perform very similarly. When looking at the noise data between 0-7000ft, ther was a difference of <400 people between Option A (best performing) and Option D (worst performing). Similarly when looking at the 60dB Lamax data, there is less than 200 population between the best and worst performin options.
		To determine which options to take through, we've looked at the IOA categories where the comparative performanc of options A-D varies; these were the noise, CO ₂ /Fuel burn assessments and Controlled Airspace (CAS)/General Aviation.
		It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN option depends on a variety of factors including the technical waypoint configuration of the route (particularly th Final Approach Fix (FAF) positioning). When considering this element with the detail available at this stage, th options are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.
		Overall, when looking at the IOA summary tables, the four PBN options A, B, C and D perform similarly whe compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybri scenario, we therefore looked at the performance of each option within the IOA categories to understand if an performed comparatively better than others.
		Option C would require additional CAS and this is expected to be a greater volume than options B and D. It is on the basis of CAS that Option C is discontinued at this stage.
		When considering track mileage, CO ₂ and fuel burn, there are only very small differences between the four option A-D. Of the four options, Option C is the worst performing for track miles.
		With regards to noise, Options A-D perform very similarly. When looking at the noise data between 0-7000ft, there was a difference of <400 people between Option A (best performing) and Option D (worst performing). Similarly when looking at the 60dB LAmax data, there is less than 200 population between the best and worst performing options.
Runway 05 Arrival Option C	No	To determine which options to take through, we've looked at the IOA categories where the comparative performanc of options A-D varies; these were the noise, CO ₂ /Fuel burn assessments and Controlled Airspace (CAS)/General Aviation.
		It's important to note that the final positioning of the PBN element to accompany our 'Hybrid Vectors and PBN option depends on a variety of factors including the technical waypoint configuration of the route (particularly the Final Approach Fix (FAF) positioning). When considering this element with the detail available at this stage, the options are relatively similar, and we expect refinement of the design as part of the work undertaken at Stage 3.
		Overall, when looking at the IOA summary tables, the four PBN options A, B, C and D perform similarly whe compared against the baseline. When deciding which option(s) to take through to Stage 3 to use within the hybri scenario, we therefore looked at the performance of each option within the IOA categories to understand if an performed comparatively better than others.
		On balance, Option D and Option B are very similar however Option B performs slightly better in terms of population overflown, and CO_2 and is expected to require a similar volume of CAS to Option B. We have therefore chosen take forward Option B to Stage 3 of the process.
		Option B would require additional CAS unless moved slightly further East however this is expected to be less of move than would be required for Options A and C.
		When considering track mileage, CO_2 and fuel burn, there are only very small differences between the four option A-D. Of the four options, Option B is the best performing.
		With regards to noise, Options A-D perform very similarly. When looking at the noise data between 0-7000ft, the was a difference of <400 people between Option A (best performing) and Option D (worst performing). Similarly when looking at the 60dB LAmax data, there is less than 200 population between the best and worst performing options.
		To determine which options to take through, we've looked at the IOA categories where the comparative performance of options A-D varies; these were the noise, CO ₂ /Fuel burn assessments and Controlled Airspace (CAS)/Generative Aviation.

5.5. Preferred option and information to collect as part of the Full Options Appraisal

We have outlined which options we plan to take forward to Stage 3 as part of our <u>IOA Summary and conclusion section above</u>. As part of this, we have also indicated our preferred options however it's important to note that we will need to refine those options ahead of the Full Options Appraisal (FOA) to ensure they can integrate with the network, the PBN arrivals can connect to final approach in accordance with regulations and that the routes are all flyable. All refinements that lead to the final solution(s) taken to FOA and subsequent consultation will be documented as part of the design evolution.

Throughout this Initial Options Appraisal, we have highlighted where we plan to undertake further detailed appraisal as part of our Stage 3 Full Options Appraisal, in order to further assess the benefits and impacts of an option. This is particularly the case with the primary noise metric data, where at Stage 3 we will fully quantify the L_{Aeq} contours associated with each option to CAP2091 standards, allowing us to quantify the benefits and impacts. We have also identified other categories where further quantitative appraisal work is required.

We plan to collect the following data and undertake the additional assessments as part of our Full Options Appraisal assessment and following this assessment we will outline the options that we intend to take to Consultation:

- Quantify the baseline year (pre-implementation and 10 years post implementation, including 10 year traffic forecast)
- Quantitative L_{Aeq} contours, population counts and size (km²)
- WebTAG assessment
- Quantitative overflight contours that detail frequency of overflight including 100% easterlies and westerlies, and cumulative impacts from arrivals/departures and other airports
- Detailed track length comparison
- Detailed fuel burn and equivalent CO₂ emissions data
- Further information around interdependencies with the upper network and neighbouring airports
- ATC deployment / training costs
- Quantitative capacity information
- Quantified CAS requirements
- Further information following engagement with gliding areas around airspace availability

5.6. Impacted Audiences

At the 'Develop and assess' gateway, the IOA must set out impacted audiences, as this information will be a key feature in developing the consultation strategy required during Step 3A and at the 'Consult' gateway.

The following figures show our options on one map image, displayed using overflight contours and the vectoring NTK heatmap. We will use this mapping as a starting point to identify our impacted audiences and ensure that this is considered when developing our consultation strategy at Stage 3. We're aware that other factors also need to be taken into account when identifying the audience such as other noise metrics, changes to controlled airspace etc and we will ensure these are also factored in.

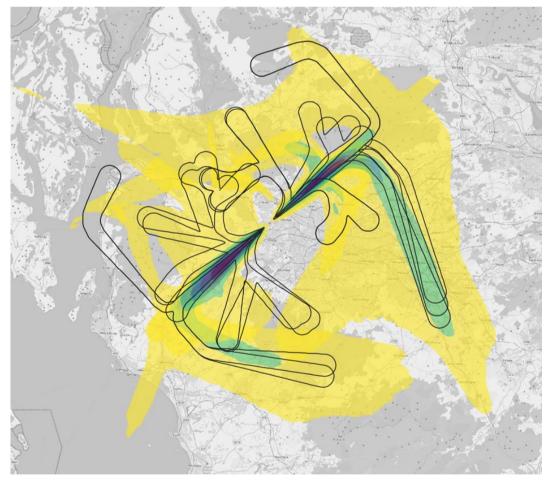


Figure 41 All Options for Stage 3 (Overflight Contours)

Glossary

Acronym	Term	Description	
ACOG	Airspace Change Organising Group	Established in 2019 at the request of the Department for Transport and Civil Aviation Authority to coordinate the delivery of key elements of the UK's Airspace Modernisation Strategy.	
ACP	Airspace Change Proposal	To carry out any permanent change to the published airspace, the Civil Aviation Authority (CAA) requires the change sponsor to carry out an airspace change proposal in accordance with <u>CAP1616</u> .	
ADS-B	Automatic Dependent Surveilland Broadcast	ceA means by which aircraft can automatically transmit and/or receive data such as identification, position, and additional data, as appropriate in a broadcast mode via a data link.	
AIP	Aeronautical Information Publication A publication which contains details of regulations, procedures and other information pertir operation of aircraft in the particular country to which it relates.		
AMS	Airspace Modernisation Strategy	gy UK Government has tasked the aviation industry to modernise airspace in the whole of the UK. long-term strategy of the CAA and the UK Government is called the Airspace Modernisation Strat (AMS). Its CAA document reference number is <u>CAP1711</u> .	
AMSL	Above Mean Sea Level		
ANSP	Air Navigation Service Provider	An organisation that provides the service of managing the aircraft in flight or on the manoeuvering area of an airport and which is the legitimate holder of that responsibility.	
AONB	Area of Outstanding Natural Beauty		
ATC	Air traffic control	The ground-based personnel and equipment concerned with controlling and monitoring air traffic within a particular area.	
ATZ	Aerodrome Traffic Zone	An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic.	
CAA	Civil Aviation Authority	The UK Regulator for aviation matters	
CAP1616	Civil Aviation Publication 1616	The airspace change process regulated by the CAA	
	Capacity	A term used to describe how many aircraft can be accommodated within an airspace area without compromising safety or generating excessive delay	
CAS	Controlled Airspace	Generic term for the airspace in which an air traffic control service is provided as standard; note that there are different sub classifications of airspace that define the particular air traffic services available in defined classes of controlled airspace.	
-	Centreline	The nominal track for a published route	
-	Concentration	Refers to a density of aircraft flight paths over a given location, this generally refers to high density where tracks are not spread out; this is the opposite of dispersal	
ССО	Continuous Climb Operations	An aircraft operating technique facilitated by the airspace and procedure design and assisted by appropriate ATC procedures, allowing the execution of a flight profile optimised to the performance of aircraft, leading to significant economy of fuel and environmental benefits in terms of noise and emissions reduction	
CDO	Continuous Descent Operations	An aircraft operating technique in which an arriving aircraft descends from an optimal position with minimum thrust and avoids level flight to the extent permitted by the safe operation of the aircraft and compliance with published procedures and ATC instructions	
-	Conventional navigation	The historic navigation standard where aircraft fly with reference to ground-based radio navigation aids	
-	Conventional route	Routes defined to the conventional navigation standard, i.e. using ground based radio navigation beacons to determine their position.	
СТА	Control Area	Controlled airspace extending upwards from a specified limit above the earth. Control Areas are situated above the Aerodrome Traffic Zone (ATZ) and afford protection over a larger area to a specified upper limit.	
CTR	Control Zone	Controlled airspace extending upwards from the surface of the earth to a specified upper limit. Aerodrome Control Zones afford protection to aircraft within the immediate vicinity of aerodromes	
db	Decibels	A unit used to measure the intensity of a sound (or the power level) of an electrical signal by comparing it with a given level on a logarithmic scale.	
DER	Declared End of Runway		
-	Dispersal	Refers to the density of aircraft flight paths over a given location, this generally refers to lower density – tracks that are spread out; this is opposite of Concentration	
DPE	Design Principle Evaluation	A evaluation of each option against each design principle which forms part of Stage 2A of the CAP1616 process	
-	Easterlies	When a runway is operating such that aircraft are taking off and landing in an easterly direction	
-	Final Approach	The final part of an arrival flight path that is directly lined up with the runway	
FL	Flight Level	The Altitude above sea-level in 100 feet units measured according to a standard atmosphere. A flight level is an indication of pressure, not of altitude. Only above the <u>transition level</u> (which depends on the local <u>QNH</u> but is typically 4000 feet above sea level) are flight levels used to indicate altitude; below the transition level feet are used.	
FLARM	Flight Alarm	FLARM (an acronym based on 'flight alarm') is the proprietary name for an electronic device which is in use as a means of alerting pilots of small aircraft, particularly gliders, to potential collisions with other aircraft which are similarly equipped.	
FUA	Flexible Use Airspace	Airspace which is not solely designated for a single purpose, but can be allocated flexibly according to need, or switched entirely on/off according to a schedule or agreed process.	
-	Flight-path	The track flown by aircraft when following a route, or when being directed by air traffic control	
ft	Feet	The standard measure for vertical distances used in air traffic control	

FASI	Future Airspace Implementation	on Under the Government's Airspace Modernisation Strategy (AMS, ref 15) airports in the UK are required to update their airspace and routes in a coordinated way.
GA	General Aviation	All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire. The most common type of GA activity is recreational flying by private light aircraft and gliders, but it can range from paragliders and parachutists to microlights, balloons, and private corporate jet flights.
IFP	Instrument Flight Procedures	A published procedure used by aircraft flying in accordance with the instrument flight rules, which is designed to achieve and maintain an acceptable level of safety in operations and includes an instrument approach procedure, a standard instrument departure, a planned departure route and a standard instrument arrival.
ILS	Instrument Landing System	An ILS operates as a ground-based instrument approach system that provides precision lateral and vertical guidance to an aircraft approaching and landing on a runway, using a combination of radio signals to enable a safe landing even during poor weather.
IOA	Initial Options Appraisal	A qualitative appraisal of an option against a baseline 'do nothing' scenario, as required at Step 2B of CAP1616
L _{Aeq}		The most common international measure of noise, meaning, 'equivalent continuous sound level'. This is a measurement of sound energy over a period of time.
L _{Aeq 16h}		The A-weighted Leq measured over the 16 busiest daytime hours (0700-2300) is the normal time- period used to develop the Airport Noise Contours for day-time operations.
L _{Aeq 8h}		The A-weighted Leq measured over the 8 night-time hours (2300-0700) is the normal time-period used to develop the Airport Noise Contours for night-time operations.
-	Lower Airspace	Airspace in the general vicinity of the airport containing arrival and departure routes below 7,000ft. Airports have the primary accountability for the design of this airspace, as its design and operation is largely dictated by local noise requirements, airport capacity and efficiency
NAP	Noise Abatement Procedures	Noise abatement procedures are designed to minimise exposure of residential areas to aircraft noise, while ensuring safety of flight operations
NATS (ATC)		NATS ATC - the air navigation service provider at Glasgow Airport under commercial contract for the aerodrome control provision.
NATS NERL		NATS NERL - The UK's licenced air traffic service provider for the en route airspace (upper network) that connects airports with each other, and with the airspace of neighbouring states.
nm	Nautical Mile	Aviation measures distances in nautical miles. One nautical mile (nm) is 1,852 metres. One road mile ('statute mile') is 1,609 metres, making a nautical mile about 15% longer than a statute mile.
-	Network Airspace / Upper network	En route airspace above 7,000ft in which NATS has accountability for safe and efficient air traffic services for aircraft travelling between the UK airports and the airspace of neighbouring states.
NTK	Noise Track Keeping	A system that monitors and records radar data to monitor aircraft operations and report statistics focused around noise.
PANS OPS	Procedures for Air Navigation Service Aircraft Operations	esPANS-OPS is contained in an ICAO Document 8168 which sets out the design criteria and rules for instrument flight procedures which include approach and departure procedures.
PBN	Performance Based Navigation	Referred to as PBN; a generic term for modern standards for aircraft navigation capabilities including satellite navigation (as opposed to 'conventional' navigation standards)
PC	Prestwick Centre	Prestwick Centre handles air traffic across northern England, Scotland and out into North East Atlantic.
RMA	Radar Manoeuvring Area	An ATC operational area articulated as a volume of airspace by the ANSP. It facilitates the close-in radar vectoring by ATC that is required to take the aircraft safely from a holding stack and established onto final approach.
RNAV / RNAV 1	aRea NaVigation	This is a generic term for a particular specification of Performance Based Navigation. The suffix '1' denotes a requirement that aircraft can navigate to with 1nm of the centreline of the route 95% or more of the time. In practice the accuracy is much greater than this.
RNP-RF	Required Navigation Performance Radius to fix	–An advanced navigation specification under the PBN umbrella. The suffix '1' denotes a requirement that aircraft can navigate to with 1nm of the centreline 95% or more of the time, with additional self- monitoring criteria. In practice the accuracy is much greater than this. The RF means Radius to Fix, where airspace designers can set extremely specific curved paths to a greater accuracy than RNAV1.
RNP-AR	Required Navigation Performance Authorisation required	-An advanced navigation specification under the PBN umbrella. 'Authorisation required' refers to aircraft and operators complying with specific airworthiness and operational requirements. RNP-AR allow

and operators complying with specific airworthiness and operational requirements. RNP-AR allow airspace designers to set extremely specific curved paths to a greater accuracy than RNAV1, these can be designed before and after the Final Approach Fix.

-	Separation	Aircraft under Air Traffic Control are kept apart by standard separation distances, as agreed by international safety standards. Participating aircraft are kept apart by at least 3nm or 5nm lateral separation (depending on the air traffic control operation), or 1,000ft vertical separation.
SID	Standard Instrument Departure	Usually abbreviated to SID; this is a route for departures to follow straight after take-off.
	Tactical Intervention	Air traffic control methods that involve controllers directing aircraft for specific reasons at that particular moment (see Vector)
TMA /	Terminal Manoeuvring Area (Terminal Airspace)	An aviation term to describe a designated area of controlled airspace surrounding a major airport or cluster of airports where there is a high volume of traffic. The airspace surrounding Glasgow &
ScTMA	/ Scottish Terminal Manoeuvring Area	Edinburgh airports is described as the Scottish TMA (ScTMA). This is the airspace that contains all the arrival and departure routes for Glasgow & Edinburgh from the surface to 6000ft.
TMZ	Transponder Mandatory Zone	Airspace of defined dimensions where the carriage and operation of transponder equipment is mandatory.

VFR	Visual Flight Rules	Visual Flight Rules (VFR) are the rules that govern the operation of aircraft in <u>Visual Meteorological</u> <u>Conditions (VMC)</u> (conditions in which flight solely by visual reference is possible)
VMC	Visual Meteorological Conditions	Visual meteorological conditions (VMC) are the meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima
VSA	VFR Significant Area	A volume of airspace which has been identified as being particularly important to VFR operations. A VSA might take the form of a route, a zone, or an area chosen for its particular importance to GA users. These areas do not have any official status but are intended to highlight the importance of a particular area so that future airspace development plans can take account of the GA activity.
-	Vector / vectoring	An air traffic control method that involves directing aircraft off the established route structure or off their own navigation – ATC instruct the pilot to fly on a compass heading and at a specific altitude. In a busy tactical environment, these can change quickly. This is done for safety and for efficiency.
-	Westerly operation	When a runway is operating such that aircraft are taking off and landing in a westerly direction