GLASGOW AIRPORT

PROUD TO SERVE SCOTLAND

Glasgow Airport FASI-North Airspace Change Proposal

Stage 2A Engagement on Comprehensive List of Options

General Aviation Stakeholders

17th Nov 2021

AGENDA

1. Introductions and project overview
2. Purpose of this Stage 2A General Aviation engagement
3. Our Approach to Option Development
4. Controlled Airspace Discussion
5. Questions
6. Next steps

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1. Introductions and overview

1. INTRODUCTION AND OVERVIEW: RECAP

Glasgow Airport is developing an airspace change proposal (ACP) to upgrade the airport's arrival and departure routes. The ACP will cover a review of routes from the ground up to 7000ft and will also review the boundaries between controlled and uncontrolled airspace.

Every ACP sponsor must follow the regulatory process for changing the airspace design, including community engagement requirements - known as CAP1616 (Civil Aviation Publication no. 1616).

- CAP1616 sets out the process for developing airspace change options. This entails engaging with affected stakeholders, evaluating the impacts of options, consulting the public, regulatory approval and implementation.
- The outputs of each stage are reviewed by the CAA to ensure the engagement and analysis is robust prior to moving to the next stage.

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1. CAP1616

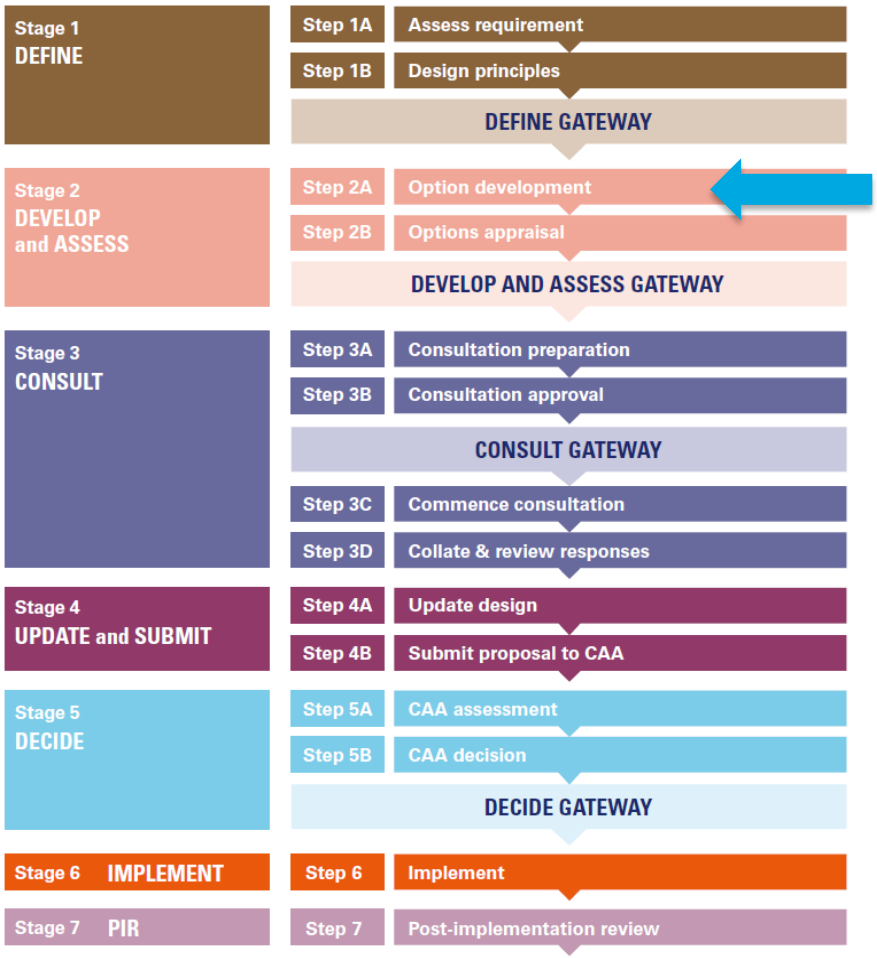
In November 2019 Glasgow Airport submitted the Stage 1 Design Principles documents to the CAA and moved onto Stage 2 of the 7-stage CAP1616 process.

The outcome of Stage 1 are 15 Design Principles that we will be utilising in Stage 2.

Due to COVID-19 the ACP was paused in April 2020.

Following the announcement in March 2021 from the Department for Transport and the CAA of short-term financial support for the next phase of the FASI project, Glasgow Airport are now able to restart this ACP.

In line with CAP1616 guidance, during Stage 2, Glasgow Airport will continue to seek involvement from the same stakeholders that were engaged as part of Step 1B.



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1. CAP1616 STAGE 2 DEVELOP & ASSESS

Our ACP is currently in Step 2A of the CAP1616 process – known as Options Development

Step 2A requires Glasgow Airport to first develop a comprehensive list options to the extent that a list is possible. This list of options should address the Statement of Need and align with the Design Principles which were developed in Stage 1.

Glasgow Airport must now carry out a preliminary test of these options with the same stakeholders who were engaged in Step 1B (Design Principles) to ensure that they are satisfied that the design options are aligned with the design principles and that the airport has properly understood and accounted for stakeholder concerns, specifically related to the design options.

Glasgow Airport will then produce a design principle evaluation which will set out how our design options have responded to the design principles.

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2. Purpose of Stage 2A General Aviation Engagement

2. PURPOSE OF THIS ENGAGEMENT

- The purpose of this engagement is to brief General Aviation Stakeholders on where we are with developing controlled airspace arrangements. We will not be presenting individual Controlled Airspace options or any proposals as part of this session however we will present an initial illustrative volume to use as a starting point for discussions to help us as we develop and refine our airspace change proposal.

- As part of this session, we will give an overview of our methodology and our comprehensive list of options however the focus will be an opportunity for GA stakeholders to ask specific questions to enable them to feedback, in slower time, around future controlled airspace arrangements.

- Attendees are still welcome to attend the wider Stakeholder briefing sessions taking place on 25th Nov, 1st Dec and 2nd Dec where we will cover in more detail the methodology and comprehensive list of route options. The full presentation from the sessions will also be available for all stakeholders to view.

3. Overview of our approach to developing the initial comprehensive list of options

3. OUR APPROACH

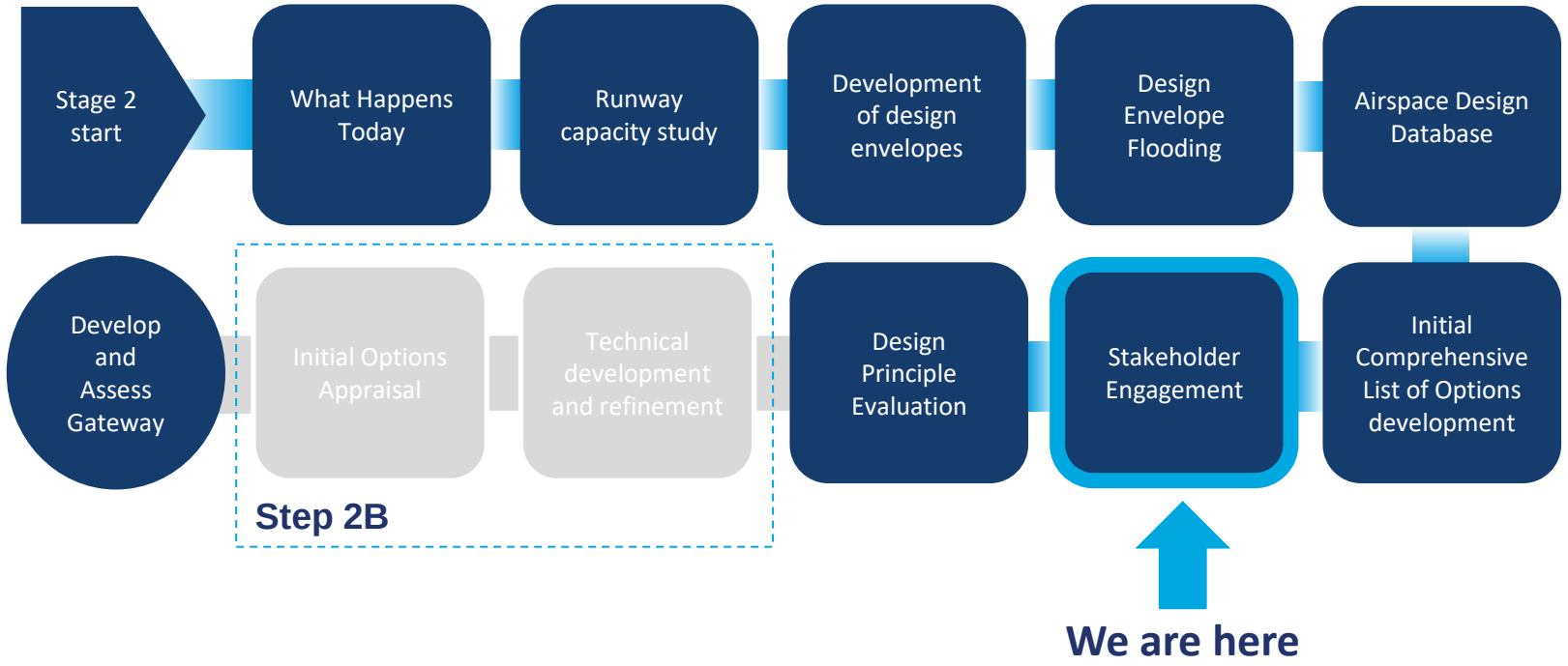
When developing Airspace Change options, Glasgow Airport must address the Statement of Need and align with the Design Principles which were developed in Stage 1 with Stakeholders:

#	Design Principle
1	The airspace design and its operation must be as safe or safer than today.
2	Facilitate the growth in quicker, quieter and cleaner traffic by configuring the airspace to improve efficiency and meet the forecast demand for air transport.
3	Design the appropriate volume of controlled airspace to support commercial air transport, enable safe, efficient access for other types of operation and release controlled airspace that is not required.
4	Mitigate any future requirements for airborne holding for inbound traffic and holding on the ground pre-departure for outbound traffic.
5	Minimise the total adverse effects of aircraft noise and visual intrusion on physical and mental health and wellbeing.
6	Offer communities options for both noise concentration and noise dispersion through the use of predictable and transparent multiple route options and other respite methods that are possible within the technical ATC system, en-route network and procedural constraints.
7	The arrival and departure routes that serve Glasgow Airport below 7000ft should avoid noise sensitive areas and buildings, national parks, areas of outstanding natural beauty/National Scenic Areas and areas that are not currently affected by aircraft noise.
8	Mitigate the impacts on local communities that are currently affected by aircraft noise on final approach or the vicinity of the immediate climb out, where overflight is unavoidable.
9	Reduce complexity and bottlenecks in controlled and uncontrolled airspace and contribute to a reduction in airspace infringements.
10	Collaborate with other Scottish airports and NATS to ensure that the airspace design options are compatible with the wider programme of lower altitude and network airspace changes being coordinated by the FASI North programme.
11	Routes to/from Glasgow and Edinburgh airports should be procedurally deconflicted from the ground to a preferred level in coordination with NATS Prestwick.
12	Minimise the growth in aircraft emissions, the further degradation in local air quality and adverse ecological impacts to address growing concerns about the impact of aviation on climate change.
13	Aircraft operating at Glasgow Airport should climb and descend continuously to/from at least 7000ft with a preference for the most environmentally beneficial option to be chose, if both cannot be achieved simultaneously.
14	Routes should be designed to meet a RNAV1 specification as a minimum in order to gain maximum benefit of the performance capabilities of the modern aircraft fleet operating at Glasgow Airport in line with the guidance provided in CAA CAP1385 on enhanced route spacing for PBN and provide sufficient resilience and redundancy against Global Navigation Satellite System (GNSS) failure.
15	The GLA ACP accords with the CAA's published Airspace Modernisation Strategy (CAP1711), any current or future plans associated with it and all other relevant policies and regulatory standards.

3. OUR APPROACH

In practice, developing a comprehensive list of options that address the statement of need and align with the design principles is a complex task, especially when faced with a 'blank sheet' approach. There are several stages of work that are required to take place in order to arrive at a comprehensive list of options. The following slides summarise the methods employed to develop as many options as practicable.

Overview of our approach:



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3. OUR APPROACH

What happens today

All DPs

The first step in developing our Comprehensive List of Options is to understand what happens today. When we restarted the project after COVID-19, we refreshed this analysis.

We took initial steps to understand the existing Airspace Environment and how we can change and improve it to meet all of the Design Principles.

This included workshops with General Aviation Stakeholders.

Runway Capacity Study

DP 2, 4, 12 & 15

In April 2020, we undertook a runway capacity study which we have used to inform the operational requirements for the system options developed at the Initial Comprehensive List of Options stage. This ensures that we meet our Statement of Need, and Design Principles (DP) 2, 4, 12 and 15.

The Runway Capacity model was based on a pre-covid forecast schedule, grown from a 2019 busy day traffic profile.

The study concluded that in order to achieve capacity at Glasgow and minimise avoidable delays, a minimum of 2, ideally 3 departure routes would be required off each runway end.

3. OUR APPROACH

Development of design envelopes

DP 1 2 5 7 10 12 13 14 15

Design Envelope Flooding

DP 1 5 7 8 12 13 14

Airspace Design Database

DP 1 3 5 7 8 12 13 14 15

We next developed design envelopes. These are outlines of geographic areas within which notional flight paths could technically be positioned.

The GLA airspace change presents a blank sheet approach to airspace design and as such, we did not initially constrain ourselves with any existing limitations.

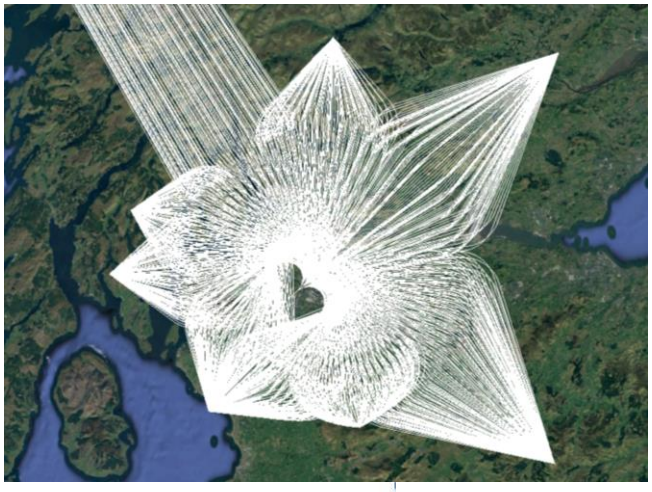
We then flooded the design envelopes with hundreds of possible notional flight paths grouped into network entry/exit points.

Information from the flooding will give us insight into which areas of the design envelope may have the potential to best meet the design principles.

An Airspace Design Database was created which allowed high performing notional flight paths to be identified. These are the flight paths which most align with our Design Principles.

The database includes a noise assessment of each path, based on single noise events such as L_{Amax} and overflight metrics. It also includes track mileage to enable high level comparison of potential fuel burn / CO_2 and information about whether an option would require additional new Controlled Airspace.

Example Runway 05 Departure design envelope



Example Runway 05 Flooded with notional departure flight paths

3. OUR APPROACH

Comprehensive List of Options Development

All Design Principles

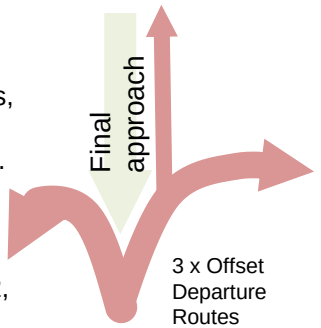
The Airspace Design Database has given us the high performing notional flight paths for each network exit/entry group however this only looks at the paths as individuals. In order to develop options that meet DP2, 4, and 6, we needed to consider how systems of arrivals and departures routes would work together, for example to create respite.

To achieve this, we developed concepts. The final stage in the process was to bring together the concepts and the best performing notional flight paths from the Airspace Design Database:

Concept

Concepts describe broad directions or splits of routes, that take into account expected traffic distribution.

These are informed by the runway capacity study and in order to try to meet DP 2, 4 & 6.



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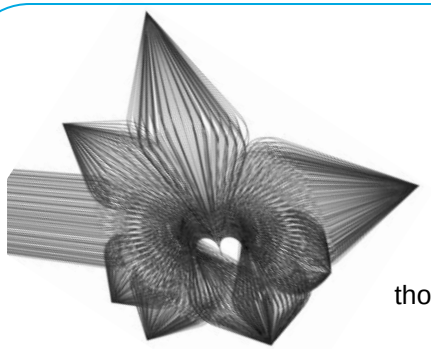


Airspace Design Database

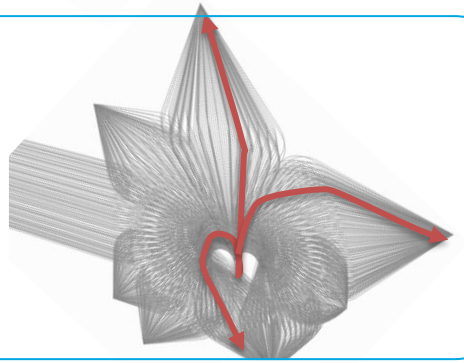
Contains noise, environment and airspace data on thousands of notional flight paths.

=

Airspace Option

The airspace option brings together the concept and the best performing notional flight paths alongside separation standards and other technical experience*, to build system options that form our initial comprehensive list of options.

*To create working systems is a complex task and therefore this is a collaborative group exercise between ATM experts, IFP designers, and ATC.



Illustrative example only

4. COMPREHENSIVE LIST OF OPTIONS

PBN Arrivals

Within the operational environment, there are different ways and means of ensuring aircraft are managed as efficiently as possible. Our options are Performance Based Navigation (PBN) transitions. PBN uses satellite based navigation technology to follow set routes.

On some occasions there may however be the requirement for aircraft to be tactically controlled by Air Traffic Controllers (ATC) where pilots are given instructions about which direction to fly and when to climb or descend. This means that aircraft do not follow a set route.

At this early stage in the development process, we are still considering all of the potential options for how aircraft could arrive at Glasgow Airport:

Full PBN Arrival	Partial PBN Arrival	Tactical ATC Controlling	PBN Arrival and ATC Mix
Aircraft would fly the full PBN route from the holding stack and onto final approach. This would start above 7000ft all the way to the runway.	Aircraft would be instructed by ATC until told to join the latter part of the PBN route. The PBN route may start from typically 4,000-6,000ft to the final approach.	Aircraft would be provided with instructions by ATC from above 7,000ft until joining final approach, very similar to today. PBN arrival routes would not be available.	Some aircraft would fly the PBN transitions and others may be instructed by ATC depending on circumstances. For example, PBN transitions could be used at night or during periods of low frequency of arrival, and ATC instructions used during the busy periods.

PBN arrival routes could potentially be alternated to provide respite for communities although this is not possible once an arrival has joined the final approach. The following slides show the PBN arrival routes currently under consideration:

4. COMPREHENSIVE LIST OF OPTIONS

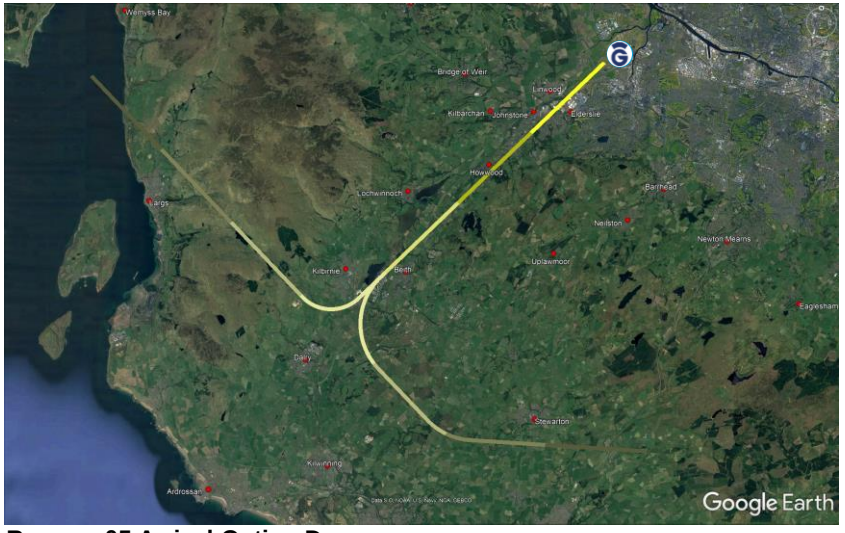
All Runway 05 Arrival Options:

Runway 05 Arrival Option A

Runway 05 Arrival Option B

Indicative (Conservative) Altitude (ft)	Arrival Options and aircraft track data
0 – 1000	
1000 – 2000	
2000 – 3000	
3000 – 4000	
4000 – 5000	
5000 – 6000	
6000 - 7000	

Runway 05 Arrival Option C



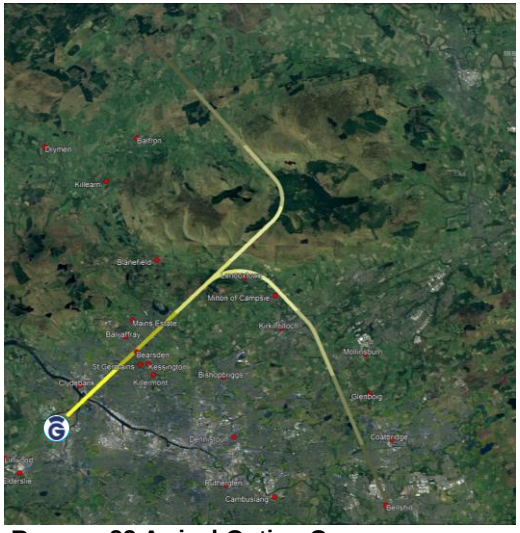
Runway 05 Arrival Option D

4. COMPREHENSIVE LIST OF OPTIONS

All Runway 23 Arrival Options:

Runway 23 Arrival Option A

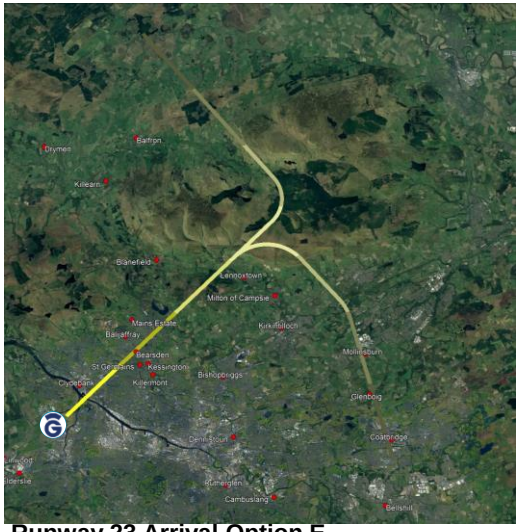
Runway 23 Arrival Option B



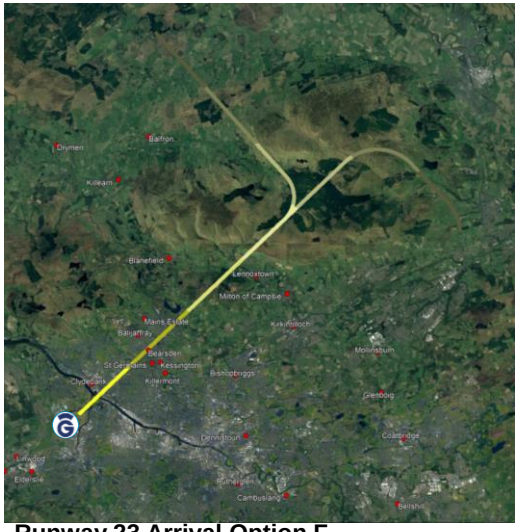
Runway 23 Arrival Option C

Indicative (Conservative) Altitude (ft)	Arrival Options and aircraft track data
0 – 1000	
1000 – 2000	
2000 – 3000	
3000 – 4000	
4000 – 5000	
5000 – 6000	
6000 - 7000	

Runway 23 Arrival Option D



Runway 23 Arrival Option E



Runway 23 Arrival Option F

4. COMPREHENSIVE LIST OF OPTIONS

PBN Departures

Our Departure Options are based on PBN flight paths where an aircraft would fly the flight path centreline from take off to at least above 4,000ft through to 7000ft where they would join the upper airspace network.

PBN improves the accuracy of where aircraft fly and therefore this would result in traffic being more concentrated than today at the lower levels and potentially up to 7000ft. There may however still be some variations around the centerlines and there may be occasions where ATC have to tactically manage departures. We estimate that this will be less frequent than today, especially at lower altitudes.

The following slides show the PBN departure options currently under consideration:

4. COMPREHENSIVE LIST OF OPTIONS

All Runway 05 Departure Options:

Runway 05 Departure Option A

Runway 05 Departure Option B

Runway 05 Departure Option C

Runway 05 Departure Option D

Runway 05 Departure Option E

Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data
0 – 1000	
1000 – 2000	
2000 – 3000	
3000 – 4000	
4000 – 5000	
5000 – 6000	
6000 - 7000	

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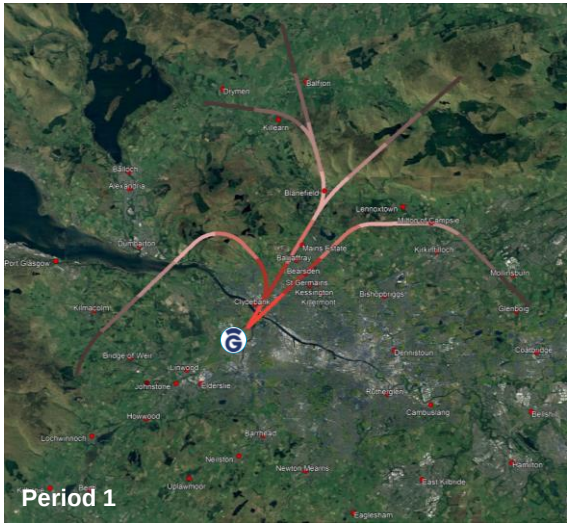
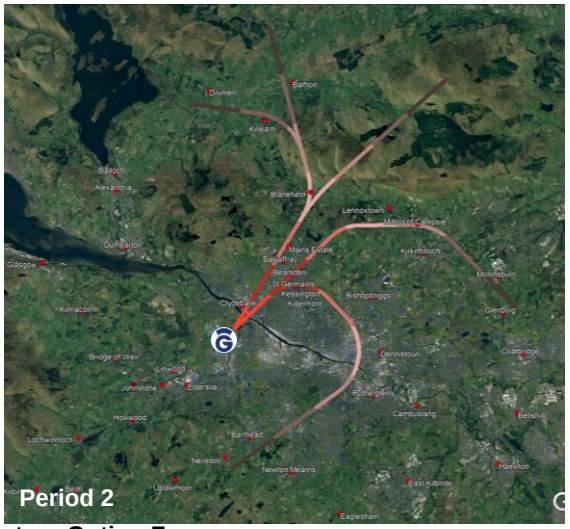
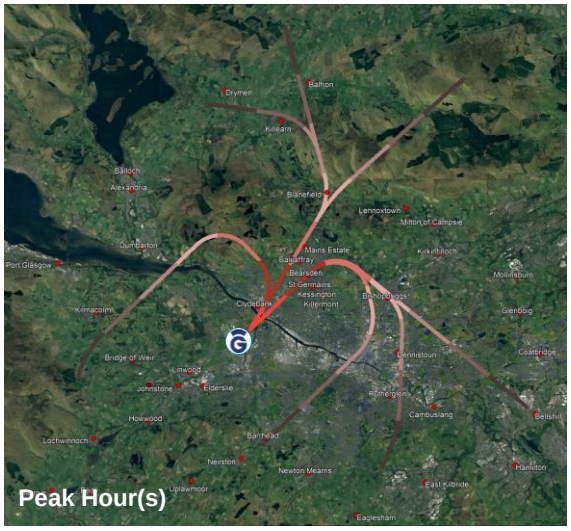
4. COMPREHENSIVE LIST OF OPTIONS

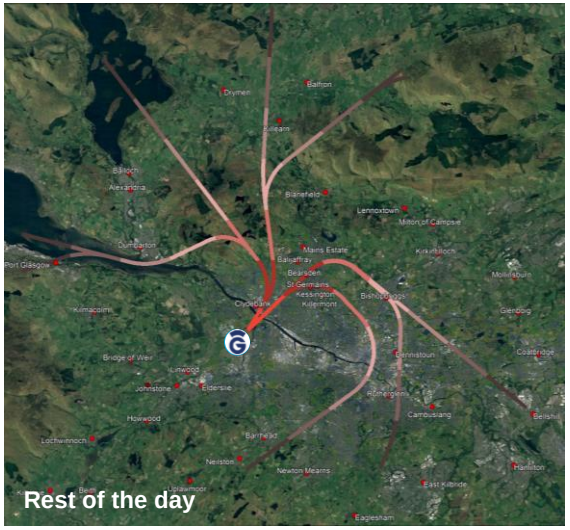
All Runway 05 Departure Options:





Runway 05 Departure Option F



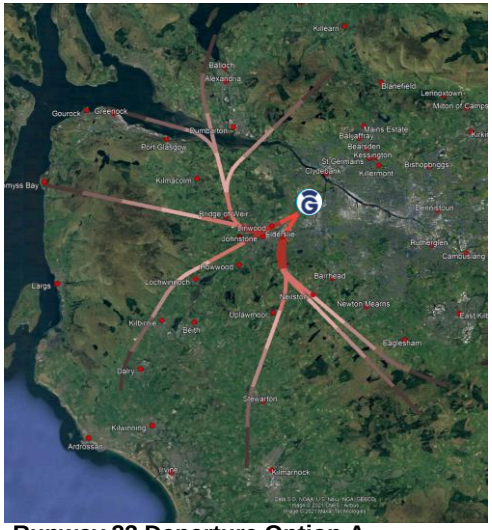


Runway 05 Departure Option G

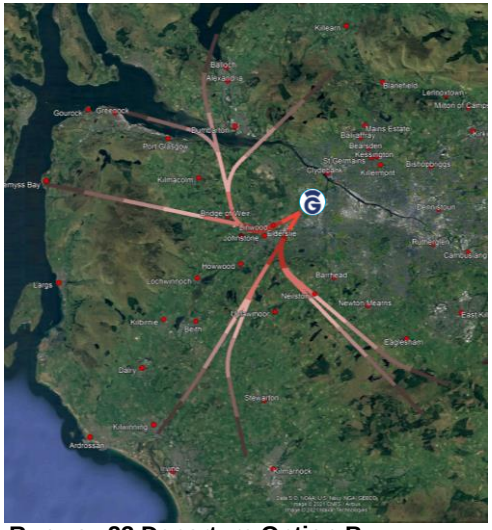
Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data
0 – 1000	
1000 – 2000	
2000 – 3000	
3000 – 4000	
4000 – 5000	
5000 – 6000	
6000 - 7000	

4. COMPREHENSIVE LIST OF OPTIONS

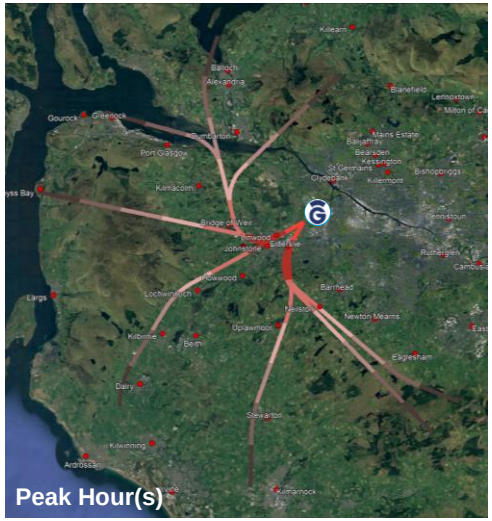
All Runway 23 Departure Options:

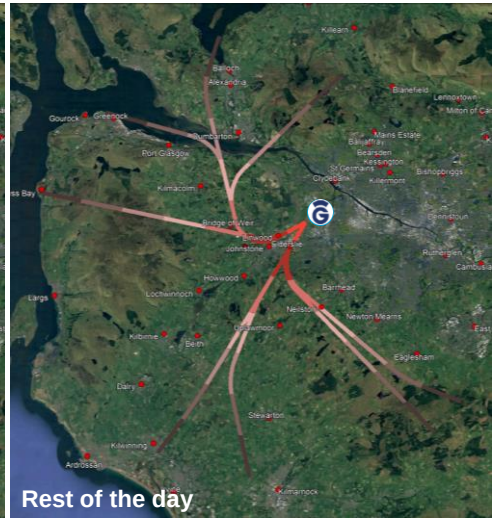


Runway 23 Departure Option A

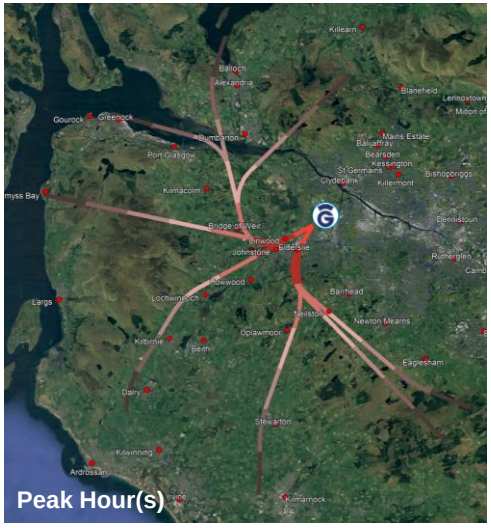


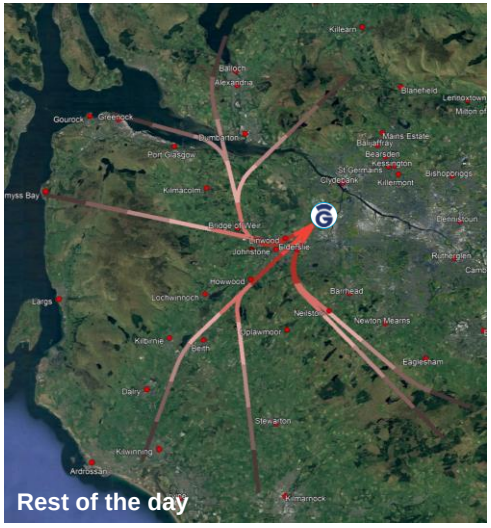
Runway 23 Departure Option B



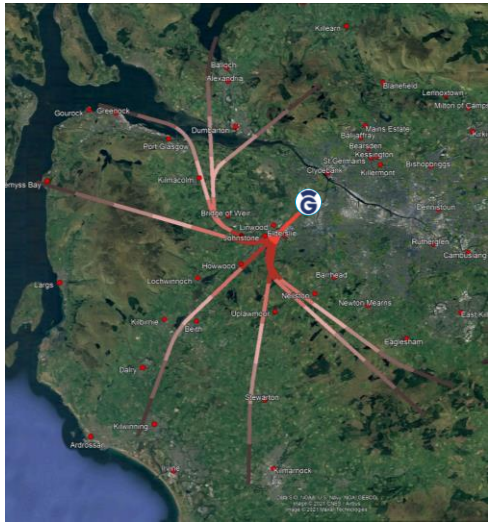


Runway 23 Departure Option C





Runway 23 Departure Option D

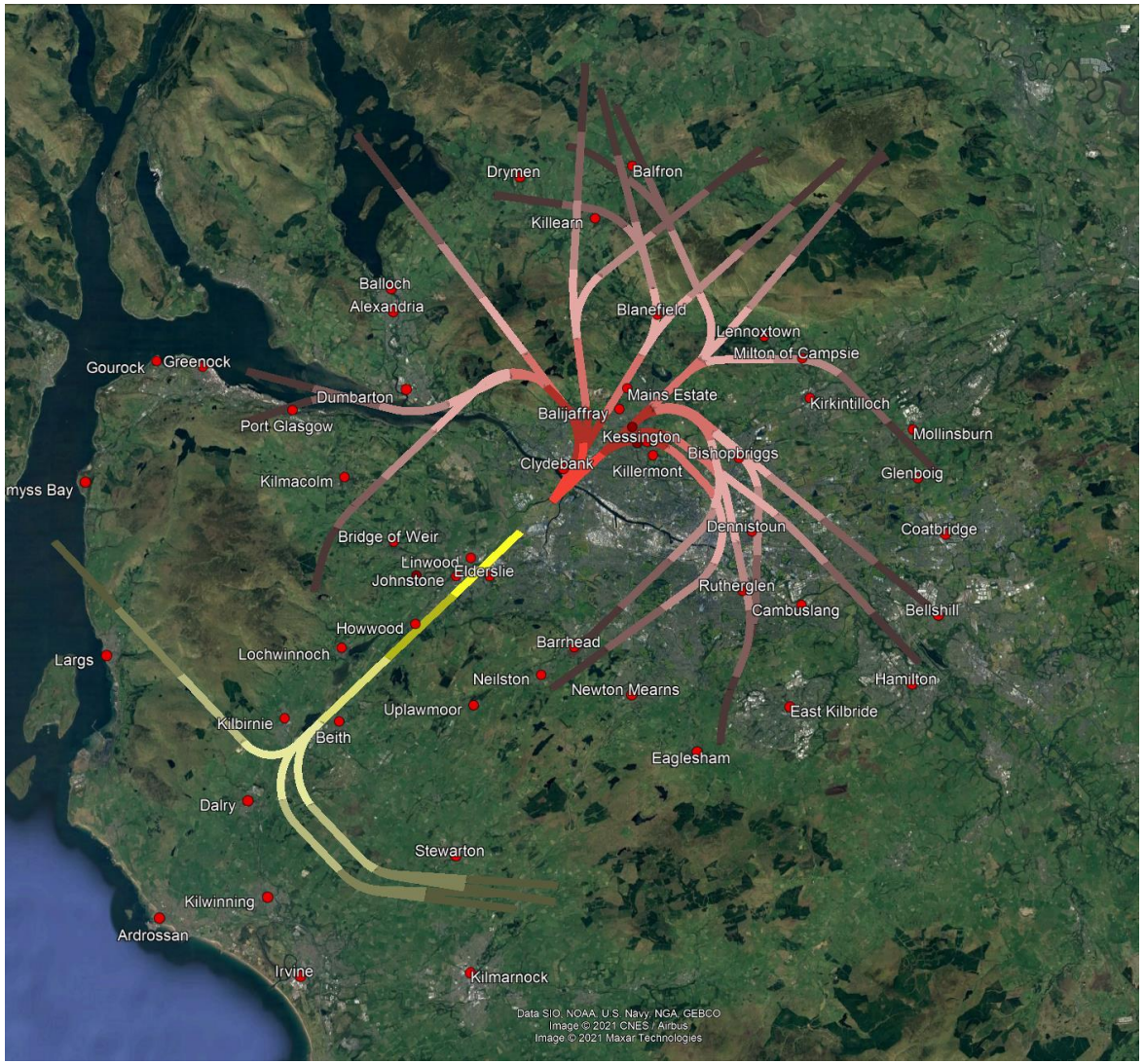


Runway 23 Departure Option E

Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data
0 – 1000	
1000 – 2000	
2000 – 3000	
3000 – 4000	
4000 – 5000	
5000 – 6000	
6000 - 7000	

4. COMPREHENSIVE LIST OF OPTIONS

All Runway 05 Options:



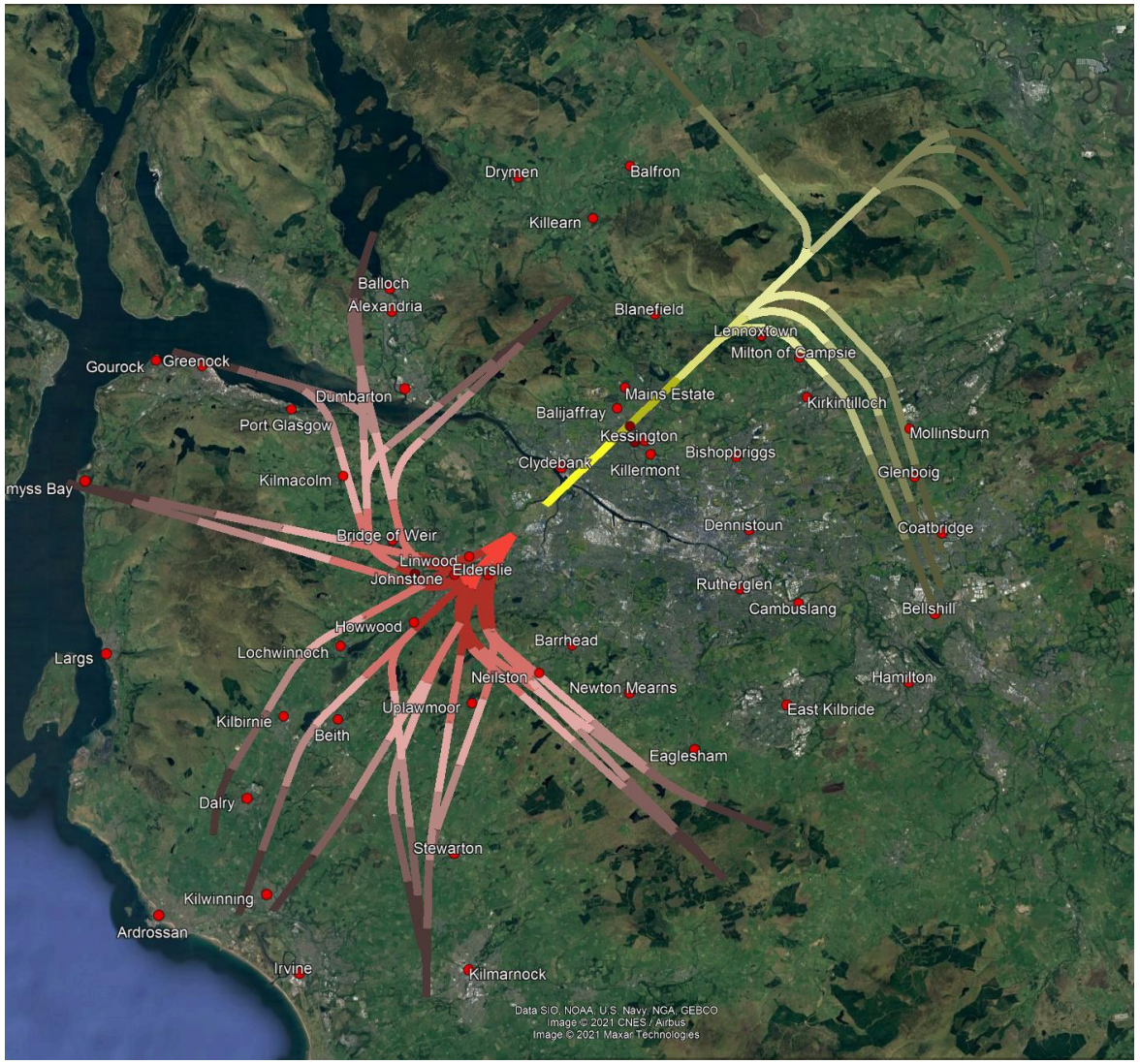
The comprehensive list of options is formed of 4 arrival options and 7 departure options for runway 23.

- At this stage, the SIDS assume a conservative 7% climb gradient from the DER
- Arrivals are based on a 3º (5.24%) approach

Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data	Arrival Options and aircraft track data
0 – 1000		
1000 – 2000		
2000 – 3000		
3000 – 4000		
4000 – 5000		
5000 – 6000		
6000 - 7000		

4. COMPREHENSIVE LIST OF OPTIONS

All Runway 23 Options:



The comprehensive list of options is formed of 6 arrival options and 5 departure options for runway 23.

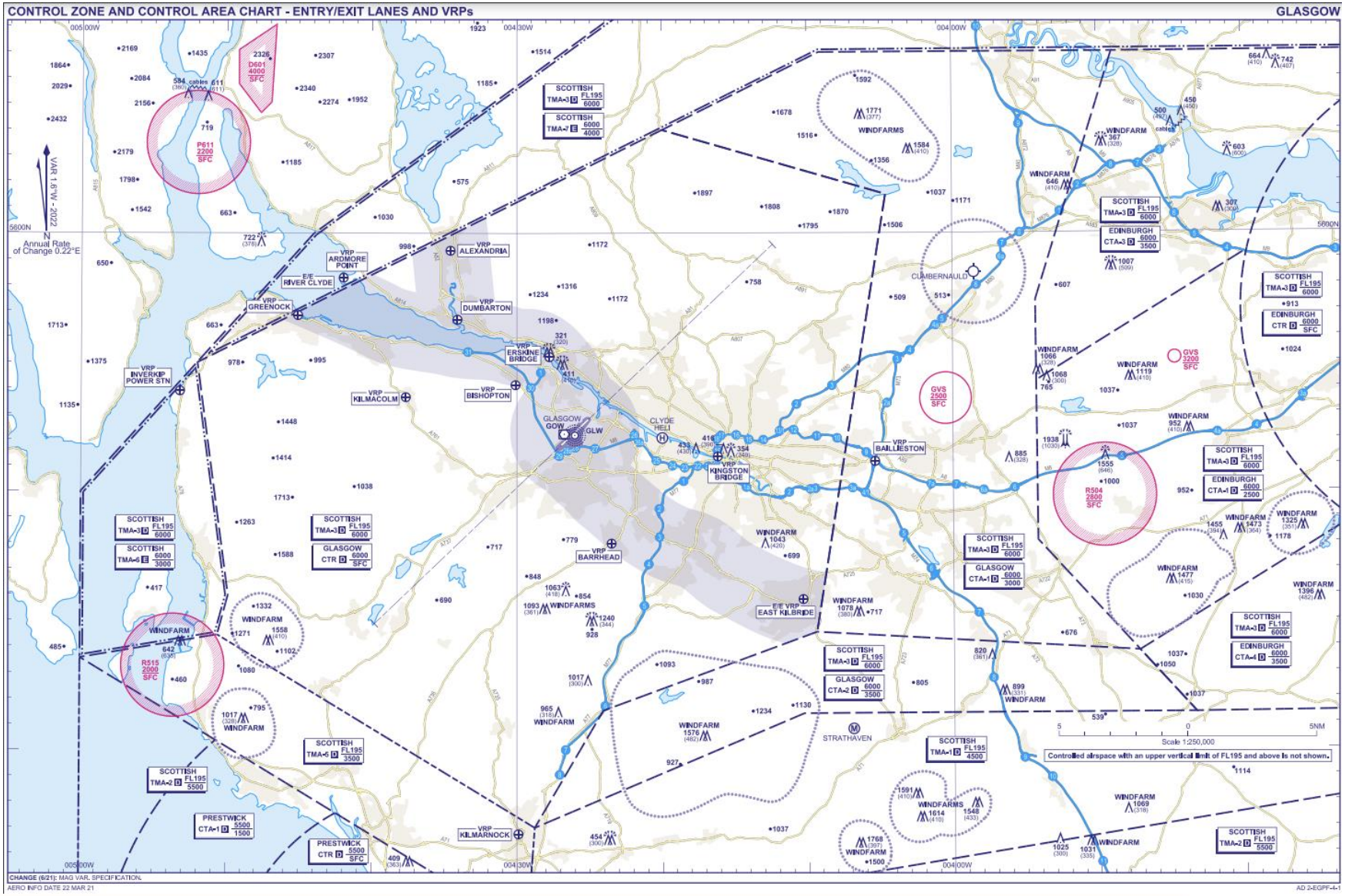
- At this stage, the SIDS assume a conservative 7% climb gradient from the DER
- Arrivals are based on a 3º (5.24%) approach

Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data	Arrival Options and aircraft track data
0 – 1000		
1000 – 2000		
2000 – 3000		
3000 – 4000		
4000 – 5000		
5000 – 6000		
6000 - 7000		

Any Questions?

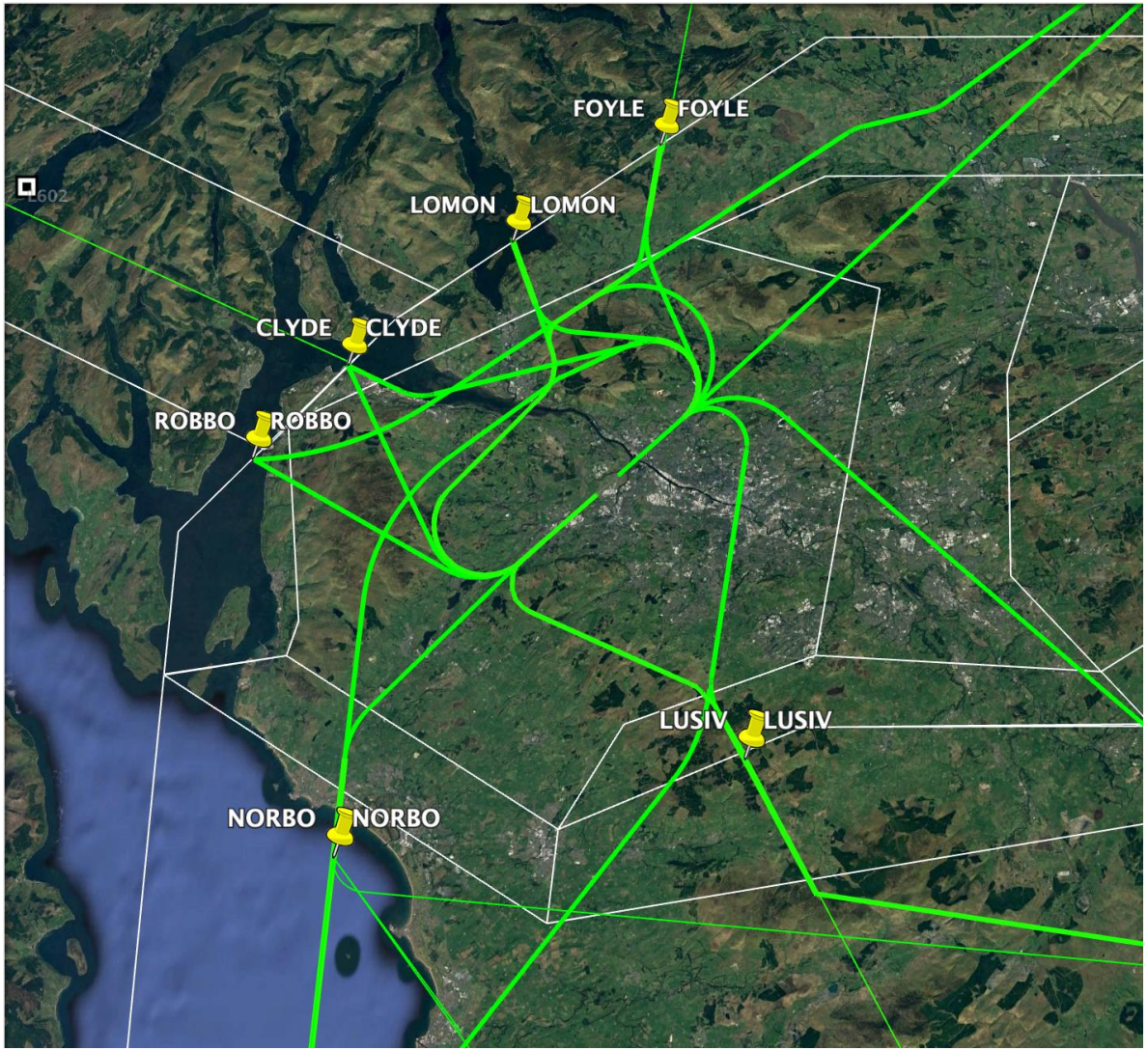
4. Controlled Airspace Discussion

4. CONTROLLED AIRSPACE ARRANGEMENTS



4. CONTROLLED AIRSPACE ARRANGEMENTS

Existing CAS and existing SIDs



Green – Existing SIDS
White – Existing CAS boundaries

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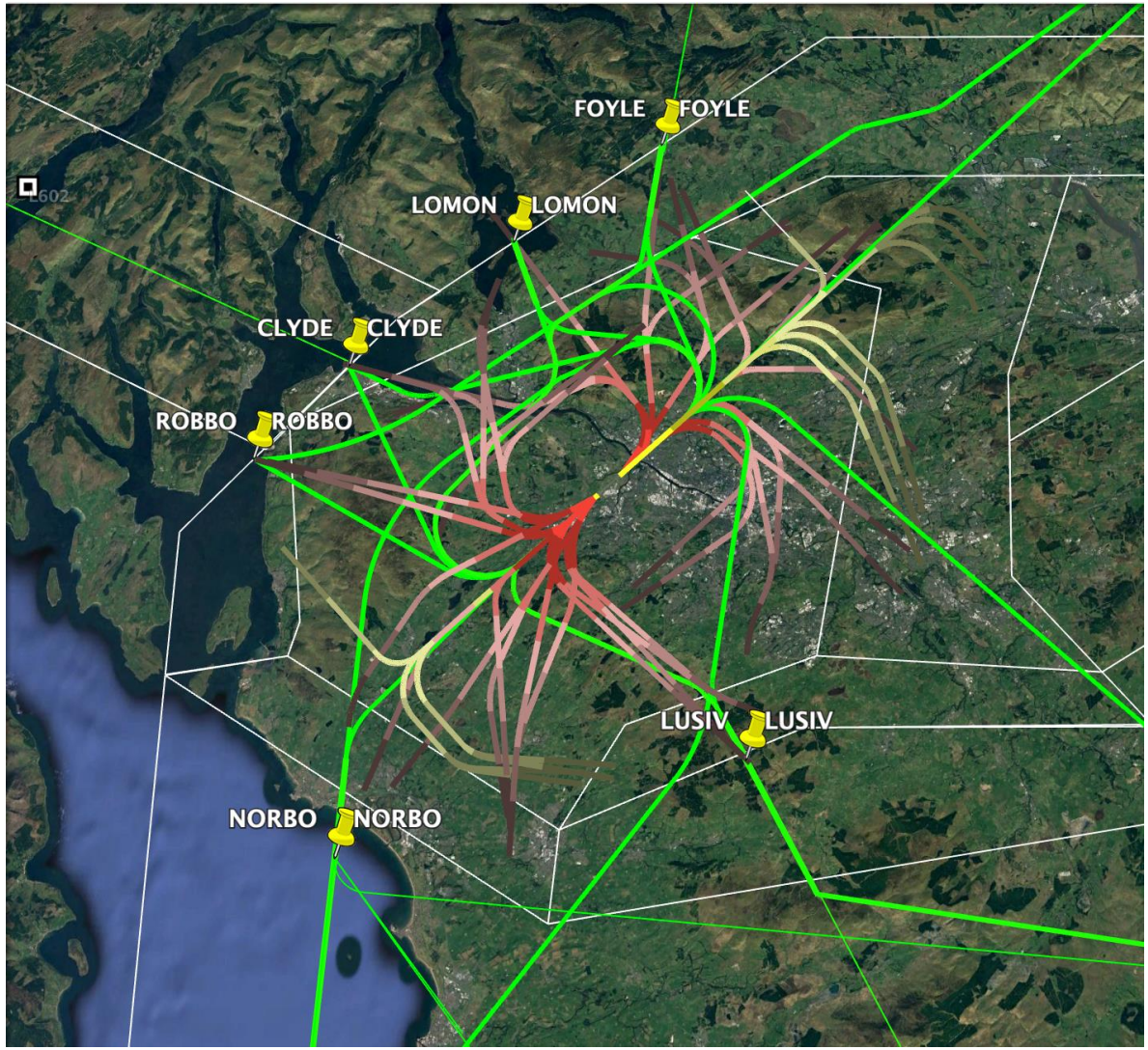
4. CONTROLLED AIRSPACE ARRANGEMENTS

Existing CAS, Existing SIDs and our Comprehensive List of Options

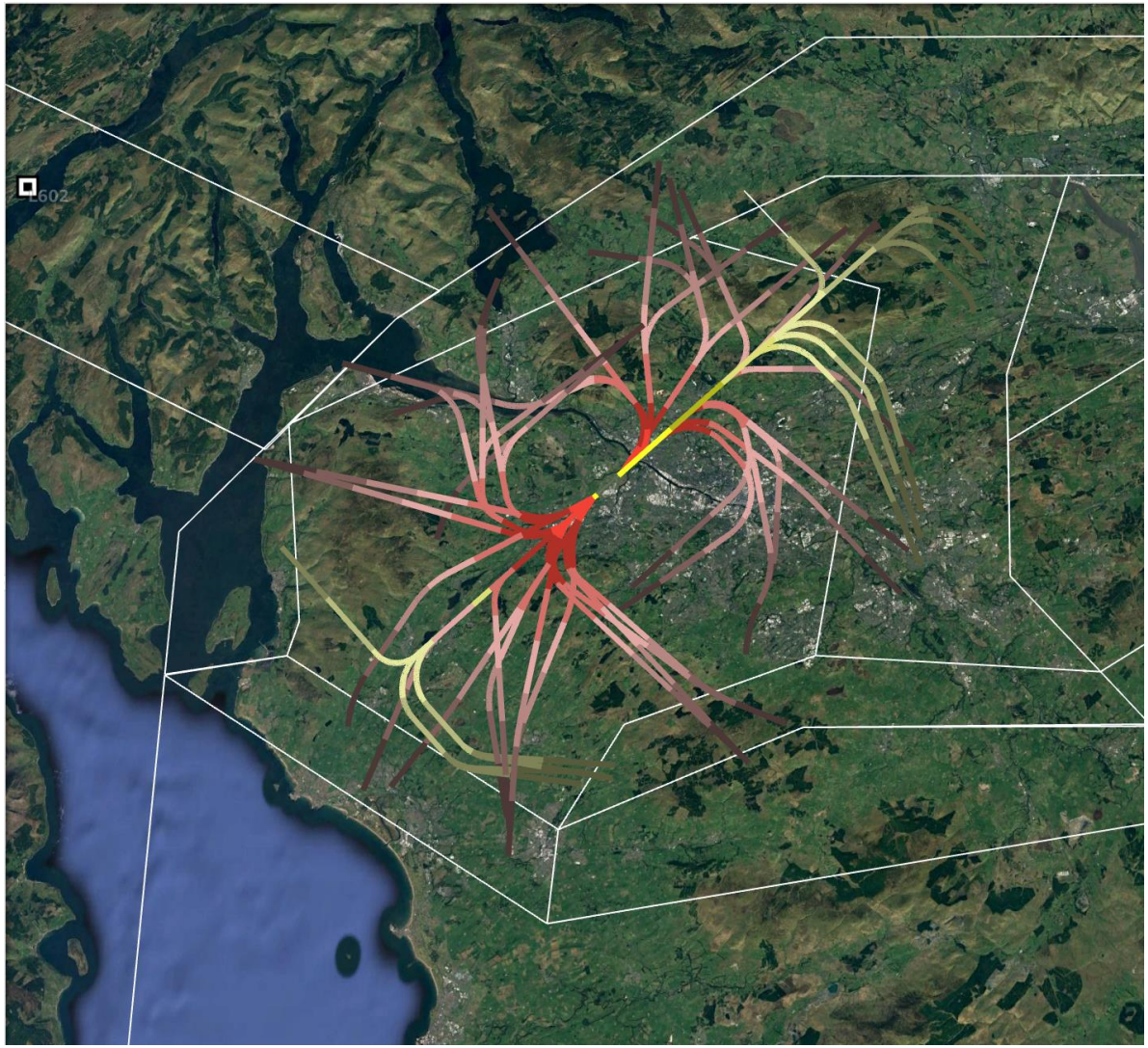


Green – Existing SIDS
White – Existing CAS boundaries
Red – Comprehensive List of Departure Options
Yellow – Comprehensive List of Arrival Options

Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data	Arrival Options and aircraft track data
0 – 1000		
1000 – 2000		
2000 – 3000		
3000 – 4000		
4000 – 5000		
5000 – 6000		
6000 - 7000		

4. CONTROLLED AIRSPACE ARRANGEMENTS

Existing CAS and our Comprehensive List of Options



Indicative (Conservative) Altitude (ft)	Departure Options and aircraft track data	Arrival Options and aircraft track data
0 – 1000		
1000 – 2000		
2000 – 3000		
3000 – 4000		
4000 – 5000		
5000 – 6000		
6000 - 7000		

4. CONTROLLED AIRSPACE ARRANGEMENTS

Comprehensive List of Options

Our Comprehensive List of Options is formed of 10 arrival options and 12 departure system options. We have ensured that the departure and arrival options are compatible however we have kept them as separate options so that we do not limit the number of potential combinations at this stage.

To generate a bespoke CAS volume for every option given the many permutations is not practical, and we will therefore develop detailed CAS volumes for the full system options shortlisted at Stage 3.

For engagement purposes and to start the conversation we have created one CAS volume which we are calling an ‘initial illustrative CAS volume’. This volume:

- Covers **all** the options in accordance with the CAA’s Controlled Airspace Containment Policy
- provides controlled airspace for a CDA from each direction,
- provides symmetry and simplicity where possible.
- doesn’t propose any particular classifications

This initial illustrative volume does not represent the proposed controlled airspace volume for Glasgow’s ACP.

4. CONTROLLED AIRSPACE ARRANGEMENTS

Comprehensive List of Options

As we progress through the process we will develop and refine this CAS volume based on:

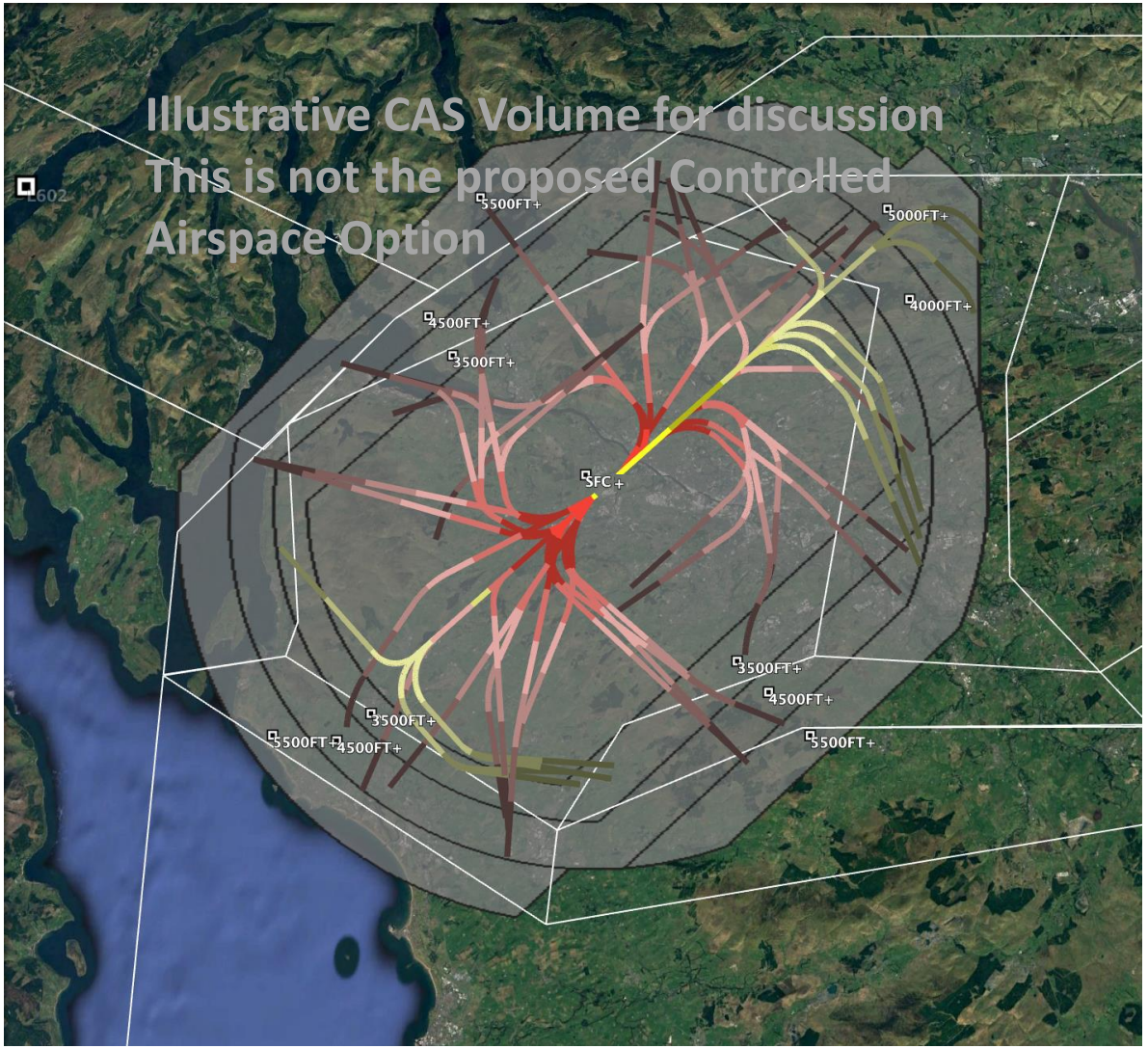
- The options that are shortlisted,
- engagement with General Aviation Stakeholders,
- engagement with Glasgow Airport's ATC team
- engagement with NATS (NERL) and integration into the ScTMA
- Engagement with Edinburgh and Prestwick Airport
- Feedback from the CAA's Airspace Classification Review

We would appreciate your initial feedback so we can understand the areas of concern as well as the areas of benefit in more detail. We will use your feedback to help us assess the different options as part of the design principle evaluation and initial options appraisal.

As part of this session, we will share an initial illustrative example which is a starting point for future CAS arrangements. At this stage, this is not the proposed volume of CAS for Glasgow's ACP but it does enable initial discussions which will help us as we refine and develop our options. We would politely ask that Stakeholders do not widely share the initial illustrative CAS volume as without this context, it could be misleading to those who have not seen the full presentation.

4. CONTROLLED AIRSPACE ARRANGEMENTS

Existing CAS, Initial Illustrative CAS Volume and our Comprehensive List of Options



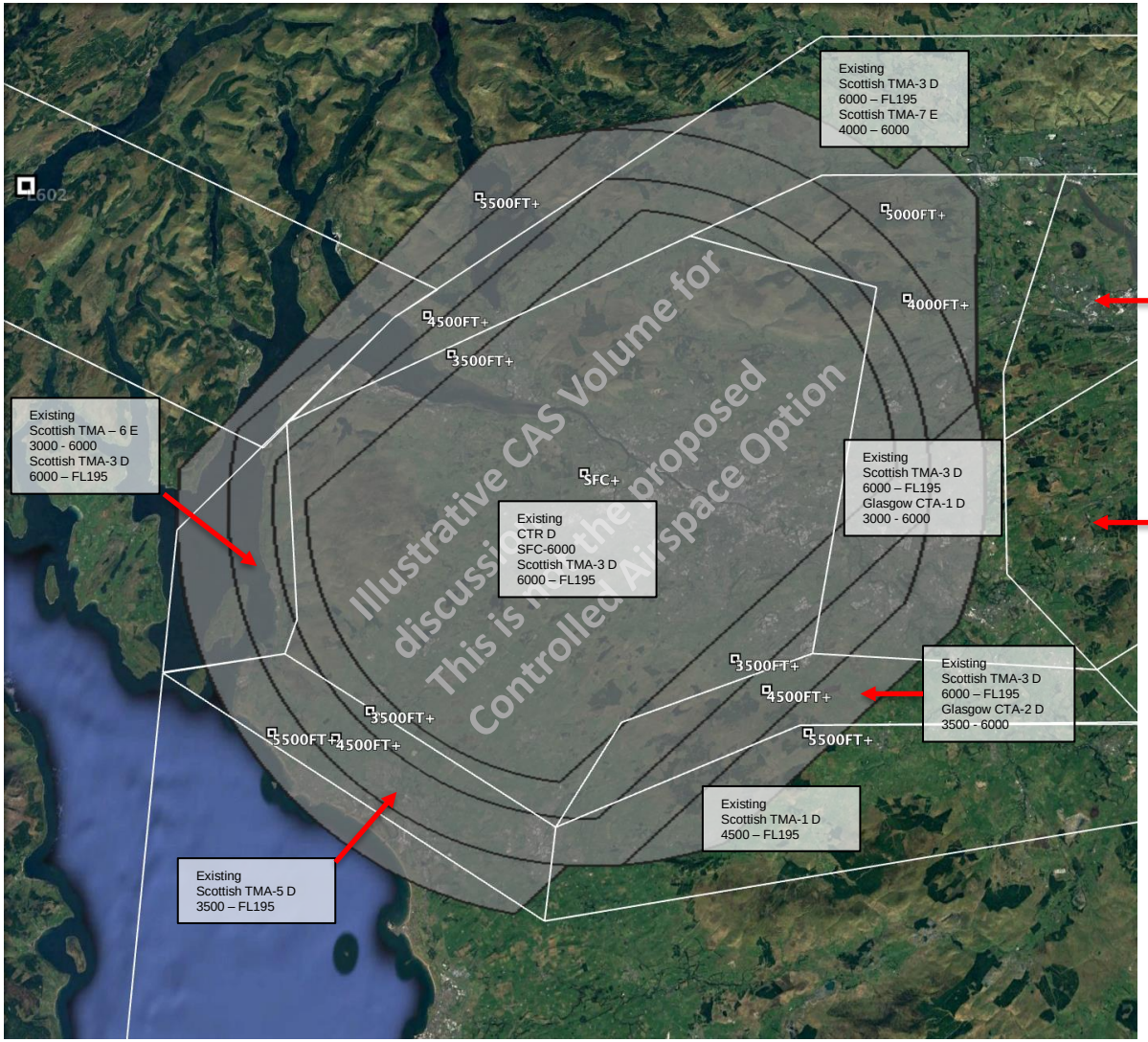
White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume
Red – Comprehensive List of Departure Options
Yellow – Comprehensive List of Arrival Options

The CAS has been designed to accommodate a CDA in both directions and contain all options according to the Controlled Airspace Containment Policy.

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Existing CAS and an Initial Illustrative CAS Volume (generated for discussion only)



White – Existing CAS boundaries and classification
Black (Shaded Grey) – Initial Illustrative CAS Volume

The CAS has been designed to accommodate a CDA in both directions and contain all options according to the Controlled Airspace Containment Policy.

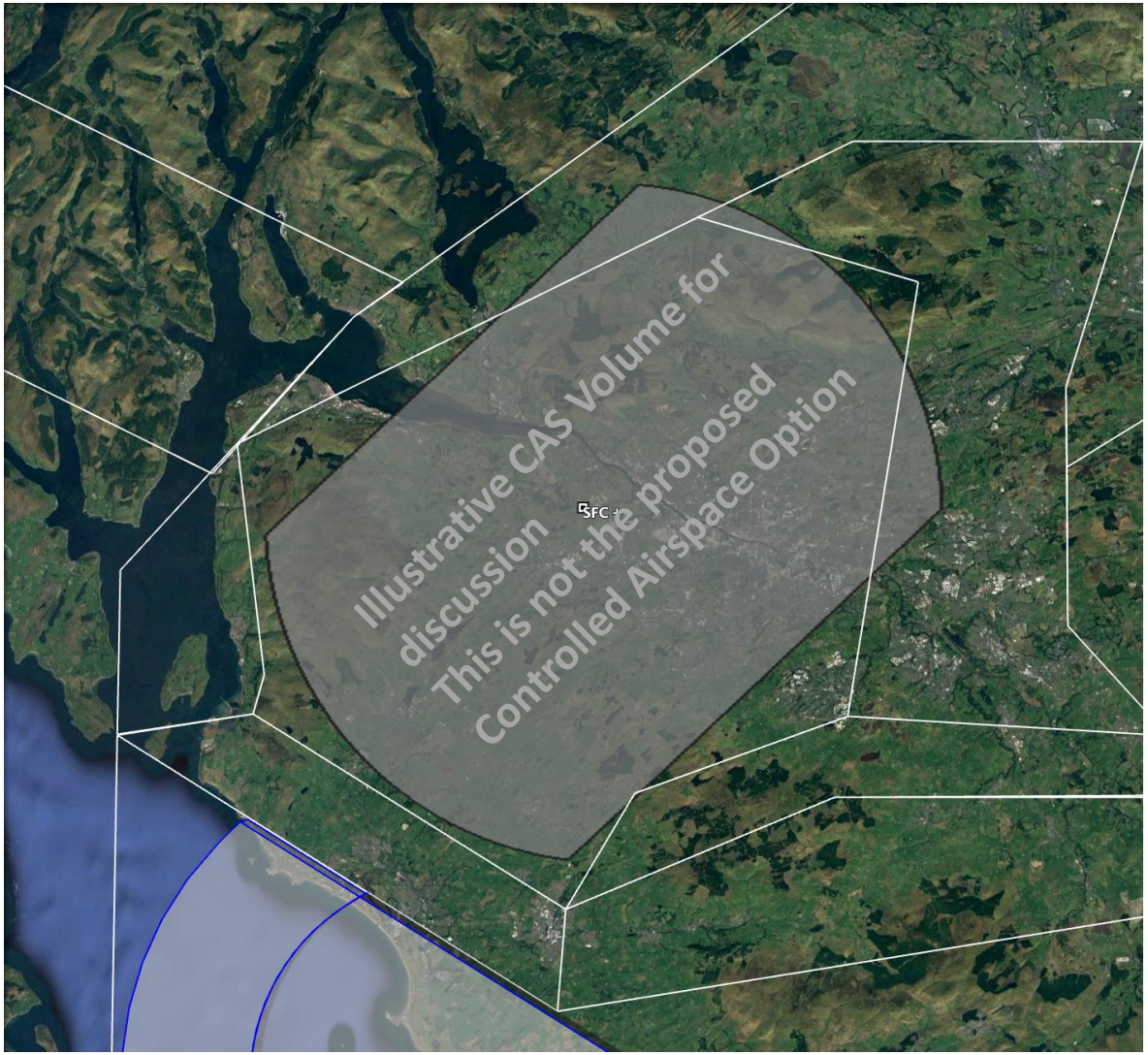
Existing
Scottish TMA-3 D
6000 – FL195
Glasgow CTA-1 D
3500 - 6000

Existing
Scottish TMA-3 D
6000 – FL195
Edinburgh CTA-1 D
2500 - 6000

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Initial Illustrative CAS Volume (generated for discussion only)



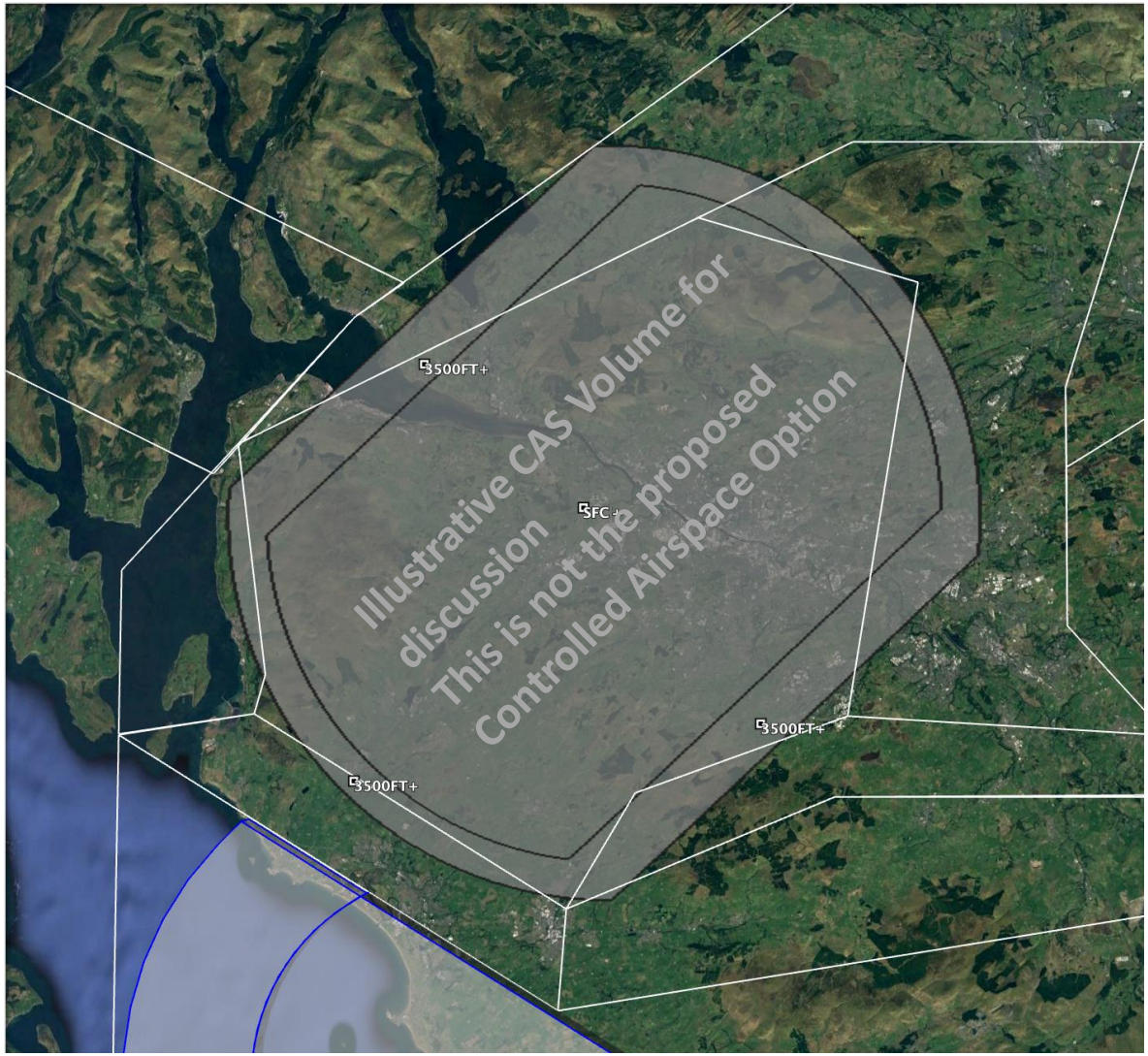
White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume

SFC+

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Initial Illustrative CAS Volume (generated for discussion only)



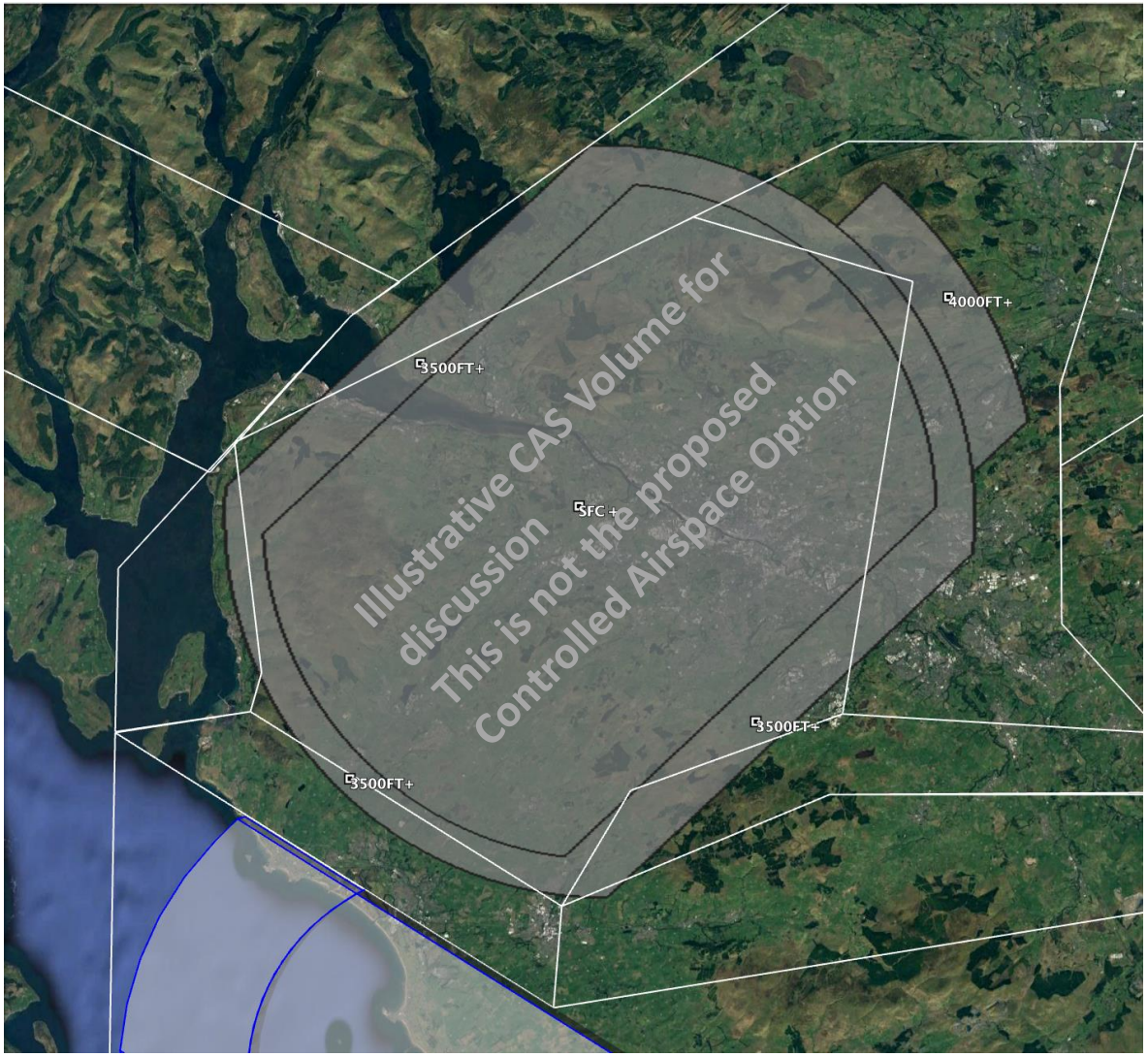
White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume

SFC+
3500ft+

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Initial Illustrative CAS Volume (generated for discussion only)



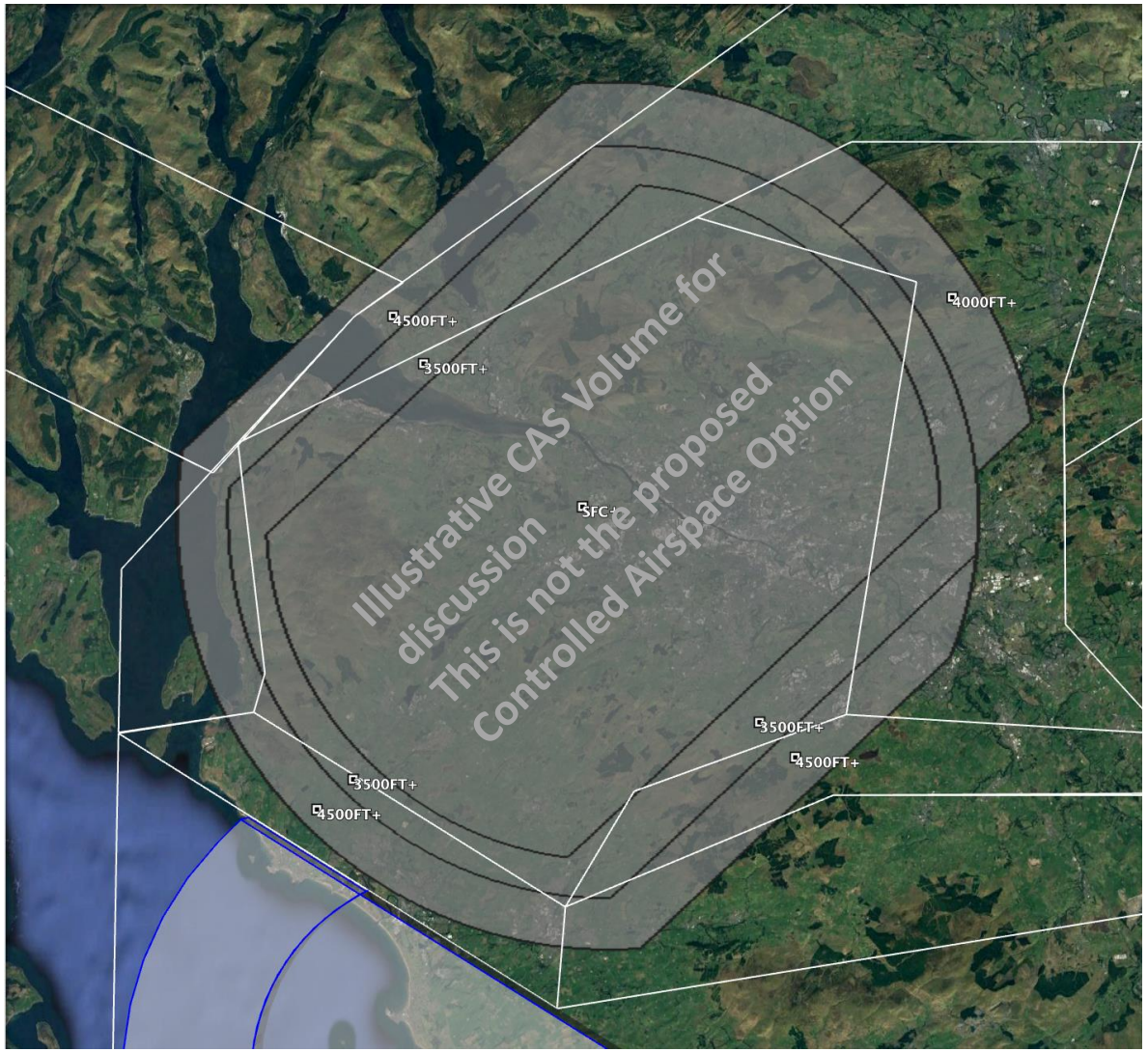
White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume

SFC+
3500ft+
4000ft+

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Initial Illustrative CAS Volume (generated for discussion only)



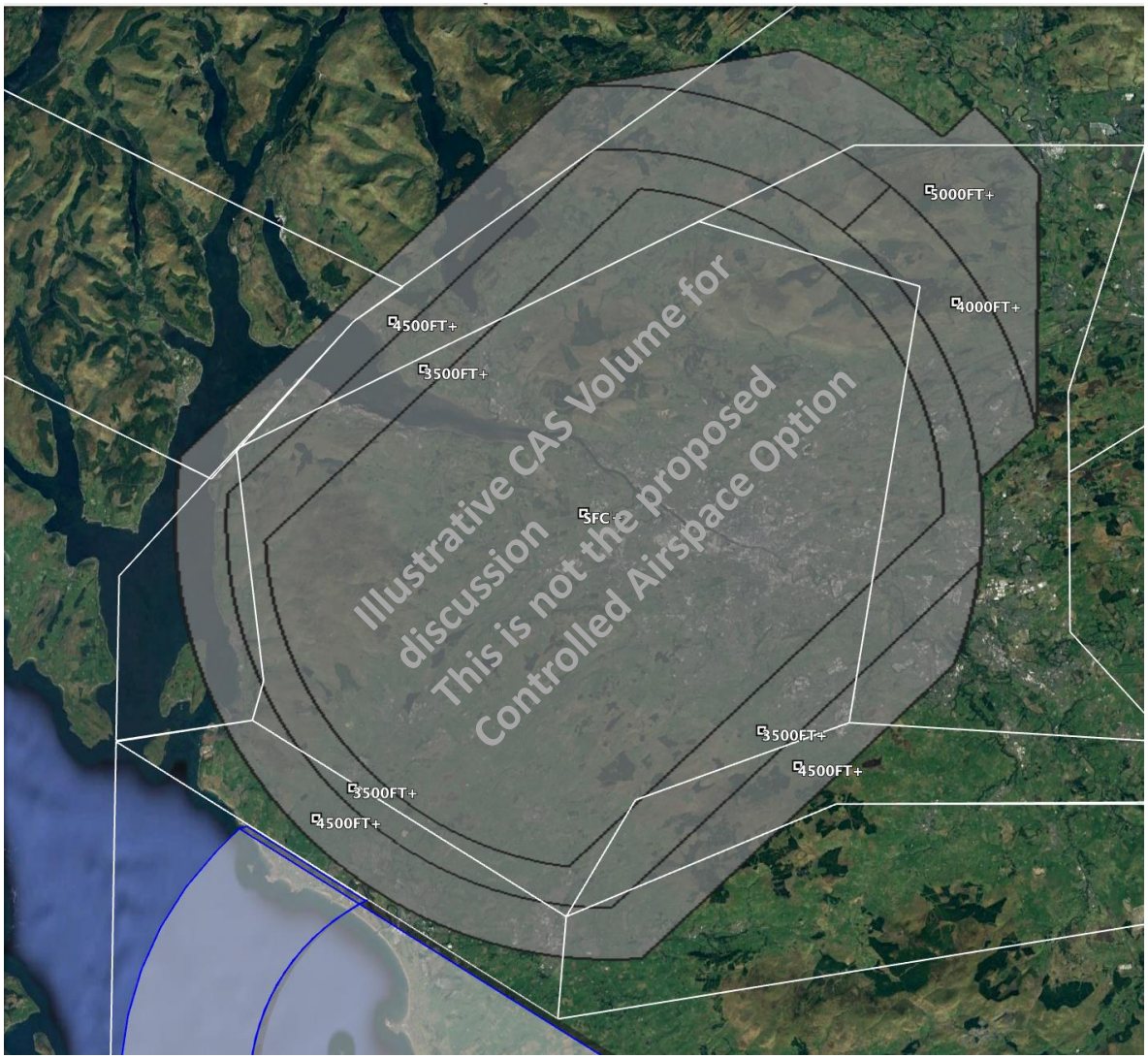
White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume

SFC+
3500ft+
4000ft+
4500ft+

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Initial Illustrative CAS Volume (generated for discussion only)



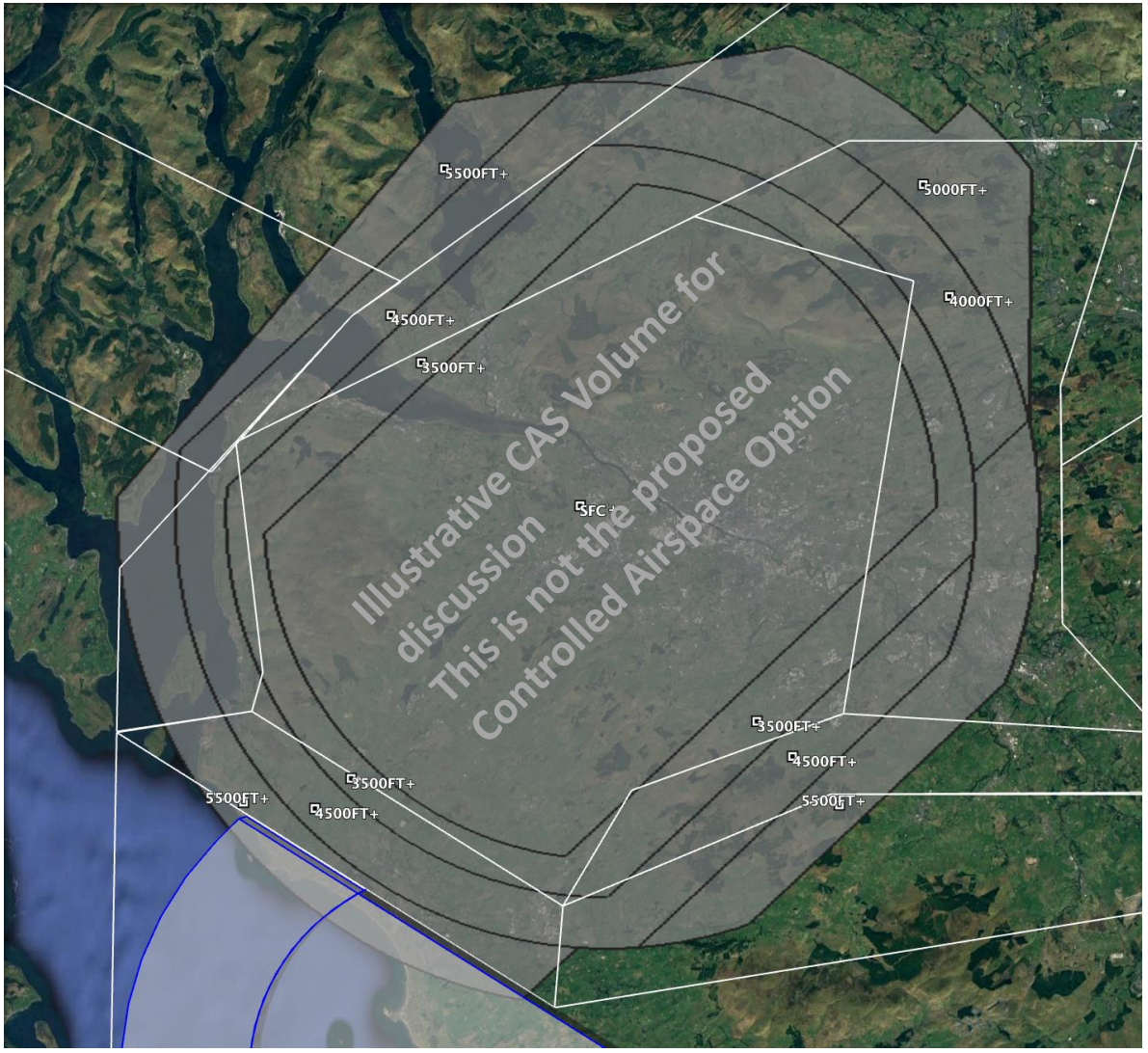
White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume

SFC+
3500ft+
4000ft+
4500ft+
5000ft+

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

Initial Illustrative CAS Volume (generated for discussion only)



White – Existing CAS boundaries
Black (Shaded Grey) – Initial Illustrative CAS Volume

SFC+
3500ft+
4000ft+
4500ft+
5000ft+
5500ft+

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

4. CONTROLLED AIRSPACE ARRANGEMENTS

GLASGOW AIRPORT
PROUD TO SERVE SCOTLAND

5. Questions

5. QUESTIONS

We would like your feedback on our initial illustrative CAS volume so we can understand the areas of concern as well as the areas of benefit in more detail. The question we are asking General Aviation Stakeholders as part of the workshops today are:

- **What do you think about the initial illustrative CAS volume? (Please provide details of the specific areas of benefits, impacts and potential affects)**

In addition to these specific questions for GA Stakeholders, we are asking all stakeholder for their feedback on our approach for developing our comprehensive list of options. The questions we are asking:

- **Are you satisfied that we have taken into account the Design Principles when developing our comprehensive list of route options?**
- **Are there any further considerations that relate to the Design Principles which we have not taken into account?**

We are able to refine or develop more options, based on your feedback.

A link to the feedback website will be circulated to all identified Stakeholders and all surveys must be completed online by Monday 10th January 2022.

As part of this session, we have shared our initial comprehensive list of options and the initial illustrative example which is a starting point for future CAS arrangements. At this stage, this is not the proposed volume of CAS for Glasgow's ACP but it does enable initial discussions which will help us as we refine and develop our options. We would politely ask that Stakeholders do not widely share the initial illustrative CAS volume as without this context, it could be misleading to those who have not seen the full presentation.

6. Next steps

6. NEXT STEPS

Design Principle Evaluation

- Following the close of the feedback period we will review all feedback from stakeholders and make any refinements or create new options where appropriate.
- Our full comprehensive list of options will then be taken forward to the Design Principle Evaluation.
- This is where we assess each option against each design principle to understand whether it has met, partially met, or not met that principle.
- This is a qualitative assessment although quantitative data from the airspace design database will be used to support the qualitative analysis undertaken where applicable.
- The feedback from General Aviation Stakeholders around our Initial Illustrative CAS volume will help us when we evaluate the options against Design Principles 3 and 9.
- The outcome of the Design Principle Evaluation will be a shortlist of options taken forward to the Initial Options Appraisal at Step 2B.