London Southend Airport Airspace Change Proposal

Introduction of New Approach Procedures

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Prepared by:
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Acronyms

Acronym:	Description:
3AF	3rd Air Force
ACC	Airport Consultative Committee
ACP	Airspace Change Proposal
AIP	Aeronautical Information Publication
ATC	Air Traffic Control
AONB	Area of Outstanding Natural Beauty
B-o-C	Burnham-on-Crouch
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CAS	Controlled Airspace
CDA	Continuous Descent Approach
DA	Danger Area
DAATM	Defence Airspace and Air Traffic Management
DfT	Department for Transport
DME	Distance measuring equipment
FAF	Final Approach Fix
FAS	Future Airspace Strategy
FRT	Fixed Radius Turn
GA	General Aviation
GNSS	Global Navigation Satellite System
IAF	Initial Approach Fix
IAP	Instrument Approach Procedures
ICAO	International Civil Aviation Organisation
IF	Intermediate Fix
ILS	Instrument Landing System
INS	Inertial Navigation System
LNAV	Lateral Navigation
LPA	Local Planning Authority
LPV (SBAS)	Localiser Procedure with Vertical guidance (Satellite Based Augmentation System)
LSA	London Southend Airport
LSACC	London Southend Airport Consultative Committee
LTMA	London Terminal Manoeuvring Area
MAA	Military Aviation Authority
MP	Member of Parliament
NATMAC	National Air Traffic Management Committee
NATS	National Air Traffic Services
NCHQ	Navy Command Headquarters
NM	Nautical Mile
NSA	National Scenic Area
PANS-OPS	Procedures for Air Navigation Services – aircraft OPerationS. (ICAO rules for designing instrument approach and departure procedures.)

PBN	Performance Based Navigation
PIR	Post Implementation Review
RAMSAR Site	Wetland site designated of international importance
RF	Radio Frequency
RF Turn	Radius-to-Fix Turn
RNAV	Area Navigation
RNP	Required Navigational Performance
RNP-APCH	Required Navigational Performance – Approach
SAC	Special Area of Conservation
SARG	Safety and Airspace Regulation Group
SBAS	Satellite Based Augmentation System
SID	Standard Instrument Departure
SPA	Special Protection Areas
SRA	Surveillance Radar Approach
SSSI	Sites of Special Scientific Interest
STAR	Standard Terminal Arrival Routes
VFR	Visual Flight Rules
VNAV	Vertical Navigation
VOR	Very High Frequency Omni-Directional Radio Range

References

Ref No:	Name:	Version No:
Reference 1	London Southend Airport Flight Path Consultation Document	1.0
Reference 2	London Southend Airport Consultation Feedback Report	1.1
Reference 3	AIP - GEGMU 1F 1G 1J 1K STAR (south)	
Reference 4	AIP – GEGMU 1B 1D STAR (east)	
Reference 5	AIP - SPEAR 1A STAR (north and west)	
Reference 6	ICAO PANS-OPS RNAV Flight Procedures and Construction of Procedures	
Reference 7	Southend DME/ DME Assessment Report	
Reference 8	Doc 8168 PANS-OPS Vol I Flight Procedures/ Vol II Construction of Procedures	
Reference 9	HazID/ Safety Analysis	
Reference 10	Southend PBN Approaches – Procedure Design Submission	3.0
Reference 11	Phase 1 Justification Paper – Straight-in Approaches	
Reference 12	CAA Airspace Design CAP1616	
Reference 13	UK Air Navigation Guidance 2017	
Reference 14	Engagement with NATS Swanwick TC – Southend TC Ops Interface Meeting Minutes	
Reference 15	Validation / Simulation Plan – London Southend Airport RNAV Approaches	1.0
Reference 16	Southend RNP APCH Safety Case	1.1

1. Introduction

1.1. Project Overview

This Airspace Change Proposal (ACP) concerns the introduction of new approach procedures at London Southend Airport (LSA). These will be based on the Area Navigation or RNAV1 navigation standard which uses GNSS (Global Navigation Satellite System) augmentation to achieve more precise flight path track keeping and will operate alongside the existing approach methods used today.

This change will enable the deployment of modern aircraft technologies (namely RNAV1) to upgrade the approach function at LSA. These approaches will utilise Performance Based Navigation (PBN) on board suitably equipped aircraft to deliver satellite-based track keeping, allowing aircraft to follow routes with a greater level of accuracy than today. This will enable a more efficient use of the airspace.

This ACP proposes the introduction of PBN instrument approach procedures (IAP) to two runway ends with three initial approaches for runway 23 and two for runway 05 (see Figure 1), these include two RNAV1 Missed Approach Procedures (one for each runway) and an RNAV1 arrival transition for Runway 05 (see Figure 2). Further procedures designed to augment and replicate the current ILS approach paths for tactically vectored aircraft are described in section. The project is targeting an earliest implementation date of 10th October 2019 (AIRAC 11); dependent on available CAA resource.

The proposed procedures will complement the current conventional procedures, and will not act as a replacement. They have been designed to reflect existing routings that are flown by aircraft on approach to LSA as closely as possible. The design process took into account environmental, operational and procedure design criteria as well as feedback from the public consultation. Where replication of current aircraft flight paths has not been possible due to RNAV design constraints, the key design priority has been to minimise the number of people overflown, where technically feasible.

LSA completed a formal public consultation on these proposals, which ran from Tuesday 6th June to Wednesday 30th September 2017. This had been increased by two weeks in order to allow some stakeholders additional time to respond. The Consultation Document(Ref1) detailed the proposed approach procedures and gave the justification for these changes. Throughout the consultation, LSA engaged with stakeholders including airspace users, local councils and residents. The consultation received a total of 74 responses which were analysed and summarised in the Consultation Feedback Report(Ref2).

It should be noted that this ACP will follow the CAA's process, CAP725 'CAA Guidance on the Application of the Airspace Change Process' to introduce these procedures as agreed with the CAA.

Out of Scope of This ACP

A separate ACP is currently underway by LSA which proposes the introduction of new Standard Instrument Departures at LSA (ref ACP-2015-20). The two proposals are not linked.

1.2. Changes to the Proposal

As a consequence of the delay in progressing the proposal and taking account of feedback from the CAA, the ACP will include, in addition to the procedures outlined in section 1.1, a shorter straight-in approach to both runways. These will be used for vectored approaches ie Air Traffic Control (ATC) will tactically position the aircraft to a specified point (called the IF or Intermediate Fix) at the start of this part of the final approach track, in a similar manner to today (see Figure 3). These procedures will use PBN technology to replicate the current Instrument Landing System (ILS) or glide path.

These shorter straight-in approaches are a replication of today's operation and in consultation with the CAA it was determined at the Framework Briefing (FWB) on 1st November 2016 that they should result in no discernible difference in either ground track or noise. As a consequence it was initially decided that a shorter Justification Paper(Ref10) be submitted outlining this aspect of the proposed change rather than the submission of an ACP. However, due to the afore mentioned delays this aspect of the change will now be covered in this ACP submission and will reference the previously submitted Justification Paper.

1.3. Proposed Procedures

LSA is proposing the introduction of the following PBN instrument flight procedures:

- 2 approach procedures for Runway 05 (Figure 1) with a single missed approach see (Figure 2)
- 3 approach procedures for Runway 23 (Figure 1) with a single missed approach see (Figure 2)
- 1 arrival transition for Runway 05 (Figure 2)
- 2 5LNC designated intermediate fixes for vectored approaches. These were not consulted on as they replicate the current vectored ILS approaches. This was agreed with the CAA in the FWB meeting (see Figure 3)
- 3 final approach minima lines for each runway encompassing LNAV, LNAV/VNAV and LPV PBN standards

Draft copies of the full procedures can be seen in Appendix B.

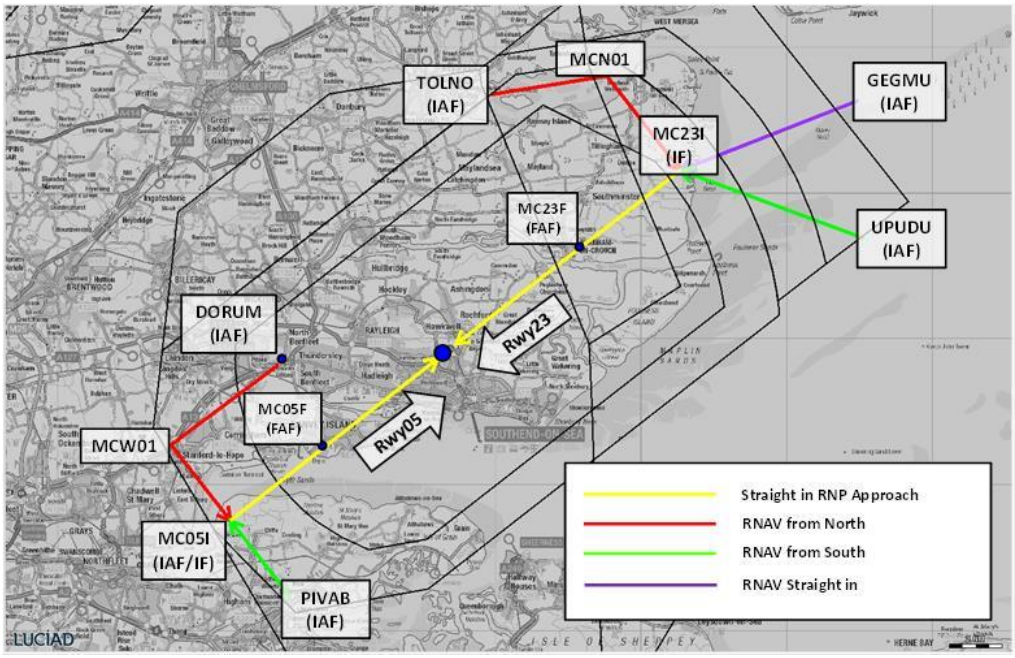


Figure 1: Proposed Approach Procedures for Runways 05 and 23

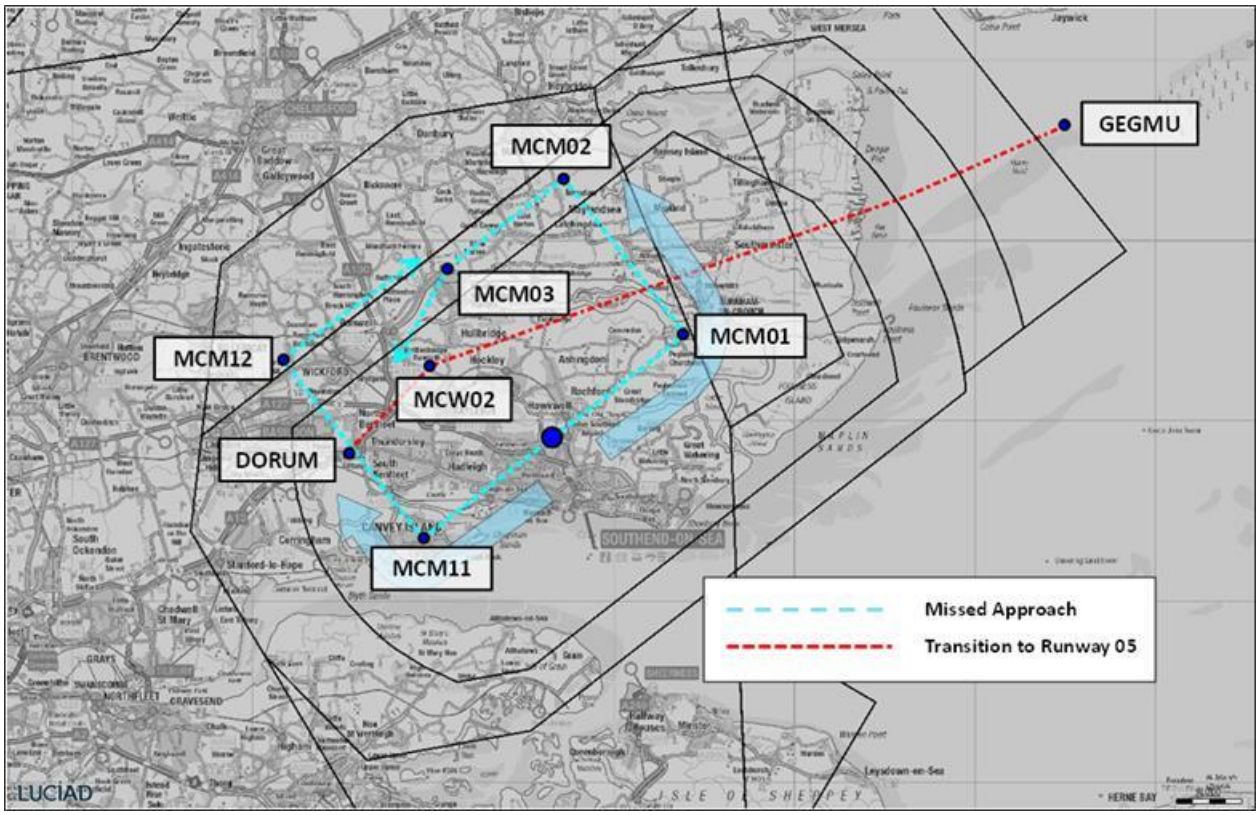


Figure 2: Proposed Missed Approach Procedures and Transition to Runway 05

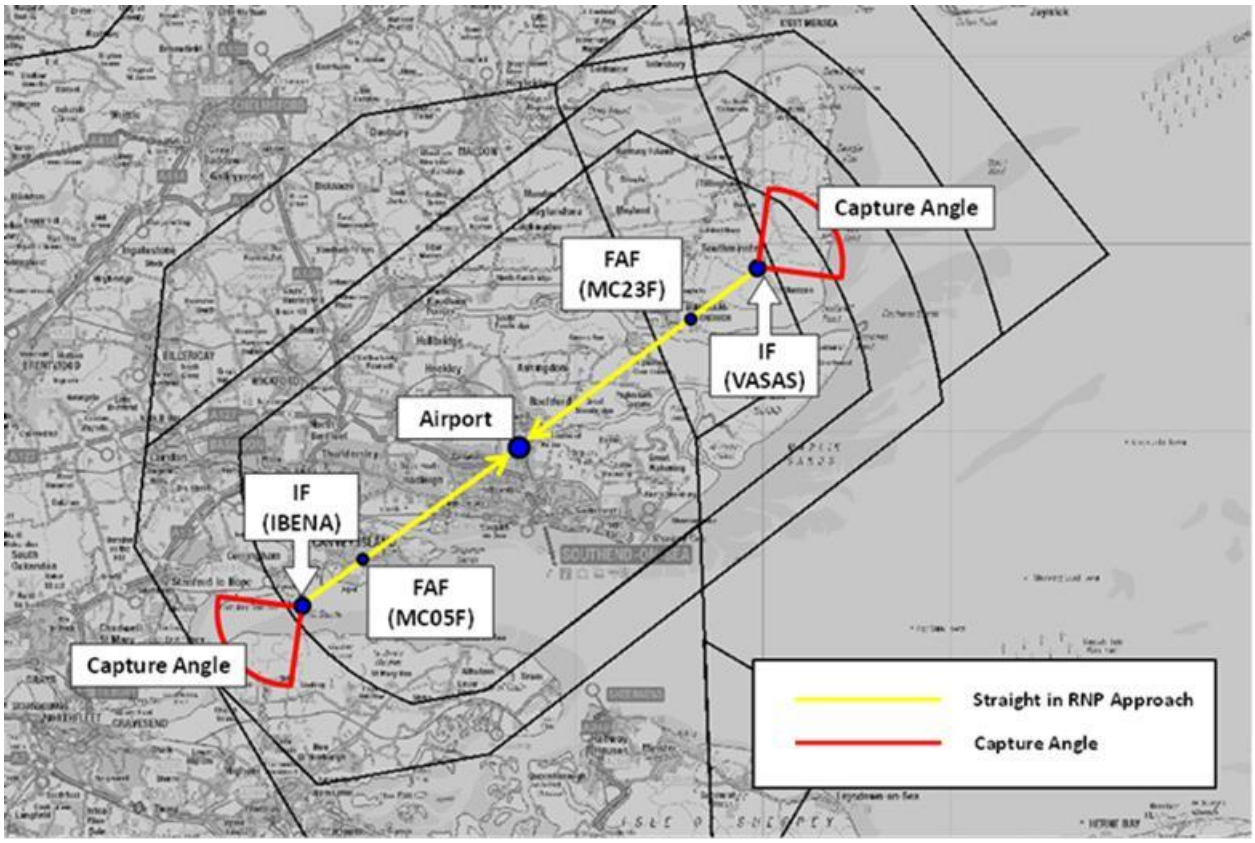


Figure 3: Proposed Tactically Vectored Straight-in Final Approaches

2. Justification and Objectives

2.1. Background and Justification

LSA is looking to modernise its airspace through the use of Performance Based Navigation (PBN) technology, which enables aircraft to follow routes more accurately. This change is necessary to update the airspace around LSA to align with the CAA's Future Airspace Strategy (FAS) and Airspace Modernisation Strategy (AMS), see section 2.3.

Modernising the airspace will allow LSA to complement the current flight paths with new arrival and approach procedures using PBN capabilities. These allow aircraft to be positioned more accurately on defined routes, with less dispersal either side of the route centrelines. LSA has endeavoured to minimise the impact of aircraft to people on the ground through the route designs, particularly from overflights below 4,000ft.

A key design principle was, where possible, to maintain current flight patterns; however where improvements have been possible these have also been proposed, utilising the improved track keeping of new technologies.

Due to limitations imposed by technical design criteria for RNAV implementation(Ref8), there are some variances from current aircraft flight paths.

LSA's aim is to maximise the benefit of the proposed changes to the airport and the surrounding area of the South-East of England. In line with this objective, LSA has focussed on minimising the noise impact to those on the ground; 4,000ft below the routes in the area surrounding LSA and up to 7,000ft below the routes in the wider area.

2.2. Objectives

The objectives of the Airspace Change Proposal are as follows:

- Introduce RNAV1 procedures in support of the CAA's FAS/AMS and to be consistent with the Government's objectives to improve the efficiency of UK airspace;
- Minimise the noise impact on overflown populations, particularly below 4,000ft and newly impacted populations;
- Increase operational resilience through the introduction of alternative final approach procedures
- Improve the accuracy and predictability of arrival track patterns;
- Where possible, improve upon current procedures through the use of PBN technology;
- Not to increase the overall volume of controlled airspace;
- Not to impact the LTMA (London Terminal Manoeuvring Area) operation West of LSA's airspace;
- Improve upon the level of safety and efficiency of the Air Traffic Control (ATC) operation, with less controller intervention required for arrivals;
- Mitigate the environmental impact of aviation;
- Minimise impact on military operations.

The final design will reflect a balanced approach between these potentially competing objectives and requirements.

2.3. CAA Future Airspace Strategy (FAS) Alignment

When LSA commenced this proposal process, the FAS was clearly focussed on upgrading the airspace throughout the UK and Ireland to increase capacity and efficiency, whilst maintaining safety. The FAS was created to align with the Single European Sky project with the aim to simplify and harmonise the way airspace and air traffic control is used.

The CAA's Airspace Modernisation Strategy (AMS) published in December 2018, has replaced the FAS; as well as responding to a requirement for a strategy which covers airspace modernisation up to 2040. The introduction of RNAV arrival procedures at LSA would improve systemisation of air traffic in the South-East region and upgrade the navigation capability in accordance with the FAS and AMS recommendations.

The proposed changes at LSA are also in support of airspace modernisation through new operational procedures which will increase the operational resilience and reduce reliance on non-precision approaches, should the ILS not be available. These improvements therefore also support the objectives outlined in the updated strategy.

3. Current Airspace

3.1. Current Arrival Flight Paths

LSA is situated to the East of London and is overflown by some of the busiest and most complex airspace in the world. It is affected by the traffic flows to and from major London airports including Stansted, Luton, London City, Gatwick and Heathrow. LSA is located underneath the LTMA airspace which is a demanding area used by air traffic controllers to manage the flights of LSA alongside other inbound/outbound flights to London airports.

There is one runway at LSA which is 1,856m in length. The runway is aligned to the North-East (runway 05) and South-West (runway 23). The runway names relate to the runway heading in compass degrees i.e. Runway 23 has a heading of roughly 230°, so aircraft landing or departing from this runway will do so heading roughly to the South-West.

Due to the prevailing wind conditions in the UK, Runway 23 at LSA is used for approximately 70% of the time and Runway 05 the remaining 30%. Runway usage is also affected by LSA's planning obligations (Section 106). It is stipulated that, where conditions permit, aircraft should land using Runway 23 as it is over a less densely populated area.

Arrivals to LSA use one of four Standard Arrivals Routes (STARs) which route aircraft from the North, East, South, and North-West. Aircraft are delivered to appropriate points from which they can either hold overhead or be vectored by Air Traffic Control (ATC) directly to one of the two runways.

The following references show the four published arrival routes; these can also be found in Appendix B within this document:

- References 3 and 4 – GEGMU STARs from the South and East whereby, in both cases, the prescribed STAR terminates in a holding point called GEGMU. However in the majority of cases aircraft are tactically vectored by ATC, prior to entering the holding pattern, to the runway in use. Illustrations of actual tracks are shown in Figure 4 and Figure 5.

- Reference 5 – illustrates the STARs from the North and North-West. As above, most arrivals are vectored to the runway as shown in Figure 4 and .

3.2. Current Arrival Track Concentrations

Figure 4 and Figure 5 below illustrate the spread of arrival tracks flown into LSA, for the months of June to August 2017; these are derived from actual flight radar data. These have been split by unique Runway usage (05/23), using Runway log data for LSA. Over the three summer months, June to August 2017, there were a total of 16 days where Runway 05 was only used, and 34 days for Runway 23. The remaining days were not used in the below plots as both runways were in use. It is worth noting that on the remaining days, Runway 23 was used more frequently than Runway 05.

Figure 6 and Figure 7 have been included to illustrate the density of these arrival flight paths around LSA using the same unique runway data as for the arrival track plots (Figure 4 and Figure 5). These give a good geographical indication of where the concentration of arrival flights are currently positioned. The colour coding shows the number of overflights per day as an indication of concentration; a key has been included on both of the diagrams.

A spread of flight paths, as shown in Figure 4 and Figure 5, can be a result of many factors including:

- ATC tactically vectoring arriving aircraft off published arrival procedures directly to the runway in use;
- ATC tactically vectoring LSA aircraft away from nearby London City Airport inbound traffic to maintain safe separation;
- Variation due to weather and different runways being used. Runway usage is primarily dictated by the wind direction;
  The rate and range of descent performance across different aircraft types; typically slower aircraft will turn with tighter radii (e.g. turbo props) whereas larger aircraft fly faster and turn with wider radii (e.g. jets).

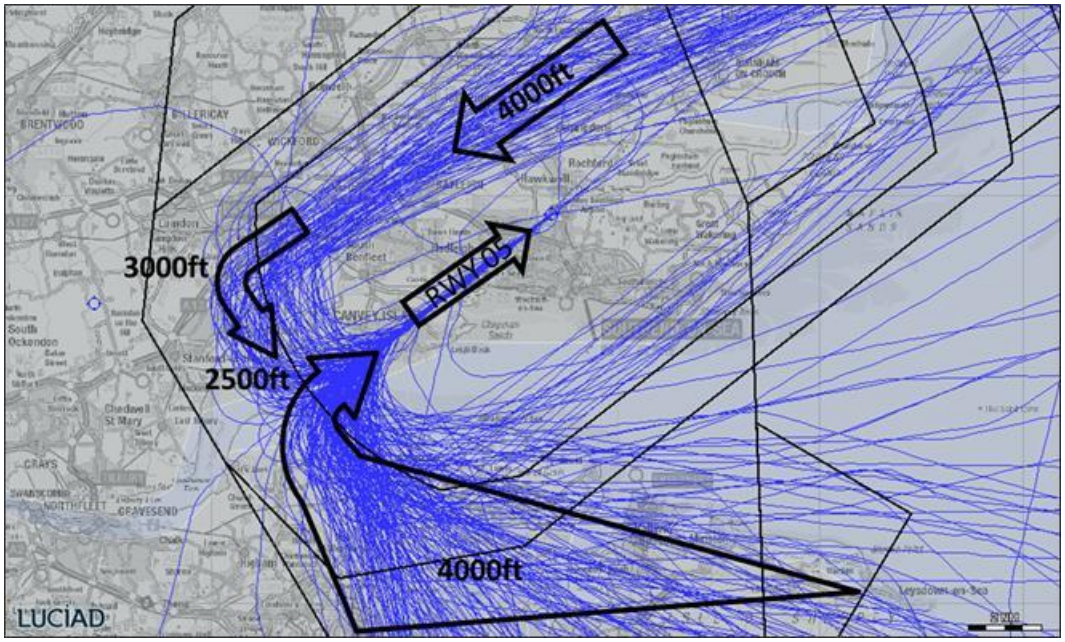


Figure 4: Current Arrival Tracks for Runway 05, June - August 2017

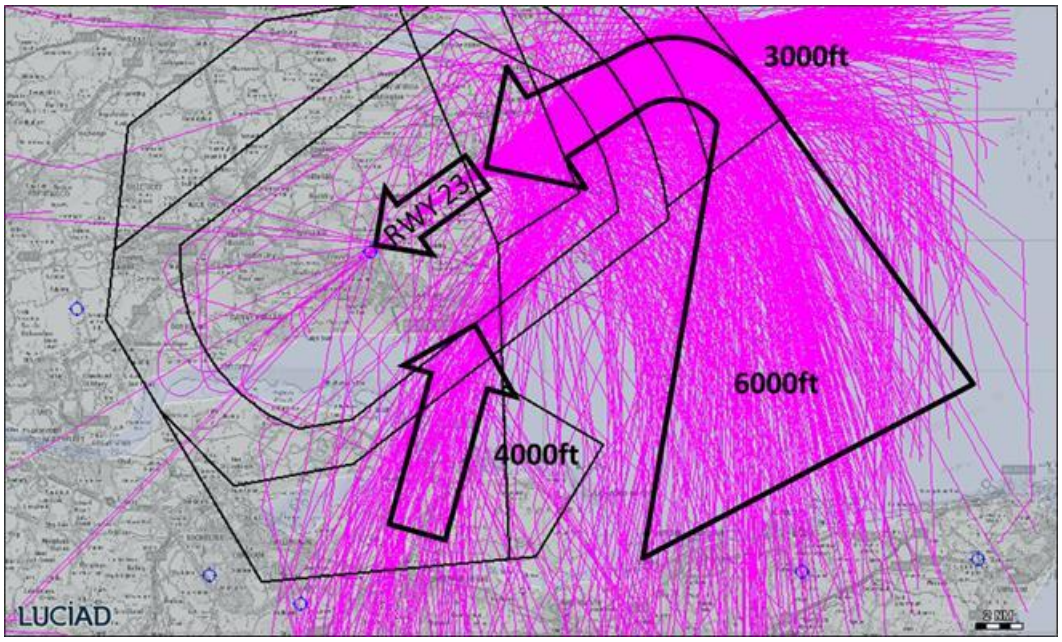


Figure 5: Current Arrival Tracks for Runway 23, June - August 2017

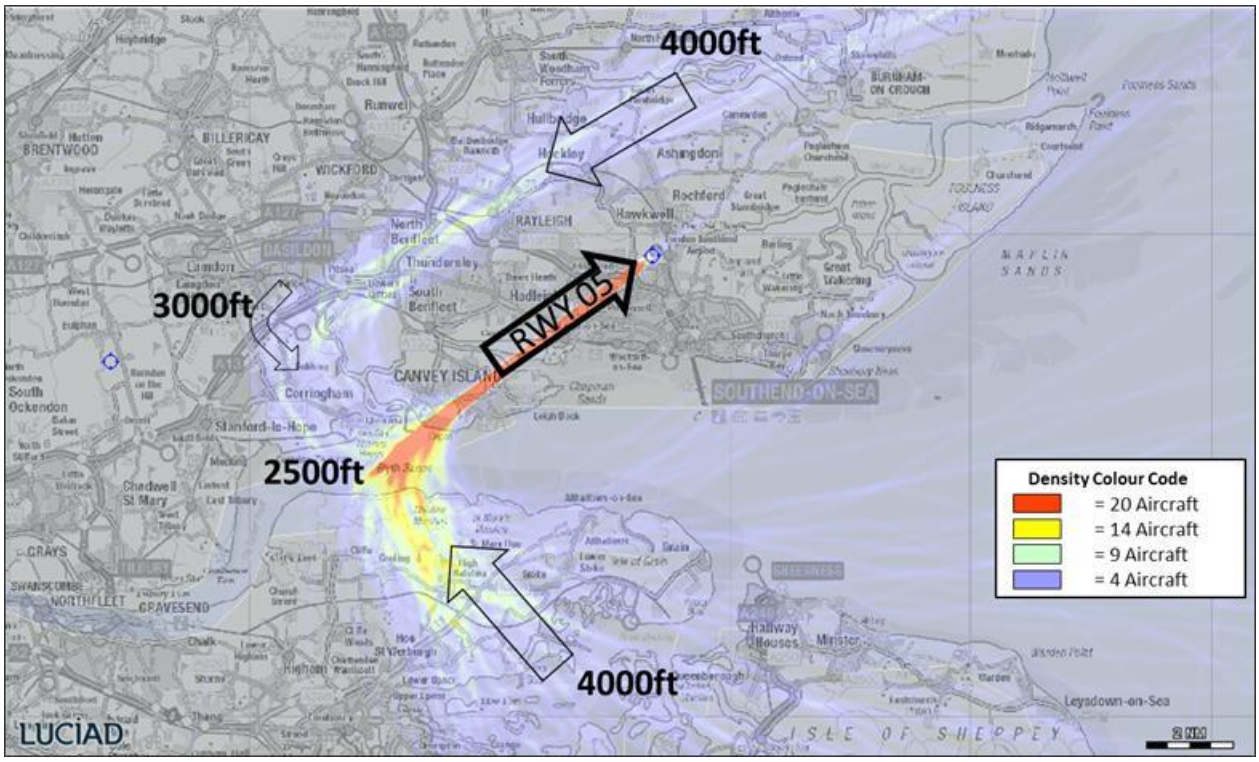


Figure 6: Density Plot for Runway 05 Arrivals, June - August 2017

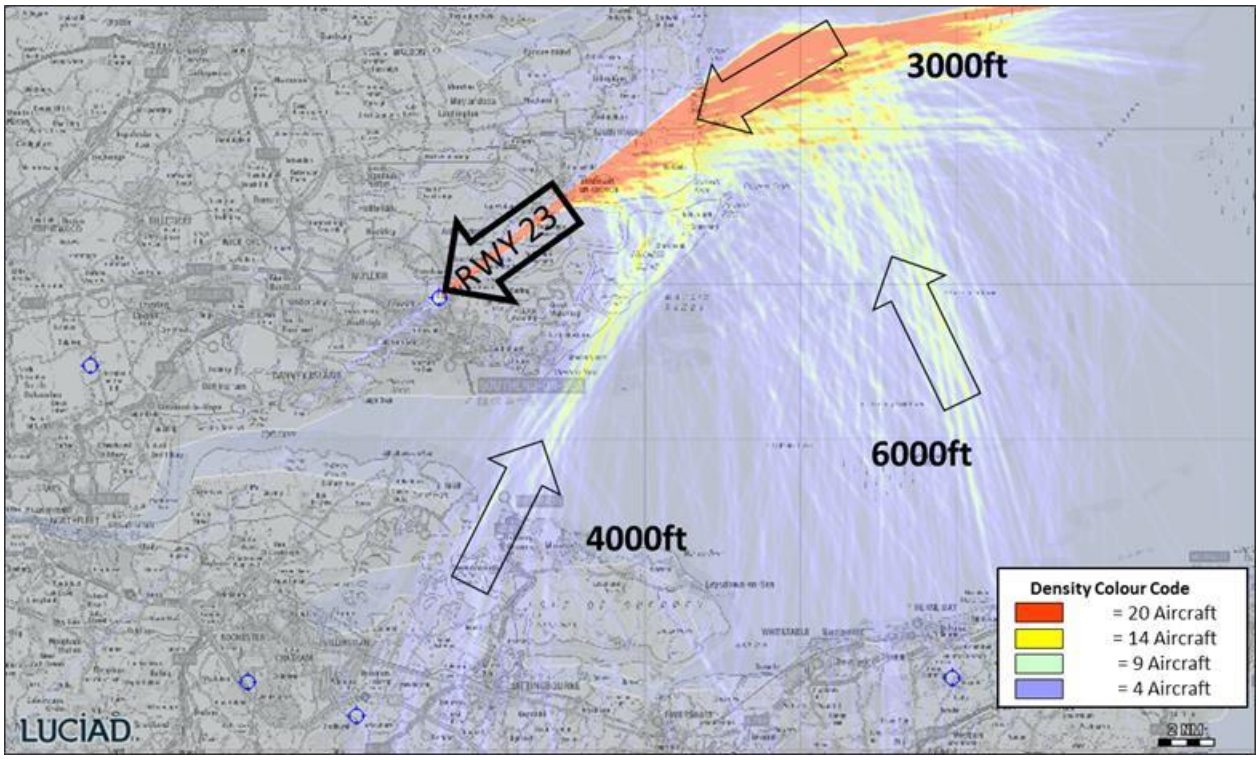


Figure 7: Density Plot for Runway 23 Arrivals, June - August 2017

3.3. Current Traffic and Aircraft Type Figures

The following section gives an overview into the current traffic mix at LSA.

Table 1 below shows the volume of movements at LSA by month of the year for 2017; note that one movement is either an arrival or departure. Of these, just under 50% of the movements were completed by General Aviation (GA) flights and just over 45% were for Air Transport (including air taxis). Table 2 below shows the LSA movements for 2017 broken down by type including General Aviation and Air Transport.

This proposal is not predicted to change the types of aircraft movements using the airport, nor the relative proportions of these.

Month - 2017	Movements
Jan	1,727 (6%)
Feb	1,597 (6%)
Mar	2,106 (8%)
Apr	2,324 (9%)
May	2,329 (9%)
Jun	2,354 (9%)
Jul	2,486 (9%)
Aug	2,735 (10%)
Sep	2,455 (9%)
Oct	2,320 (9%)
Nov	2,268 (9%)
Dec	1,973 (7%)
Total	26,674

Table 1: Southend Airport Movements, 2017

Type	Movements	Proportion
General Aviation	12,828	48.1%
Air Transport (inc Air Taxi)	12,158	45.6%
Business Aviation	797	3.0%
Positioning	766	2.9%
Military	50	0.2%
Other	69	0.2%
Official	6	0.0%
Total	**26,674**	

Table 2: Southend Airport Movement Types, 2017

Table 3 below shows the mix of aircraft types operating at LSA between 1st January – 31st December 2017; one movement is a single arrival or departure. There were a total of 26,674 movements in 2017; 18,672 (≈70%) of which used Runway 23 and the other 8,002 (≈30%) used Runway 05.

There are a wide variety of aircraft from surrounding areas which use LSA, alongside a number of commercial aircraft based at LSA. The commercial based aircraft are mainly medium sized twin engine jets (e.g. A320 group) or twin propeller aircraft (e.g. ATR group). The most frequent aircraft type at LSA are small private GA aircraft operating under Visual Flight Rules (VFR). These accounted for just under 50% of the movements in 2017.

This proposal is not intended or expected to change the aircraft types using the airport, nor the relative proportions of those aircraft types.

Aircraft Type	Total Movements	Proportion of Movements
A320 group	6,100	22.9%
ATR group	2,667	10.0%
Embraer group	2,013	7.5%
BAE146 group	823	3.1%
Business Aviation	607	2.3%
B737 group	23	0.1%
Other IFR	1,613	6.0%
Other VFR GA-types	12,828	48.1%
Total Movements 26,674		

Table 3: Southend Airport Movements by Aircraft Type, 2017

It is worth noting that equivalent data used for the consultation document(Ref1) was taken from 2016, as this was the latest available data at the time. The track and density plots in the consultation document used data from August 2016, whereas Figures 3 to 6 above are based on more recent data from June – August 2017. A large data sample was used in order to demonstrate a clearer pattern of tracks.

3.4. Operational Themes

LSA is one of the UK's fastest growing regional airports as well as being a European transport hub. There are no specific operational issues in the current operation at LSA.

The introduction of new approach procedures is based on LSA's wish to enable the use of Performance Based Navigation (PBN) technology to give aircraft a greater level of flight accuracy and increase the operational resilience of the airport. The implementation of PBN is consistent with the UK Government's objectives to improve the efficiency of the UK airspace network and mitigate environmental impacts as part of the UK's Future Airspace and proposed airspace modernisation strategies.

3.5. Environmental Priorities

LSA recognises its responsibility to minimise and reduce the impact that a change in arrival procedures has on the environment, in relation to noise and pollution.

As described in Section 5 of the consultation document(Ref1), the main environmental priority for this proposal is to minimise the noise impact of aircraft below 7,000ft. For aircraft flying between 4,000ft to 7,000ft there should be a balance between minimising the noise impact and aircraft

emissions; whilst noise is the priority below 4,000ft as described in the consultation document(Ref1).

These environmental priorities are in accordance with the altitude based priorities set out in the government's Air Navigation Guidance 2017, revised from the previous 2014 guidance. This is produced by the Department for Transport and includes guidance on airspace and noise management.

Although the proposed approach procedures have, where possible, been placed along the same routes as current tracks there are some small differences between the two. Where replication of current procedures was not possible due to constraining criteria[1], track mileage was considered to ensure there is no excess track length contributing to a negative environmental impact from this proposal.

An analysis of the environmental impact of the proposed new procedures is given in Section 5.6. This includes a summary of the impacts of fuel burn and CO_2.

3.6. Safety Priorities

There are no safety concerns with the current operation at LSA; therefore, the proposed procedures have not been designed with the aim of alleviating any specific safety issues. However, ensuring the safety of proposed changes is a priority for LSA. Safety representatives from SARG have had oversight of the safety assurance process.

All proposed procedures have been designed in accordance with ICAO PANS-OPS RNAV procedure design criteria(Ref6). See Section 5.9 for the safety assessment details of this proposal.

[1] ICAO PANS-OPS and ARINC424 criteria for RNAV1 procedures

4. Proposed Procedures

4.1. Requirements

In keeping with the aforementioned justification and objectives outlined in Section 2.2, the following benefit requirements were relevant to the proposed approach procedure designs at LSA:

- Introduce PBN routes in support of the CAA's FAS and consistent with the Government's objectives to modernise and improve the efficiency of UK airspace;
- Minimise the noise impact on overflown population, particularly below 4,000ft and new populations;
- Increase operational resilience through the provision of PBN final approach guidance
- Improve the accuracy and predictability of arrival track patterns;
- Where possible, improve upon current routes through the increased accuracy of PBN.

4.2. Proposed Approach Procedures

LSA is proposing to introduce five new PBN (Global Navigation Satellite System (GNSS)) initial approach procedures to runways 05 and 23 and PBN final approaches (three variants for each runway). The new approach procedures will complement the current routes and procedures rather than replacing them. However, the proposed approach procedures have been designed, as far as practicable, to replicate current aircraft tracks.

The proposed approaches named below are illustrated in Figure 1:

- Runway 05
  - North (IAF – DORUM)
  - South (IAF – PIVAB)
  - 3 straight-in, final approach variants
- Runway 23
  - North (IAF – TOLNO)
  - East (IAF – GEGMU)
  - South (IAF – UPUDU)
  - 3 straight-in, final approach variants

The proposed procedures will be used by aircraft either arriving at LSA via one of the Standard Instrument Arrivals (STARs) or which are receiving tactical vectors from ATC.

The 3 new RNAV (GNSS) approach procedures for Runway 23 were originally designed in a "T-Bar" configuration but later changed to a "modified Y-Bar" in order to allow the approach segments to be linked to the end point of the STARs as well as moving away from a Danger area (D138C)[(Ref11)].

The 2 new RNAV (GNSS) approach procedures for Runway 05 have been designed in a "T-Bar" configuration. Additional legs have been appended to the end of the "T-Bar" design as the main segment of the "T-Bar" was restricted from being made any longer due to airspace boundaries and the runway location. The positions of these two additional wing bars were designed in order to minimise the number of people overflown. Unlike Runway 23, Runway 05 does not include a straight-in segment due to the LSA airspace boundaries to the West.

In the consultation paper we assumed that the longer RNAV final approaches (yellow section in Figure 1) could be used to replicate the current tactically vectored ILS approaches by allowing aircraft to be vectored to the FAF and that they would be in place prior to the introduction of the full RNAV routes and approaches. A further assumption was that these tactical RNAV final approaches would be complemented by the addition of the 'full' RNAV approaches (entirety of Figure 1) utilising the Y-bar and T-bars whilst still enabling tactical vectoring to the FAF, for each runway.

As the tactically vectored RNAV final approaches were not implemented in time and as tactical vectoring to the FAF was discounted after discussion with the CAA, we are instead proposing a shorter straight-in variant (see Figure 3) to be published for each runway alongside the full RNAV T-bar and Y-bar approaches and the RNAV transition for runway 05 (see 4.3).

4.3. Proposed Arrival Transition

This ACP also proposes the introduction of a new RNAV1 (GNSS or DME/DME) arrival transition to Runway 05. This new transition procedure will take aircraft from the end of the current STARs, at GEGMU, to the start of the approach procedure to Runway 05 from the North at DORUM.

The proposed RNAV arrival transition can be seen in Figure 2, alongside the proposed Missed Approach Procedures.

4.4. Proposed Missed Approach Procedures

This ACP also includes 2 PBN missed approach procedures, one for each runway (see Figure 3).

The missed approach procedure for Runway 05 directs aircraft to fly straight ahead to 2,000ft before executing 3 left turn headings back to initiate another approach. Similarly, the missed approach procedure for Runway 23 directs aircraft to fly straight ahead to 2,000ft before executing 2 right turns directed back to initiate another approach. The missed approach procedures proposed do not differ from current missed approach procedures below 1,000ft, therefore air quality has not been assessed for these procedures.

It is very likely that Air Traffic Control will manually vector and shortcut aircraft off the missed approach procedures back to the start of the approach for both runways; either for efficiency or to cater for other traffic.

The proposed missed approach procedures for runways 05 and 23 can be seen in Figure 8 below, alongside the proposed arrival transition.

4.5. Proposed Changes Summary

LSA is proposing the introduction (to supplement existing procedures) of the following new RNAV instrument flight procedures:

- 2 approach procedures for Runway 05;
- 3 approach procedures for Runway 23;
- 1 arrival transition for Runway 05;
- 1 missed approach procedure for Runway 05;
- 1 missed approach procedure for Runway 23.
- 1 shorter tactical straight-in for runway 05
- 1 shorter tactical straight-in for runway 23

All procedures will be available H24. The procedures have been summarised below:

Procedure	Description
Runway 05 Approaches **– 2 Full RNAV Approach Procedures**	2 new approach procedures to Runway 05: one from the North and one from the South. These have been designed to deliver aircraft onto final approach in a similar pattern to today, both vertical and lateral profiles. The turn-point onto final approach has increased from 7NM from the runway to 9.7NM due to PANS-OPS design criteria. The numbers of aircraft flying the full PBN procedure is initially expected to be low. This is due to ATC tactical intervention/ vectoring to existing approach procedures (Instrument Landing System) and to the additional straight-in variant which will be published. There are also generally lower aircraft equipage and crew qualification rates for this type of approach.
Runway 05 Approaches **– 1 Tactical RNAV approach Procedure (with three variants)**	1 new approach procedure to Runway 05 for aircraft to be tactically vectored to the IF. These have been designed to deliver aircraft onto final approach in a similar pattern as today, both vertical and lateral profiles.. The procedure encompasses three PBN approach types delivering LNAV, LNAV/ VNAV and LPV minima lines for each runway end. The numbers of aircraft flying the shorter PBN procedure is initially expected to be low. This is due to ATC tactical intervention/vectoring to existing approach procedures (Instrument Landing System) and that there are also generally lower aircraft equipage and crew qualification rates for this type of approach.
Runway 23 Approaches **– 3 Approach Procedures**	3 new approach procedures to Runway 23: one from the North, East and South. The turn-point has been placed at the far end of the design criteria range, closer to the coast. These procedures have been designed to deliver aircraft onto final approach in a similar pattern as today, both vertical and lateral profiles. The numbers of aircraft flying the full PBN procedure is initially expected to be low. This is due to ATC tactical intervention/ vectoring to existing approach procedures (Instrument Landing System) and to the additional straight-in variant which will be published. There are also generally lower aircraft equipage and crew qualification rates for this type of approach.

Runway 23 Approaches **– 1 Tactical RNAV approach Procedure (with three variants)**	1 new approach procedure to Runway 23 for aircraft to be tactically vectored to the IF. These have been designed to deliver aircraft onto final approach in a similar pattern as today, both vertical and lateral profiles. The procedure encompasses three PBN approach types delivering LNAV, LNAV/ VNAV and LPV minima lines for each runway end. The numbers of aircraft flying the shorter PBN procedure is initially expected to be low. This is due to ATC tactical intervention/vectoring to existing approach procedures (Instrument Landing System) and that there are also generally lower aircraft equipage and crew qualification rates for this type of approach.
Runway 05 Arrival Transition	The proposed arrival transition procedure sends aircraft from the end of the current STARs (which are not changing) to the start of the northern approach procedure for Runway 05. It is designed in order to keep traffic inside LSA airspace. The numbers of aircraft flying the full PBN procedure is initially expected to be low. This is due to ATC tactical intervention/ vectoring to existing approach procedures (Instrument Landing System) and to the additional straight-in variant which will be published. There are also generally lower aircraft equipage and crew qualification rates for this type of approach.
Runway 05 Missed Approach Procedure	The proposed missed approach procedure would direct aircraft to climb straight ahead to 2,000ft before executing 2 left turns back to the Initial Approach Fix (IAF) for Runway 05. It is very likely that ATC will tactically vector aircraft back to the approach before completing the full procedure. This happens today.
Runway 23 Missed Approach Procedure	The proposed missed approach procedure would direct aircraft to climb straight ahead to 2,000ft before executing 2 right turns back to the Initial Approach Fix (IAF) for Runway 23. It is very likely that ATC will tactically vector aircraft back to the approach before completing the full procedure. This happens today.

4.6. Modernising Procedures

As summarised in the Consultation Document(Ref1), LSA is seeking to implement new RNAV1 procedures to provide a predictable and flight plannable route onto final approach and to provide resilience in the event of failure of the current ILS. These would be introduced alongside the current conventional arrival procedures.

LSA is looking to implement these new procedures in alignment with the CAA's Airspace Modernisation Strategy (AMS), which the Government also supports. Designing upgraded procedures based on modern technology, such as PBN, is therefore in support of the AMS.

4.6.1. RNAV Equipage

Table 3 below shows the RNAV/ RNP equipage rate for aircraft which operate from London Southend Airport. The proposed approach, transition and missed approach procedures have been designed using the RNAV1 navigation specification.

This has been taken from the NATS PBN equipage survey (July 2016 – July 2017) using archived operational flight plan data.

Airport	Equipment %	RNAV5 %	RNAV1 %	RNP1 %	Approaches %
London Southend Airport	GNSS: 96.70%	Any Means: 99.26%	Any Means: 64.64%	Any Means: 53.22%	RNP APCH: 2.39% RNP APCH with BARO: 58.86%

Table 4: Performance Based Navigation Equipage Rate at London Southend Airport

4.6.2. Accommodating non-RNAV1 Equipped Flights

All extant conventional approach procedures at LSA will remain in place. Non-RNAV1 equipped flights will be handled as today (routing via the conventional STARs, then radar vectors to join the approach procedure).

4.7. Radar, Communications and Navaid Coverage

This ACP is not proposing any new controlled airspace or changes to existing controlled airspace boundaries. The nominal centreline for each of the proposed approach, transition and missed approach procedures are contained within existing Controlled Airspace where radar and communications coverage are well established. Airspace containment issues are considered in the Southend Safety Case submission (Ref16).

A DME/DME navigation assessment has been completed for LSA which assesses the coverage down to 2,000ft for the proposed procedures. This assessment concluded that all of the proposed procedures are covered by DME/DME signal full redundancy in support of RNAV1. The full assessment has been summarised in a report(Ref7).

4.8. Traffic Forecasts and Route Usage

This ACP is not related to air traffic growth or London Southend Airport's growth in general. The annual aircraft movements at LSA are expected to grow over the next 5 years, however this is unrelated to this Airspace Change Proposal.

The intention of the proposed approach, arrival transition and missed approach procedures is not to replace any of the current procedures, but instead to provide a PBN route onto final approach so that those aircraft which are suitably equipped can take full advantage of their PBN capabilities, or to provide a final approach ILS alternative for those aircraft which are tactically vectored by ATC. It is expected that there will be a gradual migration towards the use of these procedures dependent on the uptake of PBN by the aircraft which fly into LSA.

As such, it is not possible to provide any quantitative forecast into the traffic expected over the approach and arrival procedures in the future. It is expected that traffic growth over the next 5

years will increase the total number of airspace movements per annum at LSA to 53,500. The total number of movements is subject to a cap, which is part of a Section 106 planning agreement. The proportion of flights suitably equipped to use the proposed procedures, is also expected to grow slowly over time. Hence the expectation is that initially the tracks over the ground will remain similar to today, however over a timescale of several years there is expected to be an increase in the usage of the PBN procedures. ATC will continue to tactically vector aircraft off routes as is common practice today, hence some degree of dispersal across the swathe of tracks, as seen today, is expected to continue (see Figure 4 to Figure 7).

4.9. Controlled Airspace

This ACP is not seeking to implement any new controlled airspace or any changes to existing controlled airspace boundaries. The nominal centreline of each of the proposed approach and arrival procedures are contained within the existing CAS boundaries.[(Ref16)]

5. Airspace Change Proposal Impacts

5.1. Airspace Change Proposal Impacts Summary

This section describes the airspace change impacts for the proposed procedures, with the main changes summarised below:

Safety/ Complexity

- Increased predictability of flight paths and a reduction in complexity of ATC tasks and pilot workload, including a reduction in reliance on non-precision approaches.
- See Section 5.9.

Fuel Efficiency/ CO_2

- Small increase of 10.7KG of fuel and 34.1KG of CO_2 per flight.
- See Section 5.6.

Noise

- As agreed with the CAA, the noise contours and footprints were not assessed. It is expected that, as the existing routes are on the whole being replicated by the introduction of RNAV procedures, there will be no significant change to the current noise impacts.

  See Section 5.2.

Other Environmental Factors

- See Sections 5.4 to 5.7.

Other exhaust emissions (non-CO_2: NOX etc) are expected to change broadly in line with the forecast change in CO_2 emissions. There are no significant changes expected to tranquillity, biodiversity or local air quality.

Delays & Capacity

- See Sections 3.4 & 5.12.

There are no changes forecast to capacity or delays at LSA.

Other Airspace Users

- See Section 4.

There are no changes to access for General Aviation/ recreational aviation airspace users.

5.2. Noise and Population Impacted

Through design workshops it was agreed that the primary design principle for this project would be to replicate the current day flight paths where possible. It was agreed with the CAA that noise contour assessments were not required due to the impacted areas being similar to today's tracks.

In accordance with CAP725, in low altitude airspace (below 4,000ft) the priority is to minimise aviation noise impact and the number of people on the ground significantly affected by it. In intermediate airspace (from 4,000ft to 7,000ft) the focus should continue to be on minimising the impact of aviation noise, but this should be balanced with the need for an efficient flow of traffic that minimises emissions. In higher altitude airspace (above 7,000ft), the CAA should promote the most efficient use of airspace with a view to minimising aircraft emissions and mitigating the impact of noise is no longer a priority.

This ACP aims to implement RNAV1 approach procedures, transitions and missed approach procedures, where any procedures below 4,000ft are a replication of current tracks. The use of PBN can result in some concentration of flight paths which could result in a change in the dispersal of noise.

The final approach paths are also replicated for LNAV, LNAV/VNAV and LPV approaches.

5.3. Concentration of Traffic

PBN introduces a higher degree of traffic concentration as aircraft fly more accurately and predictably than using legacy conventional navigation aids. This results in a reduced spread of flight paths, in terms of both area overflown and deviation from the track centreline. Currently there is no defined route from the ends of the STARs to the IAPs, as such the current practice is that all aircraft are radar vectored by ATC to the IAF. This results in dispersal of the flight paths. Where the proposed RNAV transitions and approach procedures are used, this will result in flights following a more consistent flight path, hence traffic will be more concentrated along the proposed route centrelines.

The RNAV procedures are being implemented to complement the current procedures and not replace them. When the RNAV1 approaches and transition are implemented it is expected that those aircraft that are equipped will initially use them as a back-up procedure or for training purposes. Hence after implementation there will be an increase in traffic concentration along the approach procedures. Subsequently migration towards the use of RNAV by the remaining aircraft is expected, due to a gradual increase in RNAV1 equipage and crew/pilot qualification.

When designing the procedures we have positioned them to, where possible, over-fly the fewest number of people, e.g. when design criteria permit. This is in accordance with DfT guidelines(Ref13).

5.4. Biodiversity

The proposed procedures do not overfly any National Parks or National Scenic Areas (NSAs). There are also no direct impacts expected on flora, fauna or biodiversity due to the proposed changes; therefore, there has been no additional biodiversity analysis undertaken.

5.5. Local Air Quality

CAA Guidance(Ref12) determines that if changes alter flight paths below 1,000ft, local air quality analysis is required. Above 1,000ft, due to atmospheric mixing, there is no significant effect on local air quality at ground level.

The segments under 1,000ft within this proposal relate to when an aircraft is on final approach and the initial part of the missed approach procedure. These segments under 1,000ft are not being changed from the current procedures. The current impact on Sites of Special Scientific Interest (SSSIs) and other similar sites will not change due to this proposal. It is therefore concluded that further, detailed local air quality assessment is not required as part of this submission.

5.6. CO_2 Emissions & Fuel Burn

The NATS Analytics, Environmental team have completed analysis on the CO_2 emissions and fuel burn change that is expected, following the implementation of the proposed procedures at LSA.

The proposed LSA approach and transition procedures are not direct replications of current routes (however the final approach paths are). As such, there were no current routes to compare the changes against. Instead, as the proposed routes are very similar to where aircraft are currently vectored, four historic flights were identified for each proposed route and an average length was used as a nominal value to compare against.

This analysis forecasts that the proposed changes would result in an overall small increase in fuel burn and CO_2 emissions, as summarised in Table 4 below. However some of the routes would show a minor improvement from the track length reducing.

This concludes that there would be a small increase of 10.7KG of fuel and 34.1KG of CO2 per flight.

Procedure	Current Average Procedure Length Flown (NM)	Proposed Procedure Length (NM)	Average Fuel Difference per Flight (KG)	Average CO_2 Difference per Flight (KG)
Runway 05 – Northern Approach	12.9	18.3	+43.8	+139.4
Runway 05 – Southern Approach	11.7	13.3	+12.7	+40.3
Runway 05 – Transition Route	23.9	23.8	-0.5	-1.7
Runway 23 – Northern Approach	15.6	19.2	+29.4	+93.4
Runway 23 – Eastern Approach	18.3	17.6	-5.6	-17.8
Runway 23 – Southern Approach	17.4	15.5	-15.4	-49.1
Total	**99.7**	**107.7**		

Table 5: Fuel and CO_2 differences, per flight

The analysis was based on the fuel flow rate for an A319 per nautical mile.

5.7. Tranquillity and Visual Intrusion

The proposed procedures do not overfly any National Parks or National Scenic Areas (NSAs). As such, no additional analysis into the tranquillity and visual intrusion of the proposed procedures has been commissioned.

5.8. Engagement and Consultation Overview

5.8.1. Consultation Overview

In accordance with the CAA CAP725 process and after discussion with the CAA, LSA carried out a 14 week consultation from 6th June to 13th September 2017, presenting the intended RNAV procedures(Ref1). This was increased to 16 weeks (until the 30th September 2017) for some stakeholders who requested further time. We consulted with several types of stakeholders varying from airspace users to the public and local councils, whilst assessing changes to the design based on their feedback(Ref2). Further meetings were held with those who required supplementary material and to answer questions; these included the LSA Consultative Committee, Essex Local Planning Authorities (LPAs), Burnham-on-Crouch Town Council, and stakeholders from the Hoo Peninsula / North Kent. The Consultation Document was publicly advertised in both The Echo (a regional newspaper and online bulletin) and the LSA website.

For the tactical straight in approaches the CAA was presented with a justification paper which defined the reasons believing that there would be no discernible change to the lateral and vertical

final approach path for either runway. Therefore this was not formally consulted on with the wider communities.

Table 4 below shows a breakdown of sub-category invitees vs. responses to the consultation for RNAV procedures at LSA.

Stakeholders	Number of Invitees	Number of Responses	%
NATMAC	32	5	15.6
Airport Consultative Committee	1	1	100
National Bodies	10	4	40
Airspace Users	36	14	38.9
Local Councils	70	36	51.4
MPs	12	1	8.3
Other	2	1	50
TOTAL ORIGINAL STAKEHOLDERS	**163**	**62**	**38.0**
Members of Public	0	12	N/A
TOTAL COMBINED	**163**	**74**	**N/A**

Table 6: Breakdown of responses received compared to stakeholders invited

***Note** - The total combined % of responses has not been calculated as the number on invitees does not include members of the public responses due to not being a clear representation of stakeholders invited to consult vs. stakeholder responses.

Figure 9 below depicts the responses from various stakeholders to the LSA consultation to implement RNAV procedures.

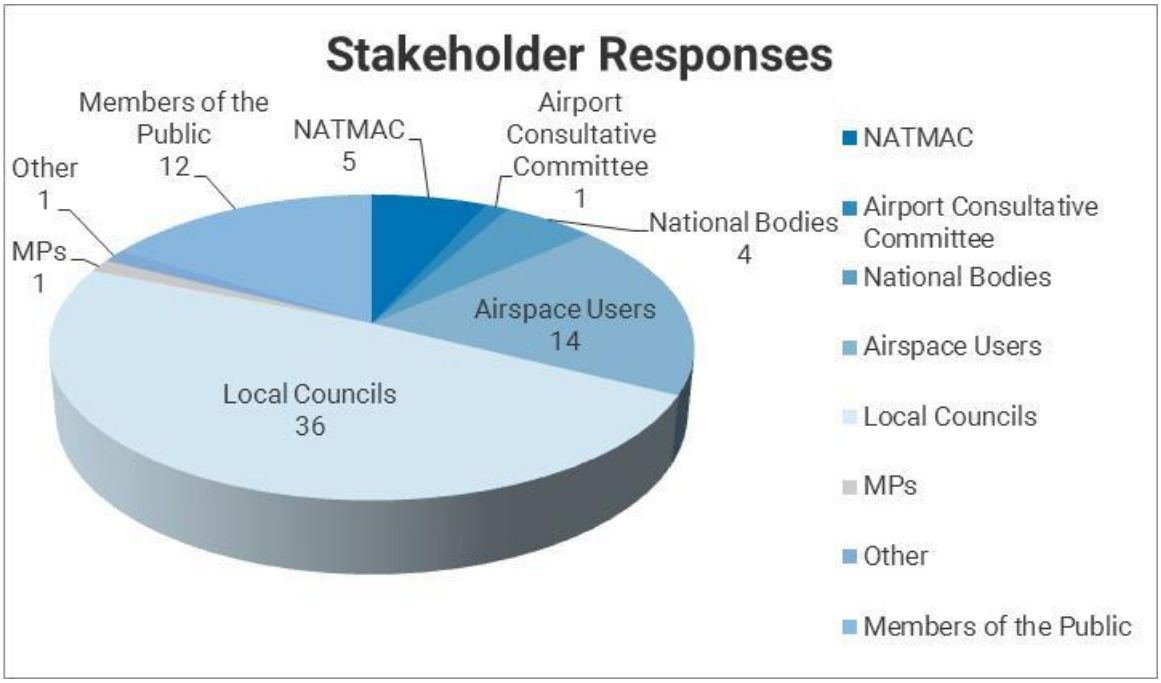


Figure 8: Chart displaying the breakdown of consultation responses

5.8.2. Responses and Key Themes

Table 5 below shows a breakdown of the nature of responses to this consultation into support, no objection, no comment, object and other categories. The 'Other' category refers to those providing 'information only feedback' or 'not responding'.

Response Themes	Number of Responses	%
Support	14	18.9
No Objection	18	24.3
No Comment	18	24.3
Object	14	18.9
Other	10	13.5
TOTAL	**74**	**100**

Table 7: Breakdown of the consultation responses

Figure 10 graphically illustrates the data given in Table 4, where the 'Other' category again refers to those providing 'information only feedback' or 'not responding'. The data presented in Table 5 and Figure 10 is also inclusive to members of the public responses.

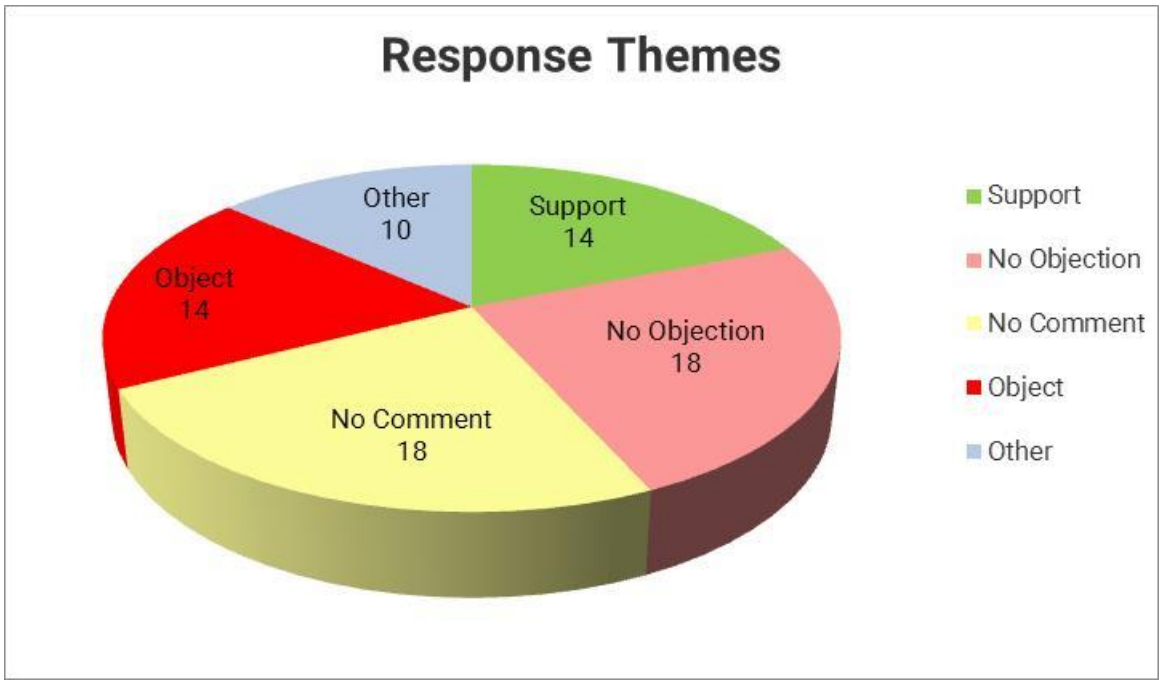


Figure 9: Chart displaying the breakdown of consultation responses

5.8.3. NATMAC/ Airspace Users

The National Air Traffic Management Advisory Committee (NATMAC) consists of representatives of all airspace users who were consulted on the proposed RNAV procedures(Ref2). The consultation material and invitations for feedback were sent out to 38 members of NATMAC representing 32 organisations. Of these 5 responded. The key themes from the NATMAC responses were:

- The introduction of PBN procedures should improve accuracy and predictability of tracks;
- No impact if LSA continue to coordinate with aviation stakeholders as in current operations.

5.8.4. Military Airspace Users

Military airspace users were consulted with to understand the impact, if any, of the implementation of the proposed RNAV1 procedures at LSA. The Defence Airspace and Air Traffic Management (DAATM) is an organisation that coordinates responses on behalf of all Military stakeholders, ensuring a single consolidated military response is provided. These stakeholders include the MAA, NCHQ, Aviation Division NCHQ, and 3AF-UK/A3. Since there is some interaction between the proposed procedures and the Shoeburyness Danger Area (D138) the operator, QinetiQ, was also asked to respond to the consultation QinetiQ agreed that DAATM would provide a single consolidated response on behalf on the military and QinetiQ.

DAATM responded in support of the proposed procedures, and a solution was agreed for the South IAF to Runway 23 which falls within the D138A danger area. The procedures were designed to ensure that they do not interact with the D138 / D138B / D138C Danger Areas. If D138A is in use, it has been agreed that the UPUDU route will not be available. This route can be seen in green on Figure 7 above.

5.8.5. London Southend Airport Consultative Committee

The London Southend Airport Consultative Committee (LSACC) is an organisation formed of borough/district councils, Southend community associations, regional businesses, Rochford Chamber of Commerce, airside users, tenant companies, and UK Border Force. The LSACC were provided with a description of the project, projected procedure designs and the Consultation Document(Ref1). The Committee confirmed they were in support of the proposed RNAV1 procedures, as they provided a greater precision in aircraft approach offering a reduced spread of inbound aircraft and noise pollution on the local community.

5.8.6. Local Authorities & MPs

The Consultation Document was distributed to county, borough, district, unitary authorities and parish councils from both Kent and Essex. This was to ensure that all councils affected had the opportunity to comment on the proposal; of which 36 responded from a total of 70 councils invited to comment.

The key themes from the Kent Councils responses were:

- An increase in noise over the Hoo Peninsula;
- PBN brings benefits of continuous descent, reducing fuel usage and noise impact;
- LSA should ensure that affected communities are engaged with to understand unforeseen impacts, post implementation;
- It is unsatisfactory that stakeholders must gauge noise contour impacts themselves as this can be difficult (additional guidance was offered by LSA where requested);
- PIVAB/IBENA track is unsuitable (“PIVAB” and “IBENA” are navigation waypoints which define segments of the proposed procedure, see Figure 2 and the Consultation Document(Ref1);
- PBN enhances safety for aircraft approaching LSA.

The key themes from the Essex Councils responses were:

- Support the general approach taken by LSA to replicate the current aircraft tracks where possible;
- This change aligns with European traffic modifications and the Future Airspace Strategy (FAS);
- A majority of councils foresee no or minimal impact from these proposed changed;
- Concentration of routes may become an issue in the future as aircraft improve their RNAV capabilities;
- Improves aircraft precision, predictability and flight efficiency;
- Detrimental effect to Burnham-on-Crouch with a potential increase in noise pollution;
- Proposed future residential developments may be affected by this proposal.

Several MPs were selected to respond to the consultation as their constituency may be affected by the proposal, including constituencies under the straight-in segment of the routes that are out of scope of this consultation. Of the 12 invited MPs, only 1 formally responded stating 'no comment'.

5.8.7. National Bodies

National Bodies were invited to respond to the consultation where they may have an environmental interest in and/or represent areas in the vicinity of LSA. 4 organisations responded out of the 10 approached to respond to the Consultation Document. The key themes from the National Bodies responses were:

- Future consultations should map the following sites:
    - Special Protection Areas (SPAs)
    - Special Areas of Conservation (SACs)
    - Wetland Conservation (RAMSAR)
    - Sites of Special Scientific Interest (SSSIs)
- Proposed flight paths could impact:
    - Hoo Peninsula
        - North Kent Marshes
        - Cliffe Pools
        - Hoo St Werburgh
        - Cliffe & Cliffe Woods

5.8.8. Airspace Users

The airspace users consulted with as part of this proposal included flying clubs, private jet organisations, airlines, and local aerodromes. 14 organisations responded out of 36 invited to respond, where the key themes arose included:

- This change will be an improvement on current Surveillance Radar Approach (SRA) procedures;
- No detrimental impact to most local aerodrome operations;
- Runway 05 approach could affect Rochester Airports future RNAV implementation plans;
- Aligns with the FAS whilst introducing modern systems for operational and training purposes;
- Supports the use of RNAV capabilities alongside the retention of the ILS;
- Improves flight safety and efficiency.

5.8.9. Members of Public

The Consultation Document was advertised via news articles and the LSA website. Through these media outlets, a total of 12 members of the public responded to the Consultation Document. These responses were received from the public living in areas including Westcliff-On-Sea, Thundersley, Hockley, High Halstow, Burnham-on-Crouch, Cliffe & Cliffe Woods.

The key themes from the members of public responses were:

- This change should improve the impact of LSA on the community;
- Increase in noise / pollution to the Hoo Peninsula and Burnham-on-Crouch;
- Consultation was not well enough publicised to those on the Hoo Peninsula;
- Over time aircraft will be concentrated over Cliffe;
- Increases to noise & environmental impact in Hockley.

5.9. Impact on Aviation Safety

LSA considers safety of the proposed changes as a priority. The following safety analyses have been completed in support of this ACP:

- Southend RNP APCH Safety Case – design and implementation of RNAV based arrival procedures(Ref16):
    - Part I includes all safety requirements;
    - Part II includes system operation and maintenance arrangements, and system assurance;
    - Parts III and IV address the assurance claim that "the airspace can be safely managed during implementation of the procedures and ongoing ATM operations"

Assurance for implementation will be conditional on completion of the implementation checklist (See Appendix B of the Southend Safety Case)(Ref16). The safety case will require no further updates prior to implementation, subject to acceptance in its current state by the CAA. Implementation protocol merely requires LSA to confirm the checklist activities have been completed as part of a readiness review.

5.10. Economic Impact

LSA offers a London based commercial runway, and a diverse range of services including passenger, cargo, and general aviation services. The airport contributes to the local and UK economy ; supporting in excess of c350 jobs.

The airport is looking to build on its contribution to increase employment opportunities, trade and tourism. The airport terminal currently handles around 1.1 million passengers each year (2017), however the terminal has capacity to support passenger growth.

The benefits of modernising the arrival procedures will support the gradual changeover to a high-precision approach infrastructure. The procedures also provide the benefit of future-proofing LSA to accommodate growth and development efficiently. At the time of writing this ACP, there are no notified methods of analysing economic impact; therefore no analysis has been undertaken to quantify the economic benefit of the proposed changes. These proposed changes also complement the on-going nationwide airspace redesign and modernisation, as part of the FASI-S programme.

5.11. Procedure Flight Validation (Flyability)

The proposed procedures are to be validated to confirm their flyability through the use of Flight Validation Simulations. The Flight Validation Plan (Ref 15) contain the flight simulator objectives, schedule conditions, procedures to be tested and all charts and coding tables.

The LNAV/ VNAV element of the procedures will be validated using easyJet, as a based operator, in their A319/ A320 simulator, avionics Honeywell Release A. Additionally the LPV element of the approach procedures are also scheduled to be validated by LSA. The proposed approach procedures will be tested and conducted using either a simulator or a live flight. A simulator or a Cirrus aircraft would be used; both avionics are Garmin G1000 and both are SBAS enabled for LPV approved approaches.

The flight validations are being conducted alongside the submission of this ACP, with the results from all fixed base and / or live flight simulators being submitted as soon as they are available. There are no expected issues from the proposed procedures as no unrealistic path terminators have been designed. This ACP submission is therefore subject to this Flight Validation exercise taking place.

5.12. Resilience to Bad Weather

The Flight Validation exercise aims to assess the ability for aircraft to fly the proposed procedures in varying environmental conditions including:

- Varying wind direction - these will be made unfavourable for each procedure dependent on the direction;
- Strong wind - 30kts surface wind;
- Still wind.

There have been no design objectives or requirements relating to the ATC system's resilience to bad weather.

The occurrence and impact of the following conditions are not expected to change in comparison to current procedures:

- Disruptive weather events;
- Extreme weather conditions such as low temperature events;
- Icing conditions;
- Unusually high/low pressure.

The design is resilient to extreme low temperature events as its minimum design temperature is -20°C. Analysis of 5 years of historical data shows that the probability of this minimum occurring is very low. This is covered fully in the Safety Analysis(Ref16).

6. Analysis of Options

6.1. Introduction

The final proposed procedures designed for LSA were based on a number of design principles and objectives, as outlined in Section 2.2. All of the procedures designed by LSA have been determined by the restrictions of the surrounding airspace and design criteria.

One of the primary objectives of this project has been to improve the resilience and efficiency of the arrival procedures through predictability of flight paths from the new technology, whilst optimising fuel burn and CO_2 emissions. Where possible, opportunities to reduce the noise impact to those affected on the ground have also been taken.

LSA carried out a 14 week public consultation period from 6th June to 13th September 2017. An additional 2 weeks extension was granted until the 30th September 2017, to allow stakeholders additional time to respond. A consultation document was produced to outline the current airspace, proposed additions and rationale behind the proposed procedures(Ref1). The document also explained how stakeholders could respond alongside being advertised in a local newspaper and online.

There were 74 responses to the consultation received which have been summarised in Section 5.8 and recorded in detail within the Feedback Report(Ref2). The main themes from the responses were extracted and summarised in the Feedback Report and, where appropriate, technical queries about the procedure positions were also responded to. Following the consultation feedback, there were no further track changes to the procedures with all reasons explained in Section 5 of the Feedback Report.

However as covered fully in Section 7 below, we have made a number of additional changes to the proposal which are different to the those which we consulted upon. This is due to the consultation being completed in parallel to the IFP design work. The changes to the design, as covered in Section 7.3.2, are:

- Nomenclature changes to reporting points
- A longer final approach for RNAV traffic and a shorter stand-alone final approach for vectored traffic
- Introduced some fixed level and speed restrictions for approaches, final approaches, missed approaches and the transition for Runway 05; previously these were ranges.

6.2. Design Principles & Options

The proposed transition, approach and missed approach procedures for LSA have been designed by considering how closely aligned to current procedures they sit whilst looking for opportunities to improve the noise and environmental impact (fuel/ CO_2) of the procedures.

6.2.1. Do Nothing Option (rejected)

The RNAV procedures and implementation of PBN at LSA are consistent with the Government's objectives to improve the efficiency, and mitigate environmental impacts, of the UK airspace network. This forms part of the CAA's previous Future Airspace Strategy (FAS) and the current Airspace Modernisation strategy, which provides a policy structure to enable a modernised air traffic management system beyond 2020.

PBN provides the level of accuracy, safety, resilience and integrity required by satellite navigation systems. Lower level routes in and out of airports, alongside high level airways, are expected to be developed and updated in order to utilise the newer technology.

As such, "doing nothing" is not a feasible option for LSA.

6.2.2. Replicate the Current Conventional Procedures (rejected)

The proposed procedures were designed in order to replicate as closely as possible the route flown by aircraft today. However in adhering to the technical design criteria, in some places the proposed procedures could not be fully replicated; for example, due to the limiting effect of airspace boundaries. In these cases, the greater navigational accuracy of PBN was used to reduce the number of people overflown.

As such, a full replication of the current conventional procedure is not a feasible option for LSA.

6.3. Procedure Options

The proposed procedures have been designed in accordance with the following guidance:

- ICAO Doc 8168 PANS-OPS – Volume II – 6th Edition Amendment 7(Ref6).
- UK CAA Policy Statement: Use and Allocation of RNAV Waypoints, (Oct 2008).

Draft charts of the proposed RNAV arrival procedures are available in the Southend PBN Approaches Procedure Design Submission(Ref10).

There is a description for each of the approach, arrival transition and missed approach procedures below.

6.3.1. Runway 05 Approaches

A T-bar configuration was chosen for Runway 05 approaches rather than using a Y-bar as it offered the best fit for the LSA airspace. A straight-in segment from the west was removed due to restrictions with the airspace boundaries, leaving 2 approaches (from the north and south) towards the fly-by waypoint at the intersection.

The length of the T-Bar was shortened in order to move the procedure further east and away from the edge of the airspace boundary. Design restrictions prevent the T-bar from being any closer to the runway.

The T-bar design was further altered with the addition of a 'wing bar' for the northern segment; meaning the new procedures are not an exact replication of current tracks. Design criteria and airspace boundary restrictions have dictated the design of these wing bars, which may present a small increase in overflights above Stanford-le-Hope.

A shorter, straight in final approach to allow for ATC tactically vectored aircraft to utilise PBN approaches was developed. Initially assuming that aircraft could join this final approach at the FAF. However, this was rejected and instead the design utilises a capture area at the end of the approach which is classified as an IF and is 2nm further out from the runway than the FAF.

The full design description can be found in the consultation document(Ref1).

6.3.2. Runway 23 Approaches

Initially the T-bar was also chosen for Runway 23 approaches. For Runway 23 there is enough room to fit 3 straight-in segments, from the north, east and south; allowing aircraft to approach from these directions towards the intersection (fly-by waypoint).

After further design consideration, the approach from the east was linked to the waypoint GEGMU, a pre-existing point at which the STARs from the east and south terminate. The southern approach was also shifted away from the Danger area D138C. As a result, this initial segment would now resemble a Y-bar structure.

Finally, an additional 'wing bar' was added to the northern approach in order to avoid arrivals directly overflying Osea Island by flying to the north of the Island. The full design description can be found in the consultation document(Ref1).

A shorter, straight in final approach to allow for ATC tactically vectored aircraft to utilise PBN approaches was developed. Initially assuming that aircraft could join this final approach at the FAF. However, this was rejected and instead the design utilises a capture area at the end of the approach which is classified as an IF and is 2nm further out from the runway than the FAF.

6.3.3. Runway 05 Arrival Transition

The first proposal for the arrival transition was a direct route from GEGMU to the northern Initial Approach Fix (IAP) for Runway 05. This was considered to be the simplest and most direct solution.

Through further design work, the arrival transition was complemented with 2 additional turning points. The first turn, to the north, routes aircraft to the north or Rayleigh and additionally further away from Burnham-on-Crouch; both are populated towns. The second turn routes traffic to the south of the town of Southminster.

The full design description can be found in the consultation document(Ref1).

6.3.4. Runway 05 Missed Approach Procedure

Design of the missed approach procedures are subject to strict technical limitations. There is some flexibility in the turn direction and turn location, which were developed in order to deliver the best procedure to minimise noise on the ground and deliver the most predictable and efficient missed approach route for aircraft.

The first design of the missed approach procedure included a straight climb ahead before turning 90° and then again 85°, to re-join the approach procedure with tactical intervention from Air Traffic Control (ATC). This is slightly different from a standard conventional missed approach procedure which would just return aircraft to overhead the airport. It was later decided for the 2 turns to be towards the left in order to keep the procedure as close to the airport as possible.

The full design description can be found in the consultation document(Ref1).

6.3.5. Runway 23 Missed Approach Procedure

As for Runway 05 above, the turn direction and turn location concepts for the Runway 23 missed approach procedure were optimised as much as possible.

The final design of the missed approach procedure for Runway 23 contains 2 90° right turns which take aircraft back to re-join the final approach, with tactical intervention from ATC. As per the Runway 05 missed approach procedure, this is instead of returning aircraft back overhead the airport. Through the design work, the first 90°right turn was changed from an initial 75° turn in order to keep the procedure as close to the airport as possible.

The full design description can be found in the consultation document(Ref1).

7. Differences Between Documentation

7.1. Why is there a difference?

Due to the afore mentioned project delays as well as the desire to run the ACP and the IFP design aspects of the project concurrently and in dialogue with the CAA, the details being put forward in this proposal are different to those which were released in the consultation document(Ref1).

This section will detail those differences.

7.2. Amalgamation of Submission

7.2.1. Previous Plan

Previously, stage one of the change was to be the submission of the justification paper for the straight in section of the RNAV approaches. The Yellow section illustrated in Figure 1.

If this were to be agreed by the CAA it would have been implemented prior to the submission of this ACP and would provide RNAV final approaches for aircraft vectored tactically by ATC to the FAF for either runway.

Stage 2, the second submission, was to be this ACP. It would have provided the RNAV connectivity from the end of the current STARs to the beginning of the already implemented RNAV final approaches (from stage 1). The difference being that these aircraft would link to the final approach at the IF and not part way down, at the FAF. This would also include a transition to take aircraft from the end of the star at GEGMU to the RNAV approach for runway 05.

The missed approaches were to remain as extant for the stage 1 submission whilst Stage 2 would have seen these replaced with RNAV MAPs for the RNAV procedures. In this plan, an RNAV (GNSS) procedure for each end would have been published initially as a vectored-only procedure, and this would later be replaced by a T-bar based full procedure with RNAV missed approaches.

7.2.2. Current Plan

Both Stage 1 and Stage 2 as detailed in section 7.2.1 have been combined into this ACP submission. If this proposal is approved by the CAA there will be several parts to this implementations, taking place concurrently.

Part 1 is a shorter straight in final approach to both runways (Yellow sections in Figure 3) to accommodate tactically vectored aircraft which will capture the approach at the IF. These will be published as the lead ‘Z’ procedures for each runway end.

Part 2 will deliver the full RNAV approaches to both runways, on to a longer straight in intermediate approach at a different IF (see Figure 1). These will be published as the ‘Y’ variant procedures.

Part 3 will be the RNAV transition from GEGMU to runway 05 (see Figure 2).

Part 4 will be the MAPs, which will apply to both the vectored ‘Z’ and non-vectored ‘Y’ procedures (see Figure 2).

7.3. Differences in Design

7.3.1. Why is there a difference in Design

The consultation was completed with the best knowledge of the designs which LSA had at the time. A known risk was that the consultation was being progressed alongside the development of the IFPs.

Delay in assessing the IFP designs at various stages has meant that approval is still pending and that both the consultation and this ACP have been completed against a backdrop of subtle design changes as the assessment process has progressed.

The project has been approached in this manner to minimise the delay to implementation of this change and to maximise the accrual of the benefits which the change can deliver. LSA has also been approved for European funding to aid in the completion of this project and that would be jeopardised by further delay caused by running the various parts of the project in sequence rather than in parallel.

7.3.2. The Physical Differences

Naming of Reporting Points etc.

Names have been altered throughout the design process, either retaining the name but moving its location or changing the name completely. This has not altered the location of the points themselves, however some additional points have been added.

Final Approach

Originally as described in the consultation document, the final approach was planned to be a 'longer' single length which would be suitable for use by ATC vectored aircraft (vectored to join at the FAF for either runway) and RNAV aircraft who would join at the IAFs. The Y and T bars were to be added in the second stage of implementation. This is represented by the Yellow sections in Figure 10 and Figure 11.

This proposal intends to introduce this 'longer' final approach (as described in the paragraph above) but for traffic routing on the full RNAV approaches only and to implement at the same time a 'shorter' stand-alone final approach for vectored traffic. See Figure 12. The IFs or end points for the shorter final approaches are illustrated on Figure 10 and Figure 11 for comparative purposes and they have retained the names which were to be used for the original, longer final approach.

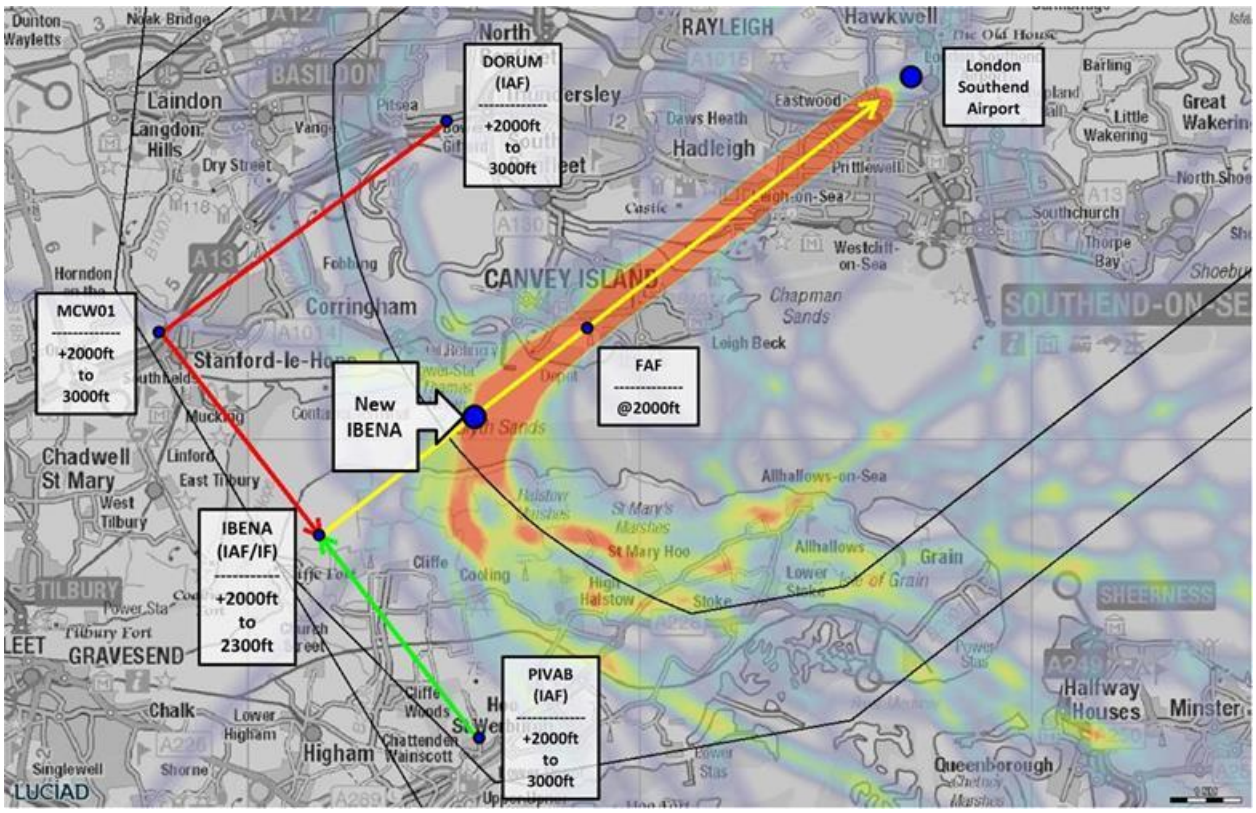


Figure 10: Originally Planned Final Approach (Yellow) Runway 05

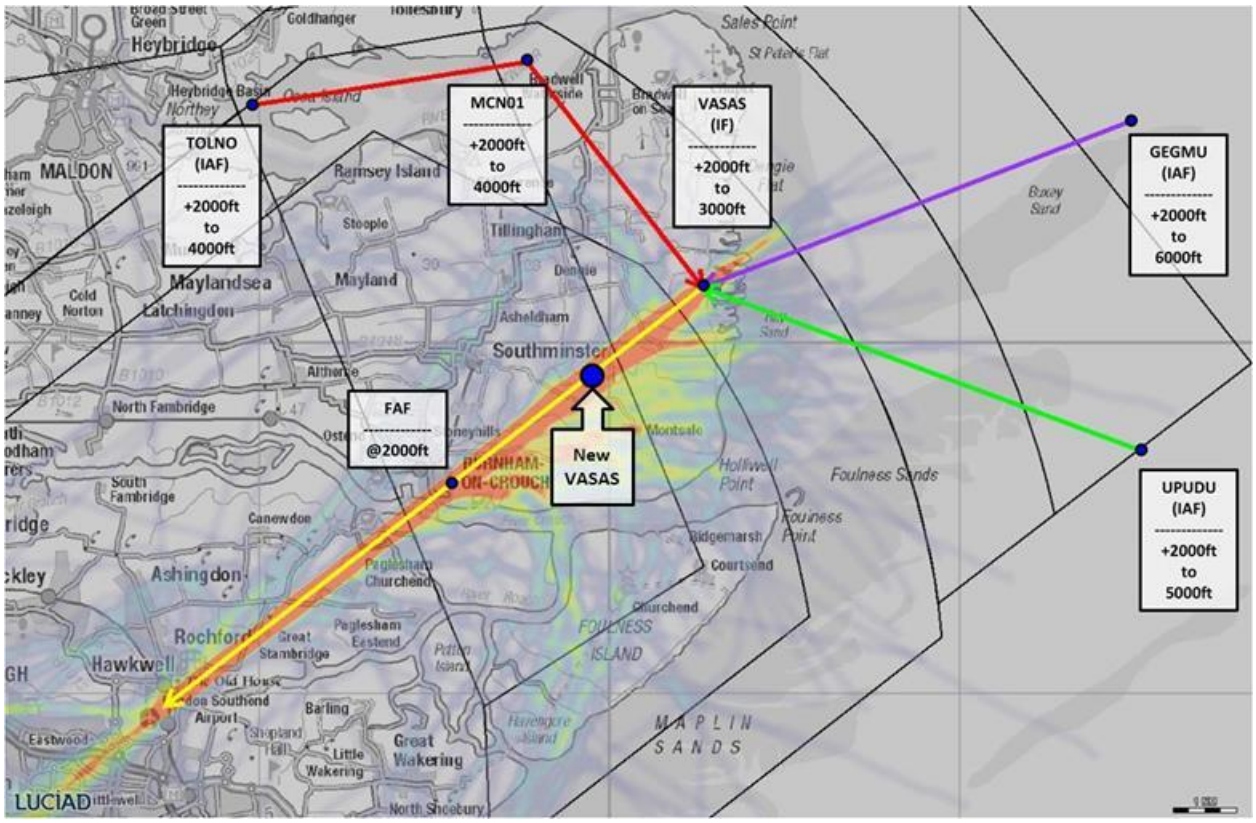


Figure 11: Originally Planned Final Approach (Yellow) Runway 23

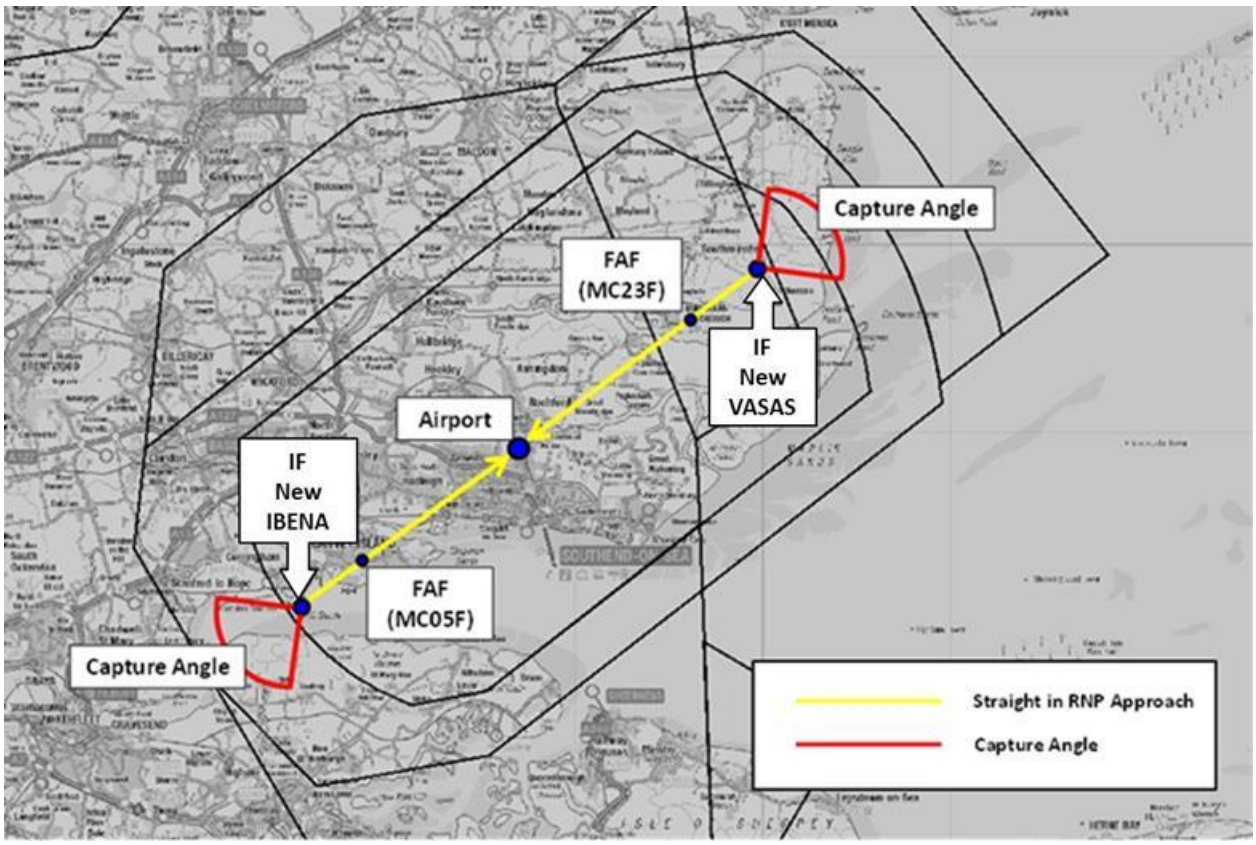


Figure 12: Proposed Shorter Vectored Final Approach

Final Approach			
Runway 05			
	IBENA*	FAF (MC05F)	New IBENA
Consultation Document	+2000ft to 2300ft	@2000ft	n/a
IFP Vectored	n/a	@2000ft	@2000ft
IFP RNAV	@2000ft	@2000ft	n/a
Runway 23			
	VASAS*	FAF (MC23F)	New VASAS
Consultation Document	+2000ft to 3000ft	@2000ft	n/a
IFP Vectored	n/a	@2000ft	@2000ft
IFP RNAV	Not below 2000ft	@2000ft	n/a

Table 8: Differences on Final Approach

*Note: The original IBENA as produced in the consultation document has been renamed MC05I and the original VASAS has been renamed MC23I in the latest IFP submission.

Approaches

The full RNAV approaches utilising the longer final approach have retained all of the original points which were consulted upon (see Figure 10 and Figure 11). However the IFs IBENA and VASAS have been renamed MC23I and MC23I respectively.

Changes in level restrictions are detailed in the table below.

Approach						
Runway 05						
	DORUM	MCW01	IBENA (MC05I)	PIVAB	FAF (MC05F)	
Consultation Document	+2000ft to 3000ft	+2000ft to 3000ft	+2000ft to 2300ft	+2000FT TO 3000FT	@2000FT	
IFP RNAV	@3000ft Max 195kts	@2000ft Max 195kts	@2000ft Max 195kts	@2000FT Max 195kts	@2000FT	
Runway 23						
	TOLNO	MCN01	VASAS (MC23I)	GEGMU	UPUDU	FAF (MC23F)
Consultation Document	+2000ft to 4000ft	+2000ft to 4000ft	+2000ft to 3000ft	+2000ft to 6000ft	+2000ft to 5000ft	@2000FT
IFP RNAV	@3000ft Max 220kts	@2000ft Max 220kts	Not Below 2000ft Max 195kts	@6000ft Max 195kts	@3000ft Max 220kts	@2000FT

Table 9: Differences on Approach

Missed Approaches

The points on the missed approaches have remained the same as the details which were included in the consultation document. However, some of the level information has changed. The MAPs for both the vectored and RNAV approaches are the same for runway 05 and different for runway 23. See Figure 13 and Figure 14 and the table below.

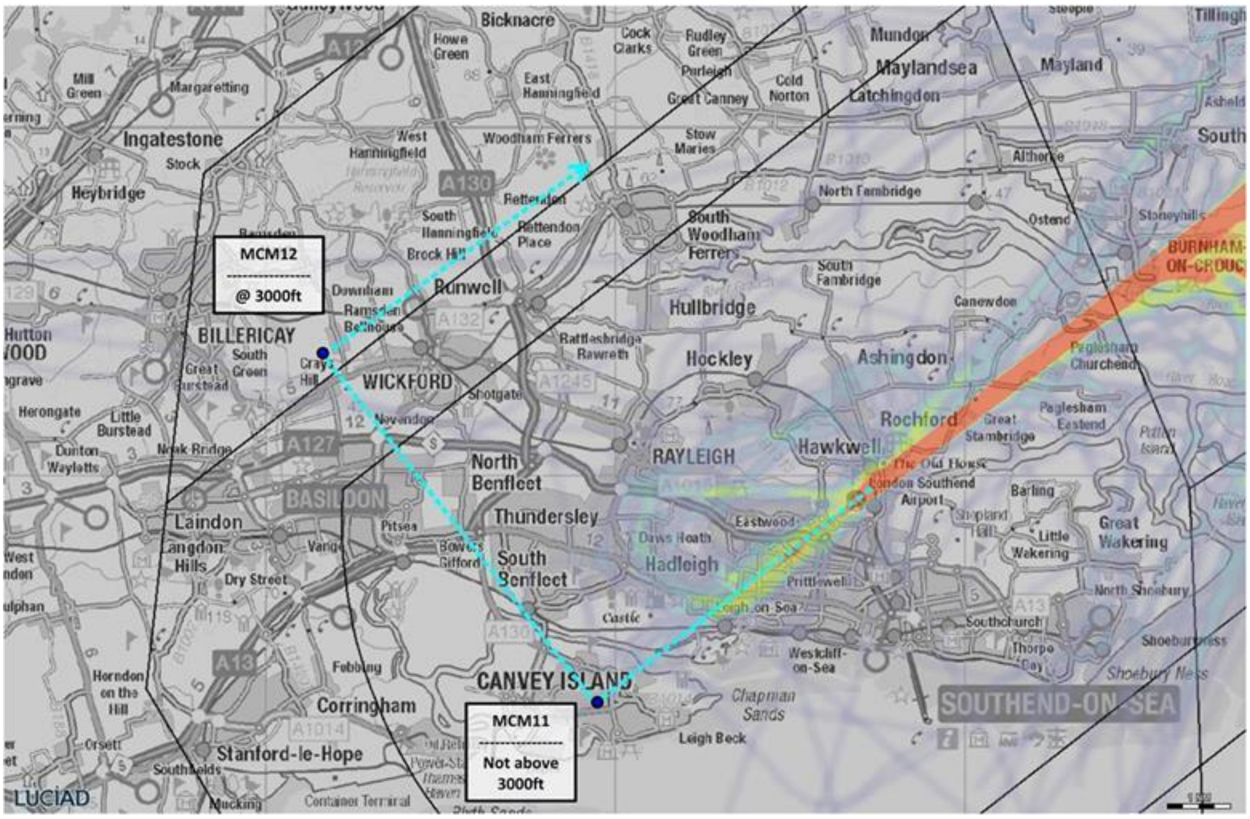


Figure 13: Missed Approach for Runway 23

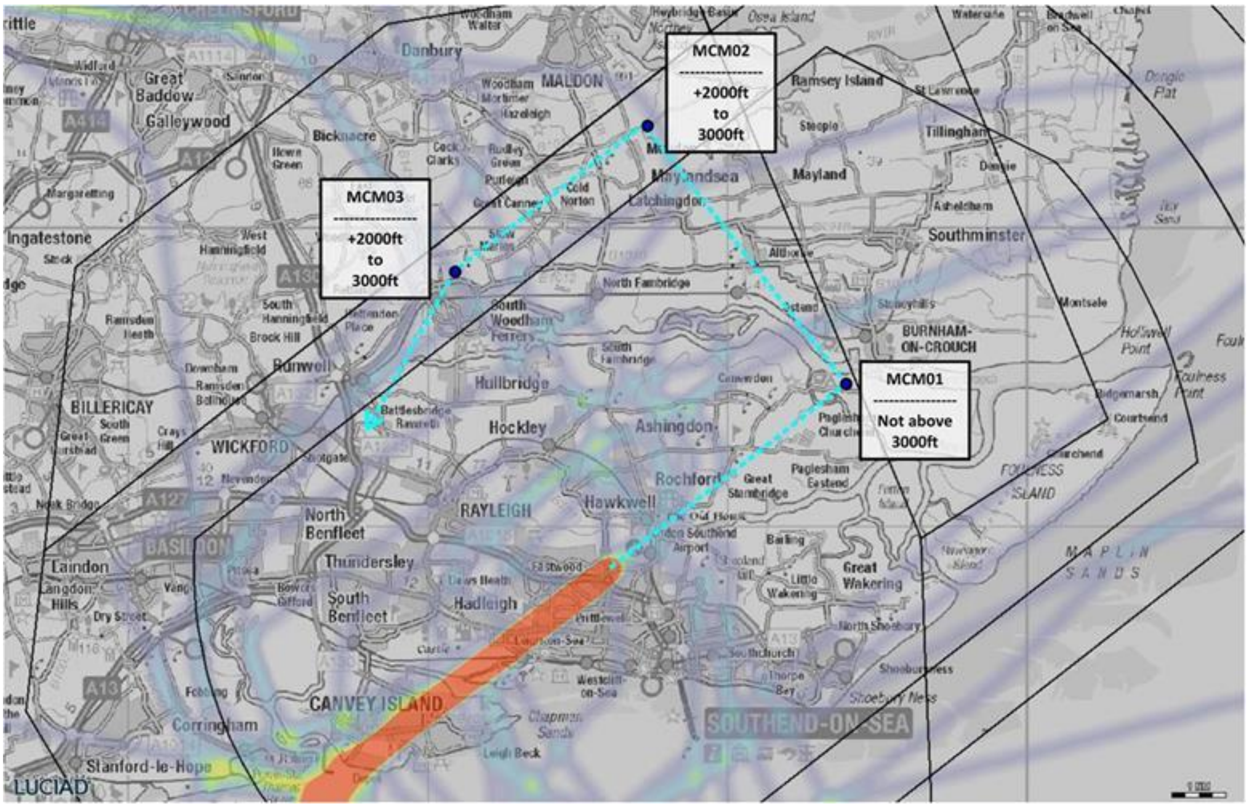


Figure 14: Missed Approach for Runway 05

Missed Approaches				
Runway 23				
	MCM11	MCM12	to TOLNO	
Consultation Document	Not above 3000ft	@ 3000ft	@ 3000ft	
IFP Vectored	Not above 2000ft Max 210kts	@3000ft Max 220kts	@3000ft Max 220kts	
IFP RNAV	Not above 2000ft Max 210kts	@3000ft Max 220kts	@ 3000ft Max 220kts	
Runway 05				
	MCM01	MCM02	MCM03	to DORUM
Consultation Document	Not above 3000ft	+2000ft to 3000ft	+2000ft to 3000ft	+2000ft to 3000ft
IFP Vectored	Climbing to 2000ft Max 195kts	Climbing to 2000ft Max 195kts	@2000ft Max 195kts	@3000ft Max 195kts
IFP RNAV	Climbing to 2000ft Max 195kts	Climbing to 2000ft Max 195kts	@2000ft Max 195kts	@3000ft Max 195kts

Table 10: Differences in Missed Approaches

Transition for Runway 05

From the consultation document to this proposal, the transition for runway 05 has subtly changed some of the level restrictions. See Figure 15 and table below.

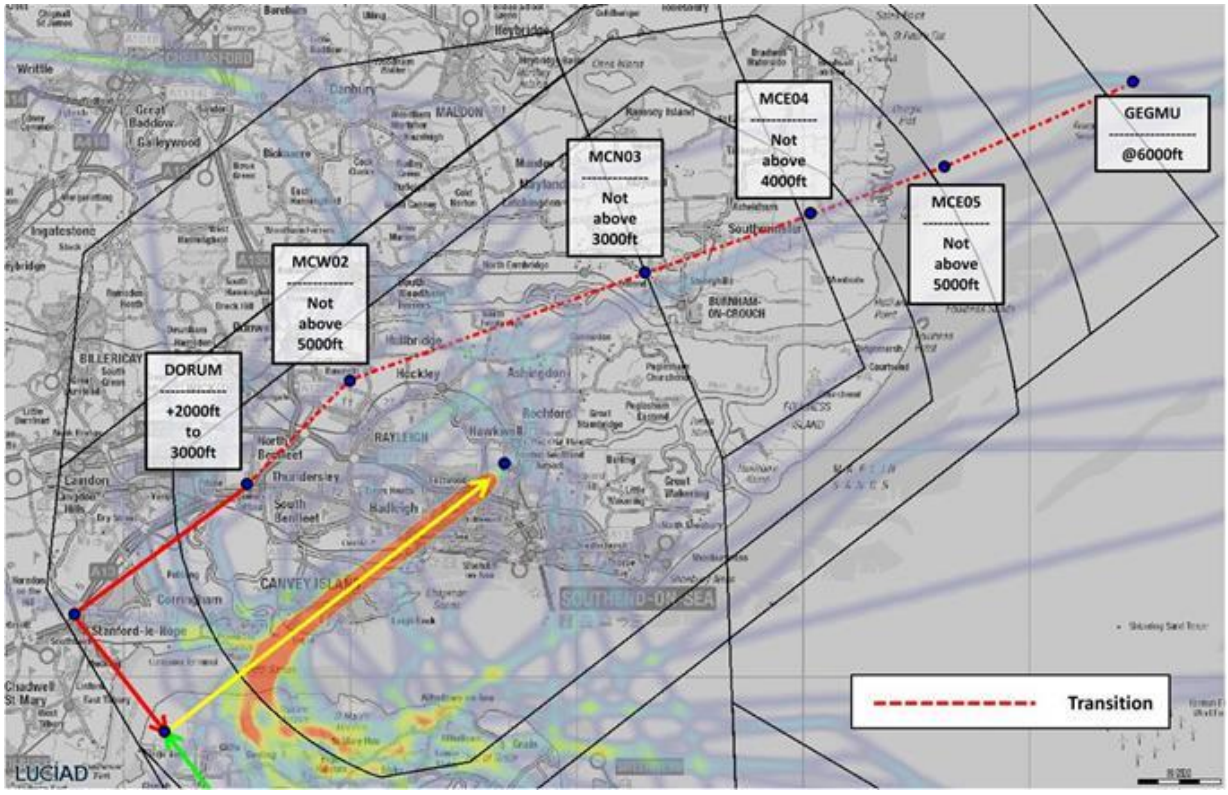


Figure 15: Transition from GEGMU for Runway 05

Transition - Runway 05						
	GEGMU	MCE05	MCE04	MCN03	MCW02	DORUM
Consultation Document	@6000ft	Not above 5000ft	Not above 4000ft	Not above 3000ft	Not above 5000ft	+2000ft to 3000ft
IFP RNAV	@6000ft	@5000ft	@4000ft	@3000ft	n/a	@3000ft

Table 11: Differences on Transition

8. Airspace Description Requirement

CAP 725 Appendix A Paragraph A5 provides a list of requirements for a proposed airspace description. These are listed below:

	CAA CAP725, Appendix A paragraph 5 Requirement. "The proposal should provide a full description of the proposed change including the following:"	**Description for this Proposal**
a	The type of route or structure; e.g. Airway, UAR, Conditional Route, Advisory Route, CTR, SIDs/STARs, Holding Patterns, etc.;	See Sections 1& 4.
b	The hours of operation of the airspace and any seasonal variations;	See Section 4.
c	Interaction with domestic and international enroute structures, TMAs or CTAs with an explanation of how connectivity is to be achieved. Connectivity to aerodromes not connected to CAS should be covered;	See Section 4.
d	Airspace buffer requirements (if any);	See Section 4.
e	Supporting information on traffic data including statistics and forecasts for the various categories of aircraft movements (Passenger, Freight, Test and Training, Aero Club, Other) and Terminal Passenger numbers;	See Section 4 and Section 5.
f	Analysis of the impact of the traffic mix on complexity and workload of operations;	See Section 5.
g	Evidence of relevant draft Letters of Agreement, including any arising out of consultation and/or Airspace Management requirements;	See Section 4 and Section 5. (LoAs will be updated pre-implementation, presuming approval. NATS Terminal Control is aware of the proposed change)
h	Evidence that the Airspace Design is compliant with ICAO Standards and Recommended Practices (SARPs) and any other UK Policy or filed differences, and UK policy on the Flexible Use of Airspace (or evidence of mitigation where it is not);	CAP1385 applied, with supporting evidence, also CAS containment evidence. See Section 4 and Appendix C – Proposed Procedure Draft Charts, also Reference 10.
i	The proposed airspace classification with justification for that classification;	No change to extant airspace classification.
j	Demonstration of commitment to provide airspace users equitable access to the airspace as per the classification and where necessary indicate resources to be applied or a commitment to provide them in-line with forecast traffic growth. 'Management by exclusion' would not be acceptable;	No change to extant airspace access. The new procedures would exist alongside existing procedures to enable continued access to current airspace users.

k	Details of and justification for any delegation of ATS.	No change to delegation of ATS.

9. Supporting Infrastructure & Resources

CAA CAP725 Appendix A Paragraph A6 provides a list of requirements for supporting infrastructure/resources. These are listed below:

	CAA CAP725, Appendix A Paragraph 6, general Requirements	**Description for this Proposal**
a	Evidence to support RNAV and conventional navigation as appropriate with details of planned availability and contingency procedures.	See Section 4 and Ref 10.
b	Evidence to support primary and secondary surveillance radar (SSR) with details of planned availability and contingency procedures.	No change, demonstrably adequate for purpose.
c	Evidence of communications infrastructure including R/T coverage, with availability and contingency procedures.	No change, demonstrably adequate for purpose.
d	The effects of failure of equipment, procedures and/or personnel with respect to the overall management of the airspace must be considered.	Failure modes will be analysed and appropriate contingency procedures established.
e	The Proposal must provide effective responses to the failure modes that will enable the functions associated with airspace to be carried out including details of navigation aid coverage, unit personnel levels, separation standards and the design of the airspace in respect of existing international standards or guidance material.	Failure modes will be analysed and appropriate contingency procedures established.
f	A clear statement on SSR code assignment requirements is also required.	No change to SSR code allocation.
g	Evidence of sufficient numbers of suitably qualified staff required to provide air traffic services following the implementation of a change.	Suitably trained staff will be in place before implementation.

10. Operational Impact

CAA CAP725 Appendix A Paragraph A7 provides a list of requirements for operational impact. These are listed below:

	CAA CAP725, Appendix A paragraph A7 requirements. "An analysis of the impact of the change on all airspace users, airfields and traffic levels must be provided, and include an outline concept of operations describing how operations within the new airspace will be managed. Specifically, consideration should be given to:"	**Evidence of Compliance/Proposed Mitigation**
a	Impact on IFR General Air Traffic and Operational Air Traffic or on VFR General Aviation (GA) traffic flow in or through the area;	See Section 5.
b	Impact on VFR operations (including VFR Routes where applicable);	See Section 5.
c	Consequential effects on procedures and capacity, i.e. on SIDs, STARs, and/or holding patterns. Details of existing or planned routes and holds;	See Section 4, Reference 10 and Appendix C – Proposed Procedure Draft Charts.
d	Impact on aerodromes and other specific activities within or adjacent to the proposed airspace;	See Section 5.
e	Any flight planning restrictions and/or route requirements.	See Section 5.

11. Airspace & Infrastructure Requirements

CAA CAP725 Appendix A Paragraphs A11-A14 provide a list of requirements for airspace and infrastructure. These are listed below:

	CAA CAP725, Appendix A paragraph A11: General Requirements	**Evidence of Compliance/Proposed Mitigation**
a	The airspace structure must be of sufficient dimensions with regard to expected aircraft navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both radar and non-radar environments;.	See Section 4 and reference 10.
b	Where an additional airspace structure is required for radar control purposes, the dimensions shall be such that radar control manoeuvres can be contained within the structure, allowing a safety buffer. This safety buffer shall be in accordance with agreed parameters as set down in SARG Policy Statement 'Special Use Airspace - Safety Buffer Policy for Airspace Design Purposes';	No new CAS is proposed.
c	The Air Traffic Management (ATM) system must be adequate to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures;	See Section 4 and Reference 10.
d	Air Traffic Control (ATC) procedures are to ensure required separation between traffic inside a new airspace structure and traffic within existing adjacent or other new airspace structures;	See Section 4.
e	Within the constraints of safety and efficiency, the airspace classification should permit access to as many classes of user as practicable;	See Section 4.
f	There must be assurance, as far as practicable, against unauthorised incursions. This is usually done through the classification and promulgation.	This change will be promulgated through the AIRAC cycle giving the requisite notice period.
h	The notification of the implementation of new airspace structures or withdrawal of redundant airspace structures shall be adequate to allow interested parties sufficient time to comply with user requirements. This is normally done through the AIRAC cycle;	This change will be promulgated through the AIRAC cycle giving the requisite notice period.

l	There must be sufficient R/T coverage to support the ATM system within the totality of proposed controlled airspace.	There is no change to the extent of the region within which the new procedures are to be placed therefore extant R/T coverage is considered to be adequate.
j	If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered;	See Section 4 and Reference 14.
k	Should there be any other aviation activity (low flying, gliding, parachuting, microlight site, etc.) in the vicinity of the new airspace structure and no suitable operating agreements or ATC Procedures can be devised, the Change Sponsor shall act to resolve any conflicting interests;	Procedures as extant.

	CAA CAP725, Appendix A paragraph A12: ATS Route Requirements	**Evidence of Compliance/Proposed Mitigation**
a	There must be sufficient accurate navigational guidance based on in-line VOR/DME or NDB or by approved RNAV derived sources, to contain the aircraft within the route to the published RNP value in accordance with ICAO/EuroControl Standards;	See Section 4 and Reference 10.
b	Where ATS routes adjoin Terminal Airspace there shall be suitable link routes as necessary for the ATM task;	See Section 4
c	All new routes should be designed to accommodate	See Section 4

	CAA CAP725, Appendix A paragraph A13: Terminal Airspace Requirements	**Evidence of Compliance/Proposed Mitigation**
a	The airspace structure shall be of sufficient dimensions to contain appropriate procedures, holding patterns and their associated protected areas;	See Section 4
b	There shall be effective integration of departure and arrival routes associated with the airspace structure and linking to designated runways and published IAPs;	See Section 4
c	Where possible, there shall be suitable linking routes between the proposed terminal airspace and existing enroute airspace structure;	See Section 4

d	The airspace structure shall be designed to ensure that adequate and appropriate terrain clearance can be readily applied within and adjacent to the proposed airspace;	See Section 4 and Reference 10.

e	Suitable arrangements for the control of all classes of aircraft (including transits) operating within or adjacent to the airspace in question, in all meteorological conditions and under all flight rules, shall be in place or will be put into effect by Change Sponsors upon implementation of the change in question (if these do not already exist);.	See Section 4.
f	Change Sponsors shall ensure that sufficient VRPs are established within or adjacent to the subject airspace to facilitate the effective integration of VFR arrivals, departures and transits of the airspace with IFR traffic;	See Section 4.
g	There shall be suitable availability of radar control facilities;	See Section 4.
h	Change Sponsors shall, upon implementation of any airspace change, devise the means of gathering (if these do not already exist) and of maintaining statistics on the number of aircraft transiting the airspace in question. Similarly, Change Sponsors shall maintain records on the numbers of aircraft refused permission to transit the airspace in question, and the reasons why. Change Sponsors should note that such records would enable ATS Managers to plan staffing requirements necessary to effectively manage the airspace under their control;	SAL has an existing, agreed process in place to capture CAS crossers and any which are denied a crossing service.
i	All new procedures should, wherever possible, incorporate Continuous Descent Approach (CDA) profiles after aircraft leave the holding facility associated with that procedure.	See Section 4 and Reference 10.

	CAA CAP725, Appendix A paragraph A14: Off Route Airspace Requirements	**Evidence of Compliance/Proposed Mitigation**
	There are no proposed changes to off route airspace structures.	

12. Environmental Requirements

This section details the required elements of an Environmental Assessment for ACP development, based upon CAP725 Appendix B.

The requirements in this section are grouped by the degree of compliance expected from airspace change sponsors. In following this guidance:

Must – change sponsors are to meet the requirements in full when this term is used.

Should – change sponsors are to meet these requirements unless there is sufficient reason which must be agreed in writing with the SARG case officer and the circumstances recorded in the formal airspace change documentation.

May – change sponsors decide whether this guidance is appropriate to the circumstances of the airspace change.

	Requirement	**Section**
1	In order to ensure that the various areas for environmental assessment by SARG are addressed, Change Sponsors should submit the documentation with the following clearly defined sections: • Description of the airspace change; • Traffic forecasts; • An assessment of the effects on noise; • An assessment of the change in fuel burn/CO2; • An assessment of the effect on local air quality; and • An economic valuation of environmental impact, if appropriate.	See Section 4 See Section 5 See Section 5.2 See Section 5.6 See Section 5.5 See Section 5.10
2	It is considered unlikely that airspace changes will have a direct impact on animals, livestock and biodiversity. However, Change Sponsors should remain alert to the possibility and may be required to include these topics in their environmental assessment.	See Section 5
3	Environmental assessment should set out the base case or current situation so that changes can be clearly identified.	See Section 5
4	Environmental assessment should follow the Basic Principles listed in CAP 725.	See Section 5
5	A technical document containing a comprehensive and complete description of the airspace change including the environmental impact will be required and must be produced for all airspace changes.	See Sections 4 & 5

6	It may be appropriate for Change Sponsors to produce a more general description of the airspace change and the rationale for its proposal in an easy-to-read style for public consumption. If such an additional separate document is produced, it must contain details of the environmental impact of the proposal.	See Sections 1& 4
7	The environmental assessment must include a high quality paper diagram of the airspace change in its entirety as well as supplementary diagrams Illustrating different parts of the change. This diagram must show the extent of the airspace change in relation to known geographical features and centres of population	See Section 4
8	The proposal should consider and assess more than one option, then demonstrate why the selected option meets safety and operational requirements and will generate an overall environmental benefit or, if not, why it is being proposed.	See Section 6
9	The Change Sponsor must provide SARG with a complete set of coordinates describing the proposed change in electronic format using World Geodetic System 1984 (WGS 84). In addition, the Sponsor must supply these locations in the form of Ordnance Survey (OS) national grid coordinates.	See Section 4 & Reference 10
10	This electronic version must provide a full description of the horizontal and vertical extent of the zones and areas contained within the airspace change. It must also include coordinates in both WGS 84 and OS national grid formats that define the centre lines of routes including airways, standard instrument departures (SID), standard arrival routes (STAR), noise preferential routes (NPR) or any other arrangement that has the effect of concentrating traffic over a particular geographical area.	See Section 4 & Reference 10
11	Change Sponsors should provide indications of the likely lateral dispersion of traffic about the centre line of each route. This should take the form of a statistical measure of variation such as the standard deviation of lateral distance from the centre line for given distances along track in circumstances where the dispersion is variable.	See Sections 4 & 5.3

12	Sponsors may supply the outputs from simulation to demonstrate the lateral dispersion of traffic within the proposed airspace change or bring forward evidence based on actual performance on a similar kind of route. It may be appropriate for Sponsors to explain different aspects of dispersion e.g. dispersion within NPRs when following a departure routeing and when vectoring – where the aircraft will go and their likely frequency	See Section 5.3 No simulation other than flight validation carried out.
13	Change Sponsors must provide a description of the vertical distribution of traffic in airways, SIDs, STARs, NPRs and other arrangements that have the effect of concentrating traffic over a particular geographical area	See Section 4 & Reference 10
14	For departing traffic, sponsors should produce profiles of the most frequent type(s) of aircraft operating within the airspace. They should show vertical profiles for the maximum, typical and minimum climb rates achievable by those aircraft.	See Sections 3.3 & 4.8
15	A vertical profile for the slowest climbing aircraft likely to use the airspace should also be produced.	See Section 4 & Reference 10
16	All profiles should be shown graphically and the underlying data provided in a spread sheet with all planning assumptions clearly documented.	See Section 4 & Reference 10
17	Change Sponsors should explain how consideration of CDA and LPLD is taken into account within their proposals	See Section 4 & Reference 10
18	In planning changes to airspace arrangements, sponsors may have conducted real and/or fast time simulations of air traffic for a number of options.	No simulation other than flight validation carried out.
19	Change Sponsors must include traffic forecasts in their environmental assessment.	See Sections 3.3 & 4.8
20	Information on air traffic must include the current level of traffic using the present airspace arrangement and a forecast. The forecast will need to indicate the traffic growth on the different routes contained within the airspace change volume.	See Sections 3.3 & 4.8
21	The sources used for the forecast must be documented.	See Sections 3.3 & 4.8
22	Typically, forecasts should be for five years from the planned implementation date of the airspace change. There may be good reasons for varying this – for example, to use data that has already been made available to the general public at planning inquiries, in airport master plans or other business plans	See Sections 3.3 & 4.8

23	It may also be appropriate to provide forecasts further into the future than five years: examples are extensive airspace changes or where traffic is forecast to grow slowly in the five-year period but faster thereafter.	n/a
24	It may be appropriate for Change Sponsors to outline the key factors [affecting traffic forecasts] and their likely impact. In these circumstances, Sponsors should consider generating a range of forecasts based on several scenarios that reflect those uncertainties – this would help prevent iterations in the assessment process.	See Sections 3.3 & 4.8
25	Traffic forecasts should contain not only numbers but also types of aircraft. Change Sponsors should provide this information by runway (for arrivals/departures) and/or by route with information on vertical distribution by height/altitude/flight level as appropriate.	See Sections 3.3 & 4.8
26	Types of aircraft may be given by aircraft type/engine fit using ICAO type designators. If this is not a straightforward exercise, then designation by the UK Aircraft Noise Contour Model (ANCON) types or by seat size categories would be acceptable.	See Sections 3.3 & 4.8
27	Change Sponsors must produce Leq, 16 hours noise exposure contours for airports where the proposed option entails changes to departure and arrival routes for traffic below 4,000 feet agl based on the published minimum departure and arrival gradients. Under these circumstances, at least three sets of contours must be produced: • Current situation – these may already be available as part of the airport's regular environmental reporting or as part of the airport master plan; • Situation immediately following the airspace change; and • Situation after traffic has increased under the new arrangements (typically five years after implementation although this should be discussed with the SARG Project Leader).	n/a
28	The contours should be produced using either the UK Aircraft Noise Contour Model (ANCON) or the US Integrated Noise Model (INM) but ANCON must be used when it is currently in use at the airport for other purposes.	n/a
29	Terrain adjustments should be included in the calculation process (i.e. the height of the air routes relative to the ground are accounted for).	n/a

30	Contours must be portrayed from 57 dBA Leq, 16 hours at 3 dB intervals.	n/a
31	Contours should not be produced at levels below 54 dBA Leq, 16 hours because this corresponds to generally low disturbance to most people.	n/a
32	Change Sponsors may include the 54 dBA Leq, 16 hours contour as a sensitivity analysis but this level has no particular relevance in policy making.	n/a
3	A table should be produced showing the following data for each 3 dB contour interval: • Area (km2); and • Population (thousands) – rounded to the nearest hundred.	n/a
	It is sometimes useful to include the number of households within each contour, especially if issues of mitigation and compensation are relevant: • This table should show cumulative totals for areas/populations/households. For example, the population for 57 dBA will include residents living in all higher contours. • The source and date of population data used should be noted adjacent to the table. Population data should be based on the latest available national census as a minimum but more recent updated population data is preferred. • The areas calculated should be cumulative and specify total area within each contour including that within the airport perimeter.	n/a

	Contours for assessment should be provided to SARG in both of the following formats: • Electronic files in the form of a comma delimited ASC2 text file containing three fields as an ordered set (i.e. coordinates should be in the order that describes the closed curve) defining the contours in Ordnance Survey National Grid in metres: - Field Name Units - 1 Level dB - 2 Easting six figure easting OS national grid reference (metres) - 3 Northing six figure northing OS national grid reference (metres) • Paper version overlaid on a good quality 1:50 000 Ordnance Survey map. However, it may be more appropriate to present contours on 1:25 000 or 1:10 000 Ordnance Survey maps.	n/a
36	Contours for a general audience may be provided overlaid on a more convenient map (e.g. an ordinary road map with a more suitable scale for publication in documents). The underlying map and contours should be sufficiently clear for an affected resident to be able to identify the extent of the contours in relation to their home and other geographical features. Hence, the underlying map must show key geographical features, e.g. street, rail lines and rivers.	n/a
37	SEL footprints must be used when the proposed airspace includes changes to the distribution of flights at night below 7,000 feet agl and within 25 km of a runway. Night is defined here as the period between 2300 and 0700 local time. If the noisiest and most frequent night operations are different, then footprints should be calculated for both of them. A separate footprint for each of these types should be calculated for each arrival and departure route. If SEL footprints are provided, they should be calculated at both 90 dBA SEL and 80 dBA SEL.	n/a
38	SEL footprints may be used when the airspace change is relevant to daytime only operations. If SEL footprints are provided, they should be calculated at both 90 dBA SEL and 80 dBA SEL.	n/a

39	SEL footprints for assessment should be provided to SARG in both of the following formats: • Electronic files in the form of a comma delimited ASC2 text file containing three fields as an ordered set (i.e. coordinates should be in the order that describes the closed curve) defining the footprints in Ordnance Survey National Grid in metres: - Field Name Units - 1 Level dB - 2 Easting six figure easting OS national grid reference (metres) - 3 Northing six figure northing OS national grid reference (metres) • Paper version overlaid on a good quality 1:50 000 Ordnance Survey map. However, it may be more appropriate to present footprints on 1:25 000 or 1:10 000 Ordnance Survey maps.	n/a
40	SEL footprints for a general audience may be provided overlaid on a more convenient map (e.g. an ordinary road map with a more suitable scale for publication in documents). The underlying map and footprints should be sufficiently clear for an affected resident to identify the extent of the footprints in relation to their home or other geographical features. Hence, this underlying map must show key geographical features, e.g. streets, rail lines and rivers. Calculations should include terrain adjustments as described in the section on Leq contours	n/a
41	Change Sponsors may use the percentage highly annoyed measure in the assessment of options in terminal airspace to supplement Leq. If they choose to use this method, then the guidance on population data for noise exposure contours set out should be followed. Sponsors should use the expression and associated results in calculating the number of those highly annoyed. If they wish to use a variant method, then this would need to be supported by appropriate research references.	n/a

42	Change Sponsors may use the LDEN metric but, if they choose to do so, they must still produce the standard Leq, 16 hours contours as previously described. If airspace change sponsors wish to use the LDEN metric they must do so in a way that is compliant with the technical aspects of the Directive and any supplementary instructions issued by DEFRA. Sponsors should note the requirement for noise levels to be calculated as received at 4 metres above ground level. In particular, the guidance on how contours are to be portrayed, as described in the section dealing with Leq contours applies. Calculations should include terrain adjustments as described in the section on Leq contours. An exception regarding LDEN contours is the production of a table showing numerical data on area, population and households which should be presented by band (e.g. 55 dBA to 60 dBA) rather than cumulatively as for UK Leq contours (e.g. >55 dBA). Change Sponsors should make it clear where areas/counts are by band or cumulative.	n/a
43	Change Sponsors may use the LNight metric within their environmental assessment and consultation. If they do so, SEL footprints must also be produced. Calculations should include terrain adjustments as described in the section on Leq contours.	n/a
44	Change Sponsors may use difference contours if it is considered that redistribution of noise impact is a potentially important issue.	n/a
45	Change Sponsors may use PEI as a supplementary assessment metric.	n/a
46	Change Sponsors may use the AIE metric as a supplementary assessment metric. If the sponsor uses PEI as a supplementary metric then AIE should also be calculated as both metrics are complementary.	n/a
47	Change Sponsors may vary the information displayed in Operations Diagrams providing that the diagram is a fair and accurate representation of the situation portrayed.	n/a
48	Change Sponsors may use maximum sound levels (Lmax) in presenting aircraft noise footprints for public consumption if they think that this would be helpful. This does not replace the obligation to comply with the requirement to produce sound exposure level (SEL) footprints, where applicable.	n/a

49	Change Sponsors may produce diagrams portraying maximum sound event levels (Lmax) for specific aircraft types at a number of locations at ground level beneath the airspace under consideration. This may be helpful in describing the impact on individuals. It is usual to include a table showing the sound levels of typical phenomenon e.g. a motor vehicle travelling at 30 mph at a distance of 50 metres.	n/a
50	Change Sponsors must demonstrate how the design and operation of airspace will impact on emissions. The kinds of questions that need to be answered by the sponsor are: • Are there options which reduce fuel burn in the vertical dimension, particularly when fuel burn is high e.g. initial climb? • Are there options that produce more direct routeing of aircraft, so that fuel burn is minimised? • Are there arrangements that ensure that aircraft in cruise operate at their most fuel-efficient altitude, possibly with step-climbs or cruise climbs?	See Section 5
51	Change Sponsors should estimate the total annual fuel burn/mass of carbon dioxide in metric tonnes emitted for the current situation, the situation immediately following the airspace change and the situation after traffic has increased under the new arrangements – typically five years after implementation. Sponsors should produce estimates for each airspace option considered.	See Section 5
52	Change Sponsors should provide the input data for their calculations including any modelling assumptions made. They should state details of the aircraft performance model used including the version numbers of software employed.	See Section 5
53	Where the need to provide additional airspace capacity, reduce delays or mitigate other environmental impact results in an increase in the total annual fuel burn/ mass of carbon dioxide in metric tonnes between the current situation and the situation following the airspace change, Sponsors should provide justification.	n/a

54	Change Sponsors must produce information on local air quality only where there is the possibility of pollutants breaching legal limits following the implementation of an airspace change. The requirement for local air quality modelling will be determined on a case by case basis as discussed with the SARG Project Leader and ERCD. This discussion will include recommendations of the appropriate local air quality model to be used. Concentrations should be portrayed in microgrammes per cubic metre (µg.m-3). They should include concentrations from all sources whether related to aviation and the airport or not. Three sets of concentration contours should be produced: • Current situation – these may already be available as part of the airport's regular environmental reporting or as part of the airport master plan; • Situation immediately following the airspace change; and • Situation after traffic has increased under the new arrangements – typically five years after implementation although this should be discussed with the SARG Project Leader.	See Section 5
55	Contours for assessment should be provided to SARG in similar formats to those used for noise exposure contours. Where Change Sponsors are required to produce concentration contours they should also produce a table showing the following data for concentrations at 10 µ.m-3 intervals: • Area (km2); and • Population (thousands) – rounded to the nearest hundred.	n/a
56	The source and date of population data used should be noted adjacent to the table. Population data should be based on the latest available national census as a minimum but more recent updated population data is preferred.	n/a

57	Change Sponsors may wish to conduct an economic appraisal of the environmental impact of the airspace change, assessing the economic benefits generated by the change. If undertaken, this should be conducted in accordance with the guidance from HM Treasury in the Green Book (HM Treasury, 2003). If Change Sponsors include a calculation of NPV then they must show financial discount rates, cash flows and their timings and any other assumptions employed. The discount rate must include that recommended in the Green Book currently set at 3.5%. Additionally, other discount rates may be used in a sensitivity analysis or because they are representative of realistic commercial considerations	n/a

Appendix A – Draft Amendments to the AIP

AD2.22 Flight Procedures

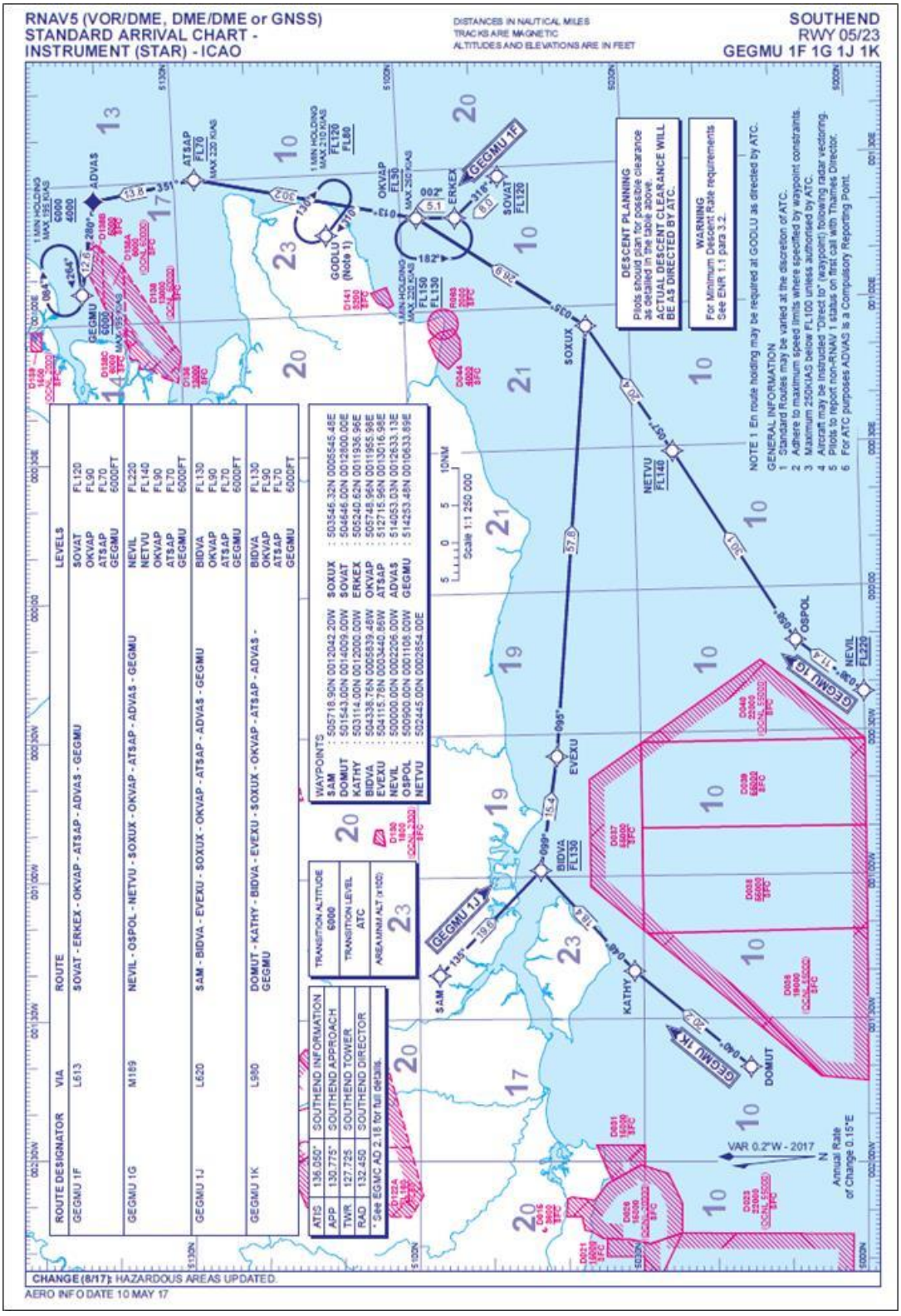
1. Procedures for IFR flights
2. Radio Communications Failure Procedures
3. IFR Holding

AD 2.24 List of new charts (as below)

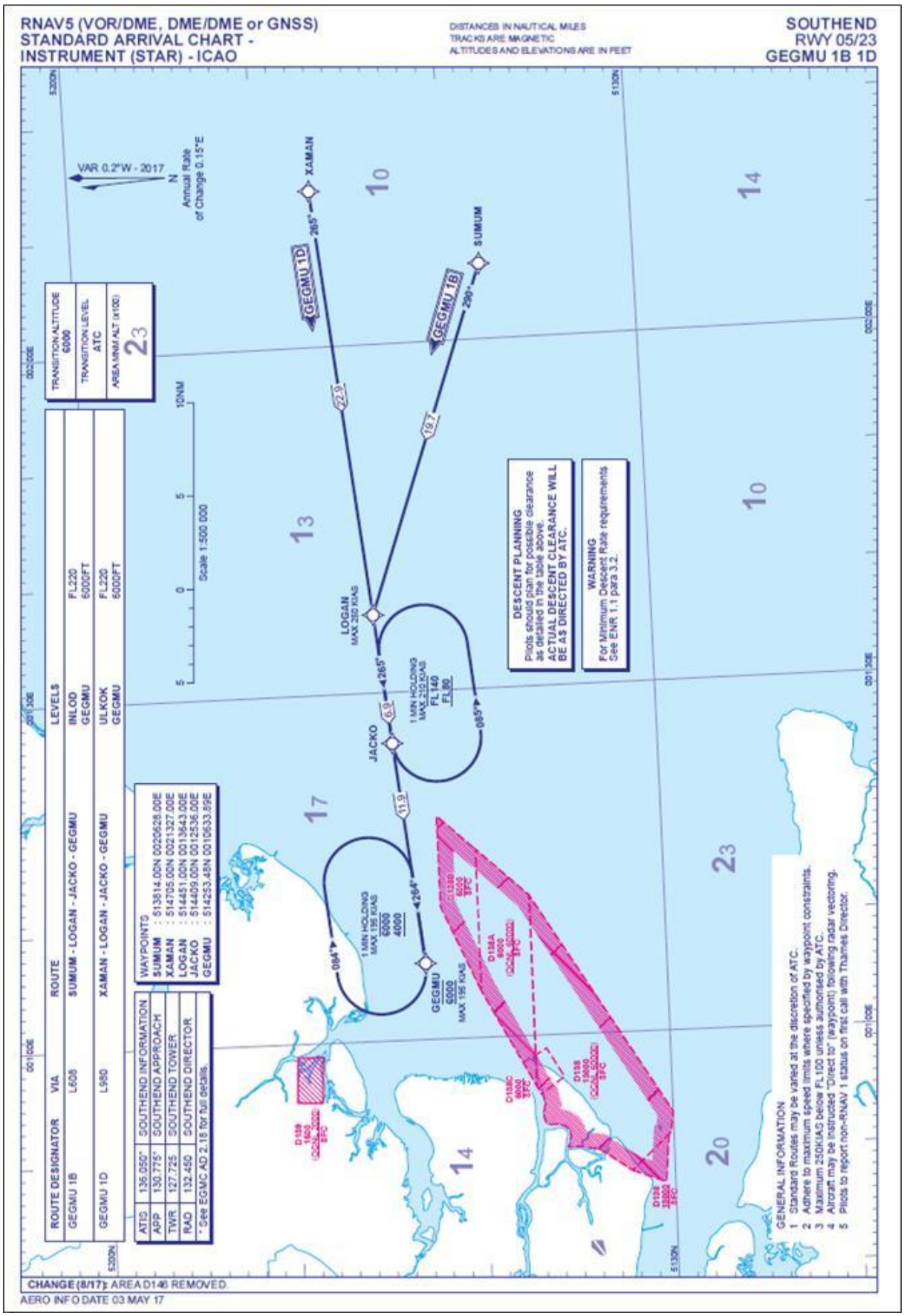
Additional charts (AD-2-EGMC-9-x?)

- RNAV Transition RWY 05
- Instrument Approach Chart - Southend RNAV Y RWY 05
- Instrument Approach Chart - Southend RNAV Z RWY 05
- Instrument Approach Chart - Southend RNAV Y RWY 23
- Instrument Approach Chart - Southend RNAV Z RWY 23
- Instrument Approach Procedure Coding Tables RWY 05 (Y) - ICAO
- Instrument Approach Procedure Coding Tables RWY 05 (Z) - ICAO
- Instrument Approach Procedure Coding Tables RWY 23 (Y) - ICAO
- Instrument Approach Procedure Coding Tables RWY 23 (Z) - ICAO
- RNAV Transition Coding Table GEGMU - RWY 05

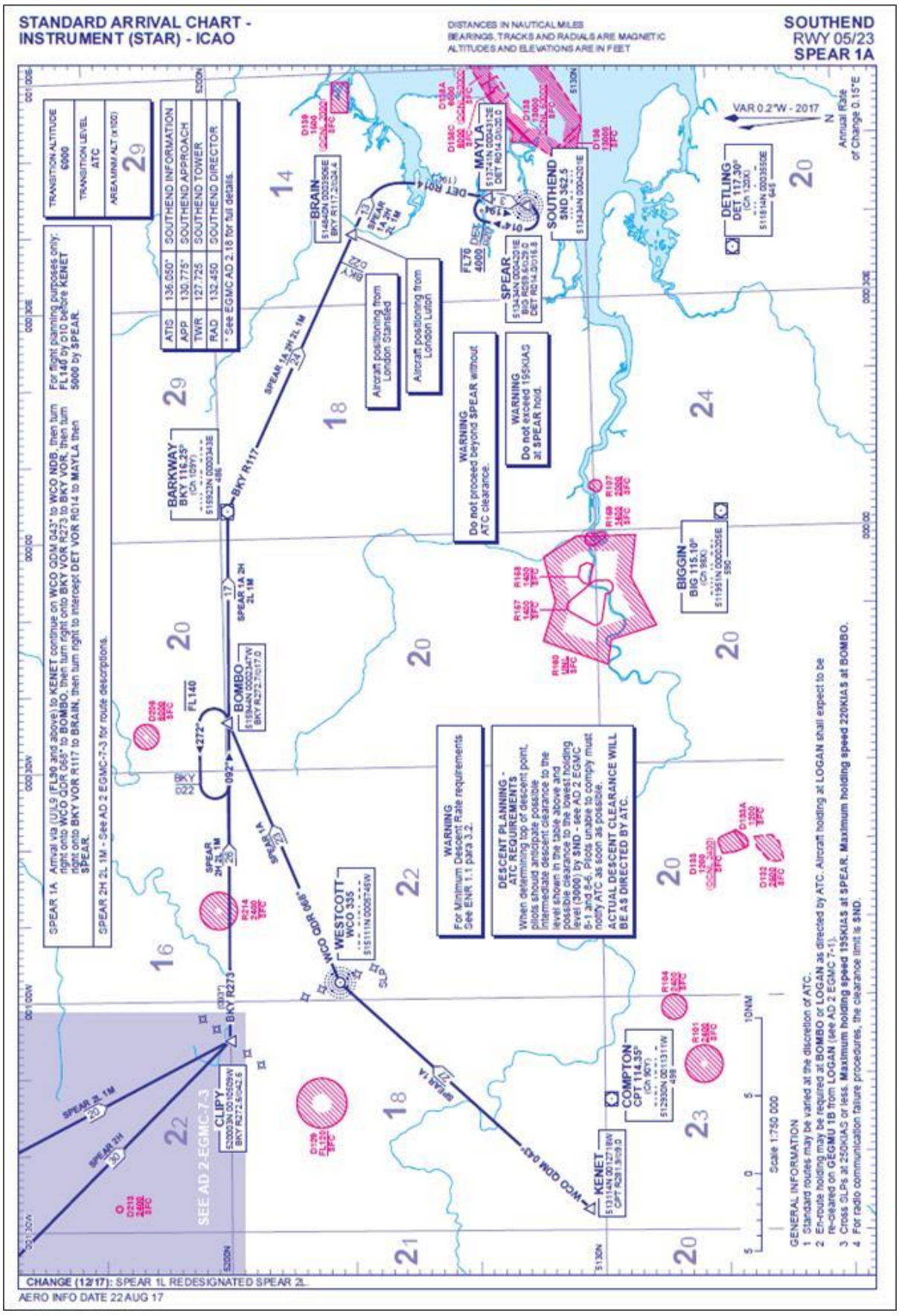
Appendix B – Current AIP STAR Charts



GEGMU 1F 1G 1J 1K STAR (south)



GEGMU 1B 1D STAR (east)



SPEAR 1A STAR (north and west)

Appendix C – Proposed Procedure Draft Charts

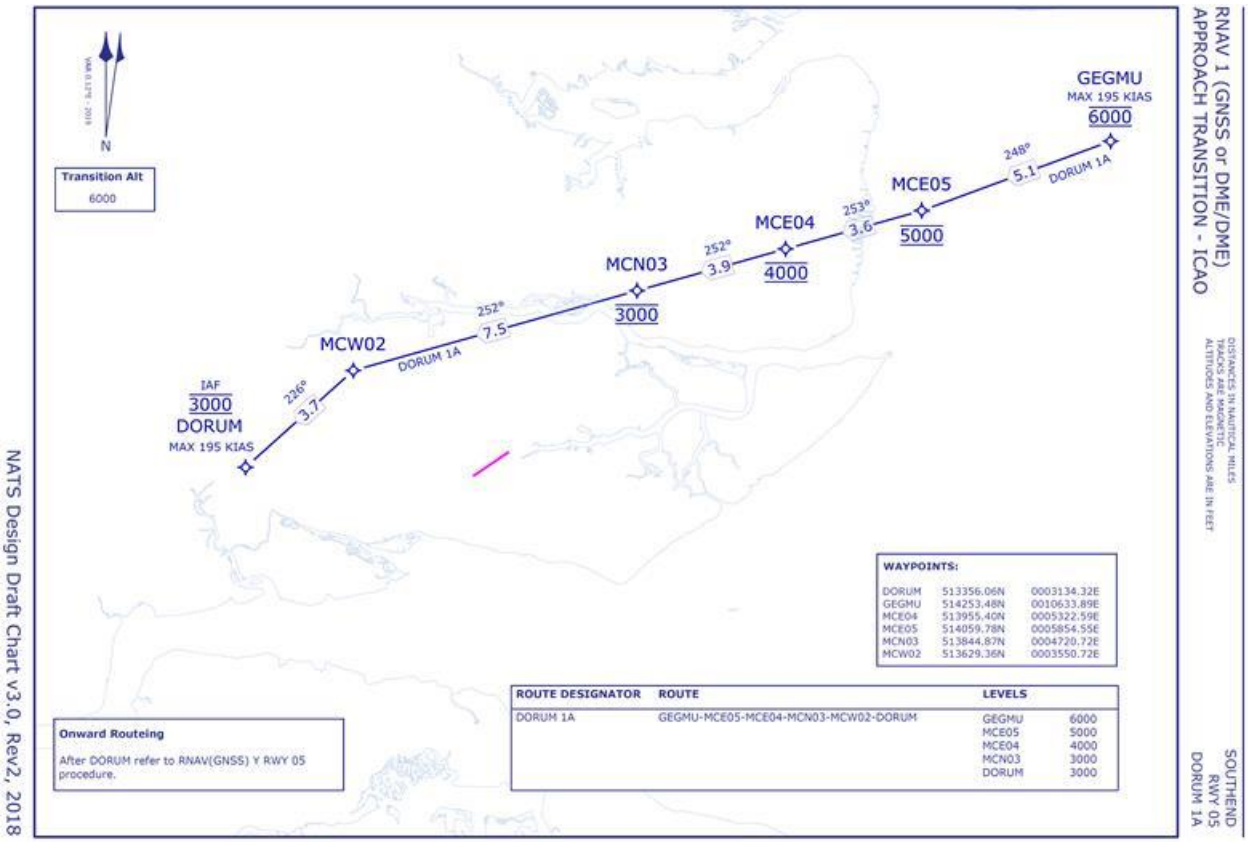


Figure 16: RNAV Transition Runway 05

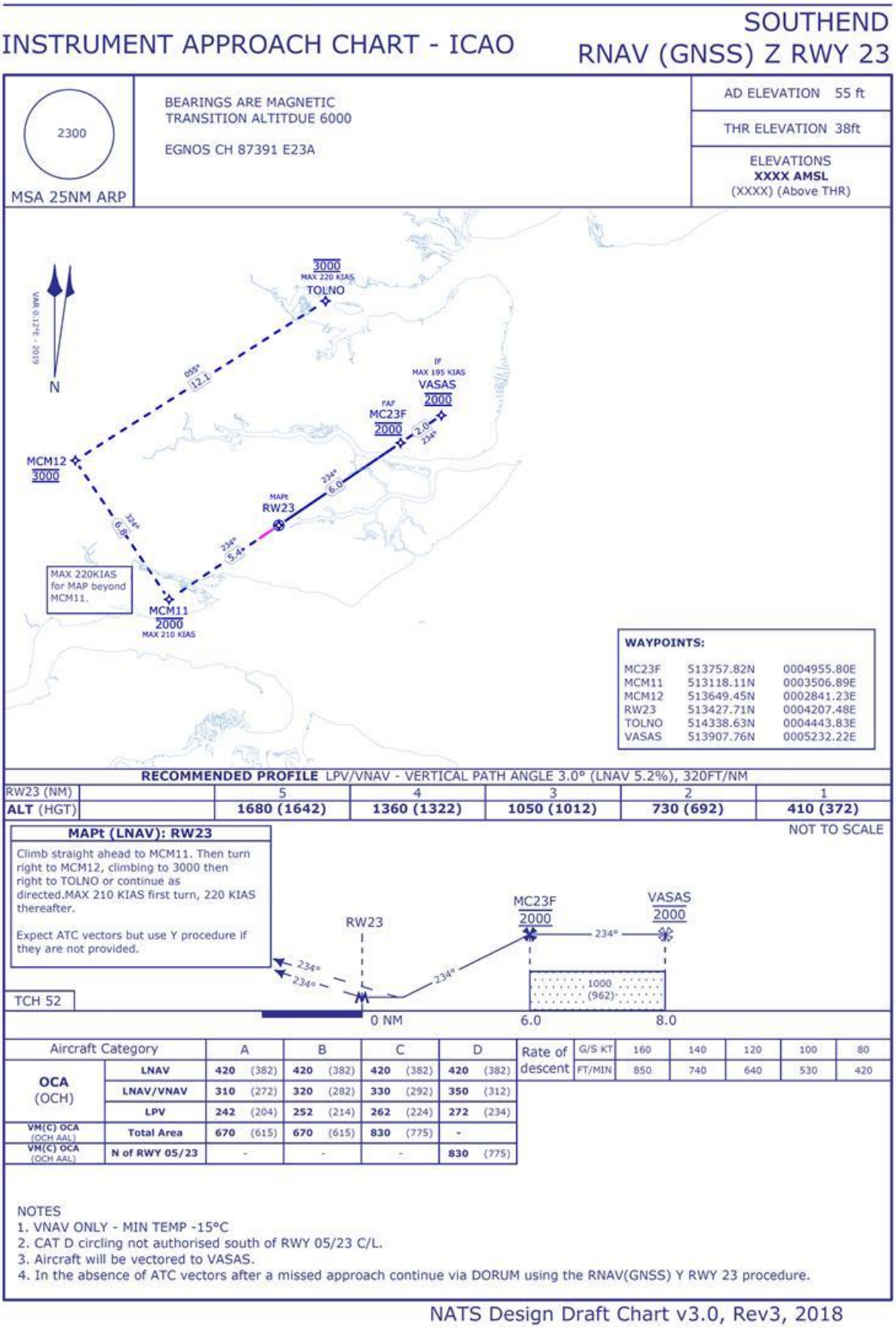


Figure 17: Tactical RNAV Final Approach & Missed Approach Runway 23

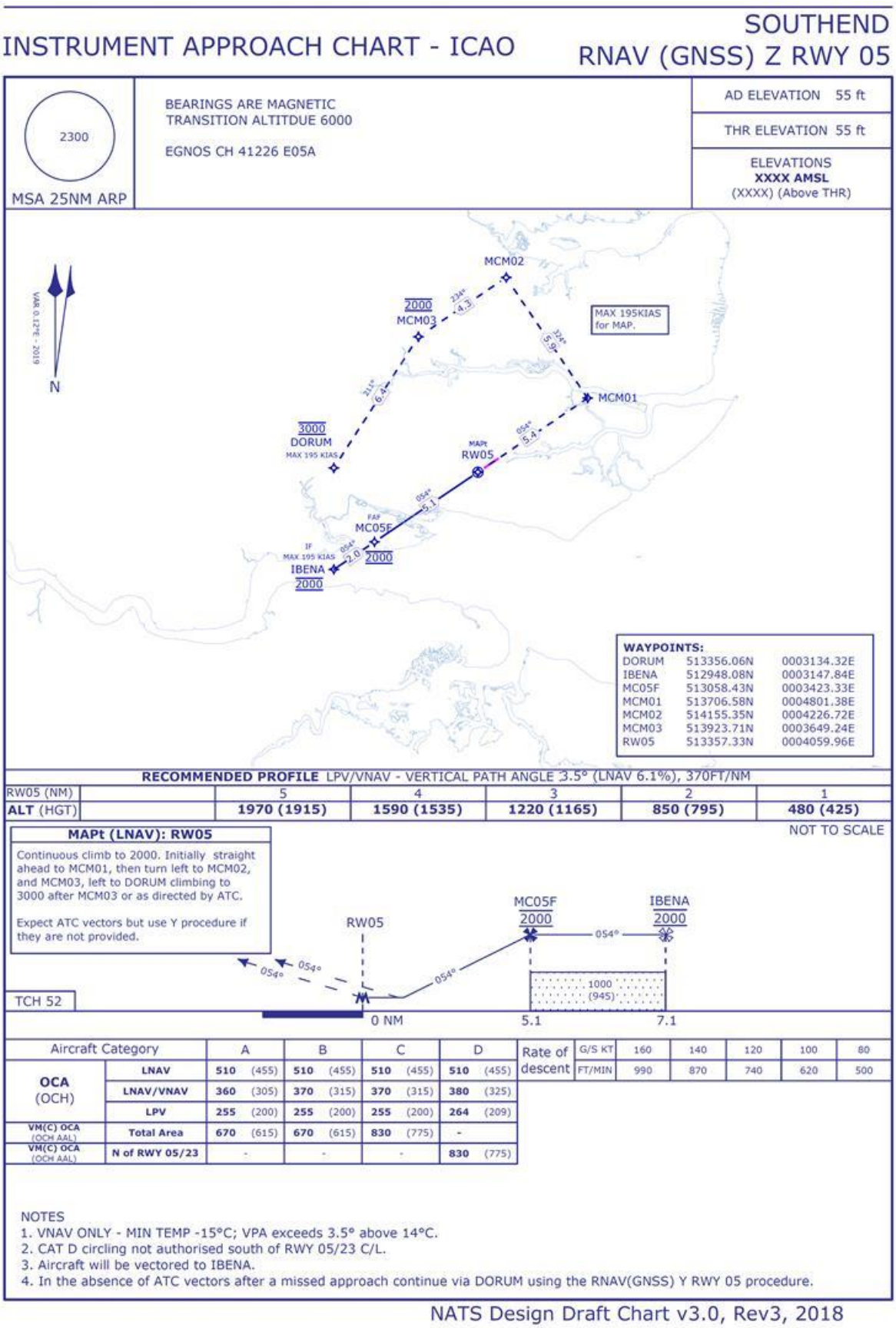


Figure 18: Tactical RNAV Final Approach & Missed Approach Runway 05

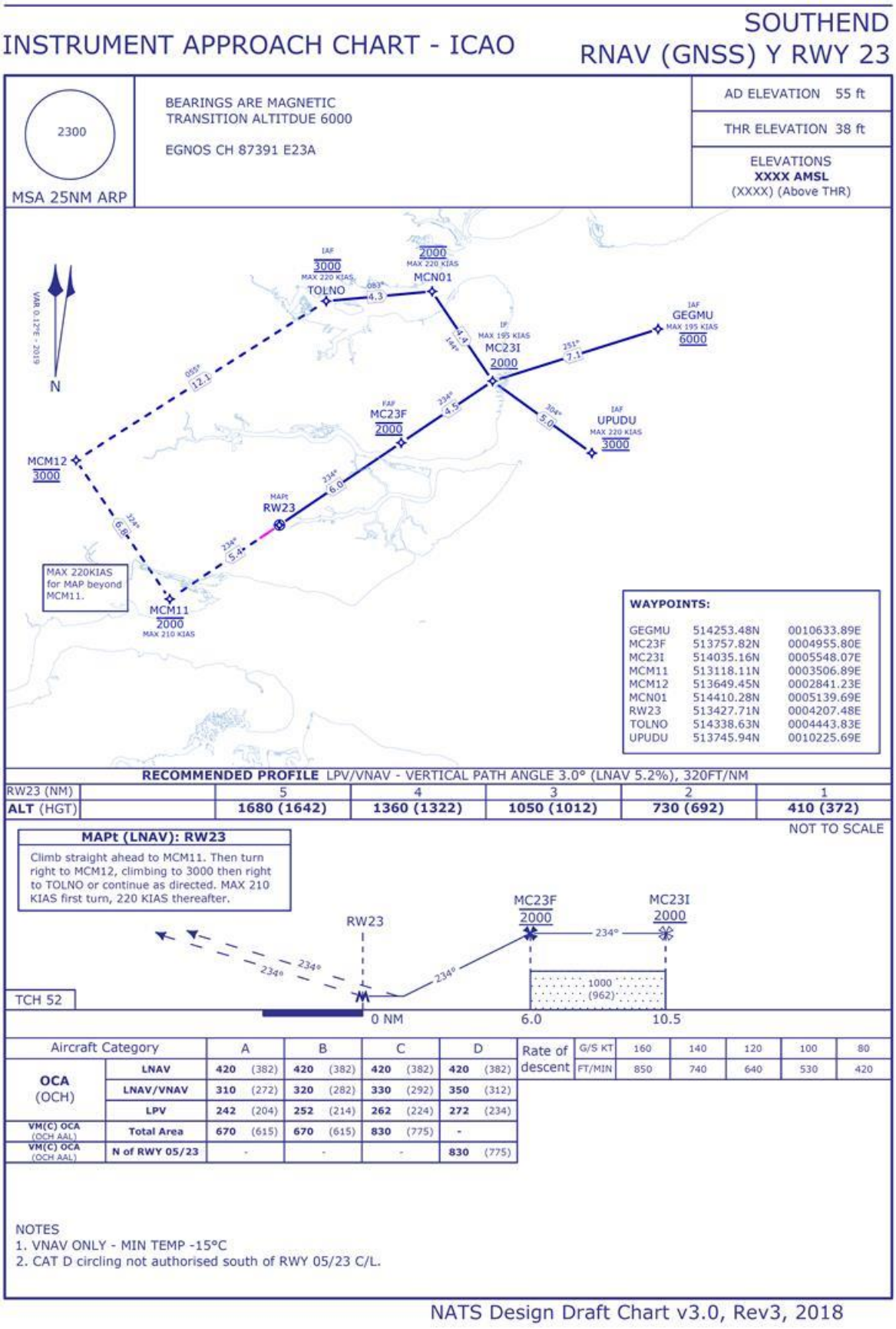


Figure 19: RNAV Approaches & MAP Runway 23

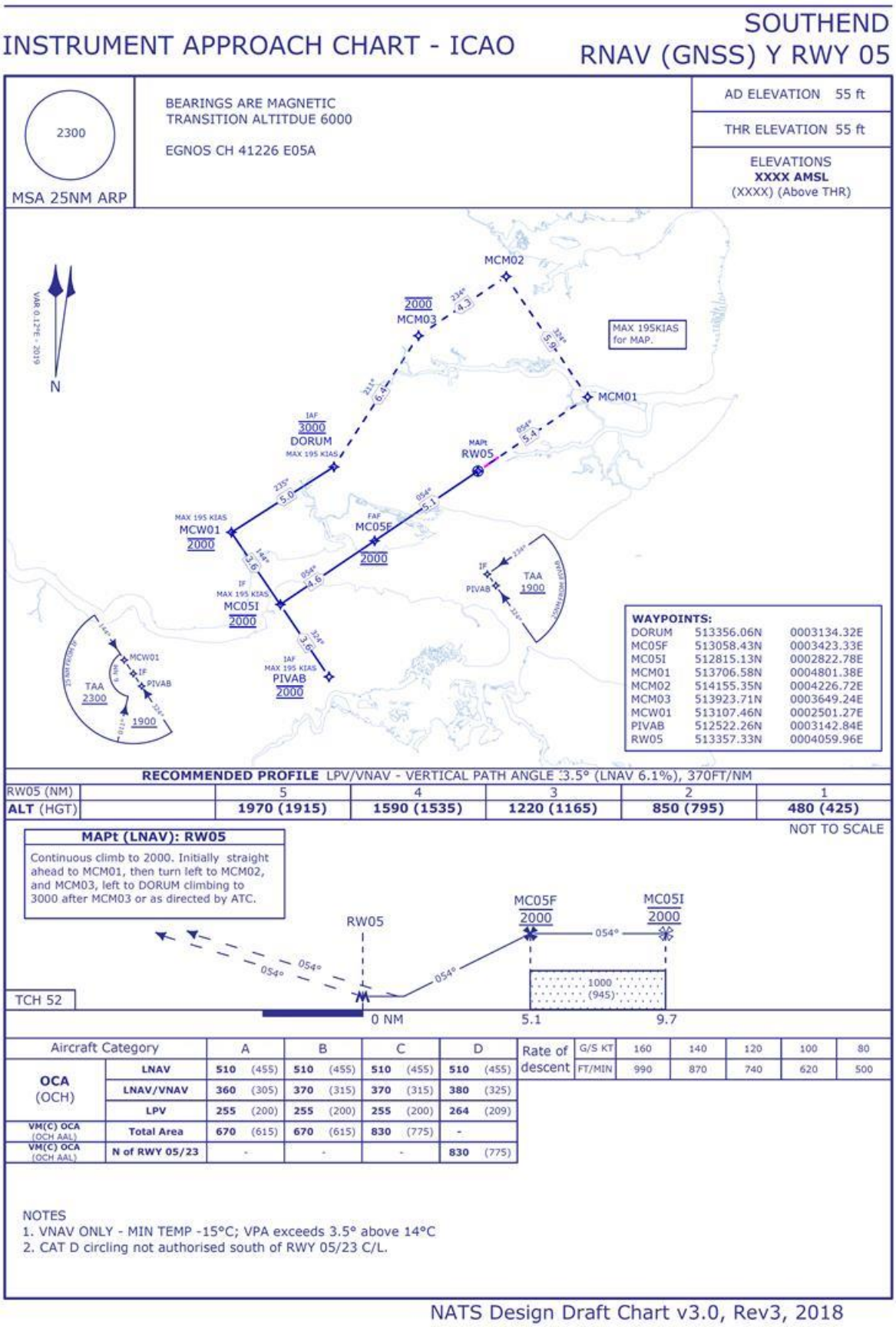


Figure 20: RNAV Approaches & MAP Runway 05