LONDON CITY AIRPORT

Our Future Skies – Airspace Modernisation

Airspace Change Process Documentation

CAA ref ACP-2018-89 Stage 2 Develop & Assess

Step 2A(i) Airspace Design Options

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Contents

1 Introduction

1.1 About this document

1.1.1 This document is titled 'Step 2A(i) Airspace Design Options' and forms part of the requirements of our airspace change proposal ACP via the UK's airspace change process known as CAP1616[1]

1.1.2 Its purpose is to describe our comprehensive list of airspace design options that address the Statement of Need and that align with the Design Principles.

1.1.3 It will also describe the engagement undertaken with stakeholders, summarise the feedback of that engagement, and describe how that feedback was incorporated into the design options.

1.1.4 It should be read in conjunction with two complementary documents:

- Step 2A(ii) Design Principle Evaluation
- Step 2B Options Appraisal (phase 1 Initial) including Safety Assessment

1.1.5 The three primary documents 2A(i), 2A(ii) and 2B, along with supporting material, were submitted to the Civil Aviation Authority (CAA) late May 2022 for their consideration at the CAA Gateway Assessment on Friday 24th June 2022.

1.1.6 All published documents for all stages of the process can be found in the CAA's public Airspace Change portal (link to the page for this proposal).

1.2 Statement of Need

1.2.1 We have completed Stage 1 of the CAP1616 process, known as Define. Stage 1 initiated the ACP by the submission of a Statement of Need (SoN) to the CAA in February 2019.

1.2.2 The SoN summarises LCY's reason for change: our participation in, and the requirements of, the Airspace Modernisation Strategy AMS[1].

1.2.3 This includes:

- Supporting the creation of additional airspace capacity;
- Enabling the efficient accommodation of additional traffic; and
- Facilitating environmental performance improvements.

1.2.4 There are no other similar airspace change examples for us to assess, due to the AMS driving the SoN.

1.2.5 The comprehensive list of design options were created to address the SoN.

1.2.6 For full SoN details see this document on the CAA Airspace Change Portal.

1.3 About the UK Airspace Modernisation Strategy

1.3.1 London City Airport (LCY) is participating in the UK Government's Airspace Modernisation Strategy (AMS). The AMS aims to create an aviation infrastructure for the future to deliver quicker, quieter and cleaner journeys, and more capacity for those using (and affected by) UK airspace.

1.3.2 The Department for Transport (DfT) and the Civil Aviation Authority (CAA) are working together to act as co-sponsors for the modernisation of the UK's airspace. Including LCY, there are 21 airports across the UK who are participating in the AMS, supported by other Air Traffic Management (ATM) organisations such as NATS, the air traffic control provider for the UK's countrywide air route network at higher altitudes.

1.3.3 For more details on the AMS see Section 9 Annexe: Airspace modernisation and the airspace change process from p.45.

[1] See Section 9 Annexe: Airspace modernisation and the airspace change process on p.45

1.4 Design Principles

1.4.1 Following the CAA acceptance of the SoN and subsequent assessment meeting, we engaged representative stakeholders on the creation of Design Principles (DPs).

1.4.2 This was completed in October 2019, and the DPs were accepted by the CAA. See p.46 (Section 10 Annexe: Design Principles (DPs) Recap).

1.4.3 For full DP details see this document on the CAA Airspace Change Portal.

1.5 Impact of Covid-19 Pandemic: ACP pause and restart

1.5.1 In 2020 there was an unprecedented drop in demand for air travel due to the Covid-19 pandemic. Most airports, including LCY, paused their ACPs because there was a direct and immediate impact on airport resources and priorities. In March 2021 we restarted our paused ACP. We are now progressing through Stage 2 of the CAP1616 process, known as Develop and Assess.

1.5.2 During Stage 2 we contacted our stakeholders' representatives - the same as Stage 1. We provided them with information explaining our design concepts in order to acquire feedback. We also held engagement sessions (mostly virtually) where attendees could interact with our ACP experts and ask questions. We highlighted the Stage 1 DPs and asked for feedback, which we have considered in our development of the design options presented in this document.

2 Introduction to London City Airport

2.1 The airport and its runways

Figure 1 Orientation of London City Airport's runway (extract from Google Earth)

2.1.1 LCY has one strip of concrete and asphalt that can be used by aircraft to take off or land in either direction, making two runways; one where aircraft take off or land heading east (Runway 09) and one where they head west (Runway 27). The wind direction determines which runway is used. In the southern UK, the prevailing wind is from the west, meaning that Runway 27 is used much more often than Runway 09. Averaged over four years from 2016-2019 pre-pandemic, the westerly Runway 27 is used $^2/_3$ of the time, twice as frequently as easterly Runway 09[2]. This proportion of westerly runway use is typical at most airports in the southern UK.

About today's flightpaths, and more on the impact of Covid-19

2.1.2 In February 2016, LCY and NATS En Route Ltd (NERL, the licensed Air Navigation Services Provider (ANSP) for the UK's countrywide air route network) implemented updated arrival and departure flightpaths as part of a project known as LAMP1A.

2.1.3 In June 2017 LCY and NERL supplied the CAA with radar-derived evidence showing the first year of changed flightpaths. In October 2018, the CAA completed their study of that evidence (link[3]), and concluded that the actual flightpath changes were consistent with these predictions. Such a study is standard practice after an airspace change, and is known as a Post Implementation Review (PIR).

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[2] Runway analysis for 1 Jan 2016 to 31 Dec 2019: Easterly 32.7% westerly 67.3%.

[3] LAMP1A consisted of five airspace change modules. Those relevant to LCY were Modules B and C.

2.1.4 There have been no changes to the flight procedures since 2016[4].

2.1.5 Flightpath data from the PIR will be used to illustrate how flights have been arriving and departing LCY since 2016.

2.1.6 As described in paragraph 1.5.1 above, 2019 was the most recent 'typical' year for air traffic.

2.1.7 2019's air traffic data will therefore be provided to complement the flightpath illustrations up to 7,000ft altitude.

2.1.8 Airports are responsible for their own local route network to and from the runway, up to an altitude of 7,000ft, and NERL is responsible for the route network at and above 7,000ft.

2.1.9 Government (DfT) environmental guidance was updated in 2017[5] detailing altitude-based priorities for airspace changes. In summary:

- Below 4,000ft the impact of aviation noise should be prioritised, with preference given to options which are most consistent with existing arrangements.
- Between 4,000ft-7,000ft minimising the impact of aviation noise should be prioritised unless this disproportionately increases CO_2 emissions.
- At and above 7,000ft changes to airspace will usually not have a noticeable noise impact[6].

2.1.10 This DfT guidance and altitude-based priorities is an important part of all ACPs and helps the reader to understand the balances between the impact of aircraft noise and the consideration of greenhouse gas emissions such as CO_2.

2.2 Typical air traffic movements and aircraft types: 2019

2.2.1 An airport 'movement' is counted when an aircraft lands or takes off.

2.2.2 LCY had 84,260 movements in 2019; half were arrivals, half were departures. Many airports have big peak differences between summer and winter seasons but LCY does not have seasonal peaks as such; there is more consistency month by month.

2.2.3 About 21,000 of these movements were over the summer period. 'Summer' is, for airspace change purposes, defined as the 92-day period from 16th June to 15th September[7].

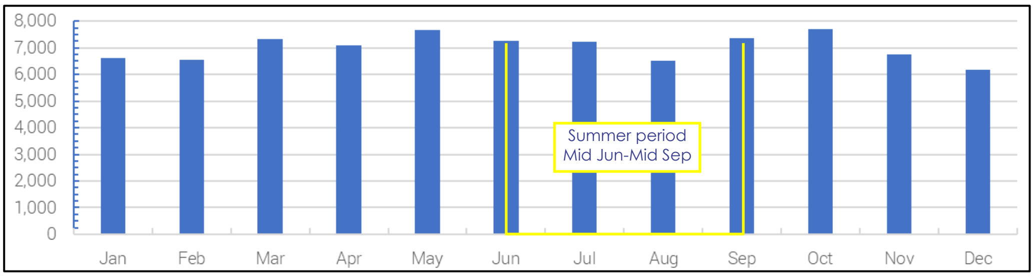

Figure 2 LCY airport movements by month (2019), total 84,260 (source: CAA), with summer period highlighted yellow

2.2.4 On average, LCY had 228 daily movements over the summer; 114 arrivals and 114 departures.

2.2.5 On the busiest days there were 316 daily movements (158 each of arrivals and departures).

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[4] Senior air traffic control managers at LCY and NERL have stated that the published PIR data is representative of flightpaths up to the start of the Covid-19 pandemic, and represents expected flightpaths as air traffic levels recover.

[5] The altitude-based priorities for impacts due to noise vs emissions are set by the Government in the Department for Transport's 2017 paper "Guidance to the CAA on its environmental objectives when carrying out its air navigation functions, and to the CAA and wider industry on airspace and noise management", known as ANG2017.

[6] This should not be taken to mean aircraft are inaudible at and above 7,000ft.

[7] These are standard dates defined in the environmental requirements technical document CAP1616A, which complements the UK airspace change process CAP1616.

2.2.6 About 61% of movements were to and from the east (such as northern and central European destinations), about 27% to and from the northwest (for example Eire and UK domestic) , and about 12% to the southwest (for example Spain, Portugal, Channel Islands), as illustrated in Figure 3 below.

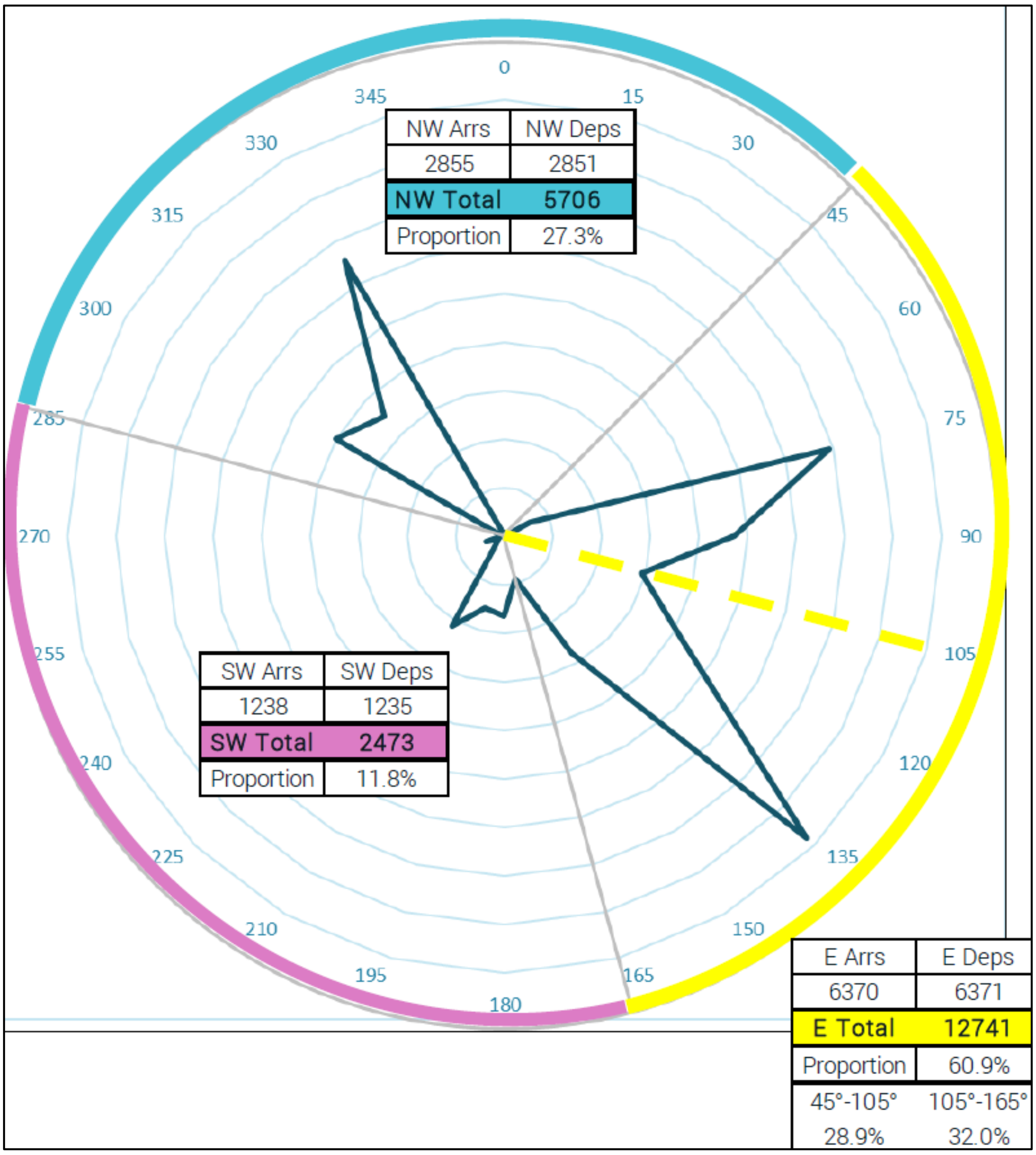


Figure 3 Illustration of arrival and departure destinations (straight line between airports), summer 2019

2.2.7 The most common aircraft category was the 70-90 seat jet (average 64% of all flights), and the most common specific type was the Embraer 190.

2.2.8 The heaviest aircraft in 2019 was the Airbus A318, which is noise-categorised by the CAA as being a 125-180 seat single aisle twin jet (even though at LCY it operated with fewer seats, for take-off weight reasons). The A318 averaged fewer than 3% of all flights in 2019. The A318 has since stopped flying into LCY. The Airbus A220 has taken over as the heaviest aircraft type in current use (2022). The A220 is similar in size and weight to the A318, is noise-categorised in the same way, and – like the A318 – operates with fewer seats for take-off weight reasons.

2.2.9 Other aircraft types using LCY include smaller commercial jets, business jets and propeller aircraft in the 50-70 seat range.

2.3 Forecasts

2.3.1 The long-term impacts of Covid-19 on the aviation industry are yet to be fully understood, though a recovery is underway. LCY's master plan, published in 2020 (link) p.47 states:

Having updated our forecasts as part of this master plan, we expect passenger demand to use London City Airport to increase to 11 million *passengers annually, accommodated by around 151,000 air transport movements, including 5,000 business aircraft movements. This long term forecast is likely to be realised by the mid to late 2030s and could see our share of expected passengers across the London airports increase from around 2.8% to around 4.3%, dependent on how capacity develops at these other airports over time.*

3 Current constraints, inefficiencies and opportunities

This section describes air traffic control and geographical considerations and constraints for the current (baseline do-nothing) option. It complements the Design Principles (see Section 10 Annexe: Design Principles (DPs) Recap on p.46), and provides additional context.

3.1 Adjacent ANSPs

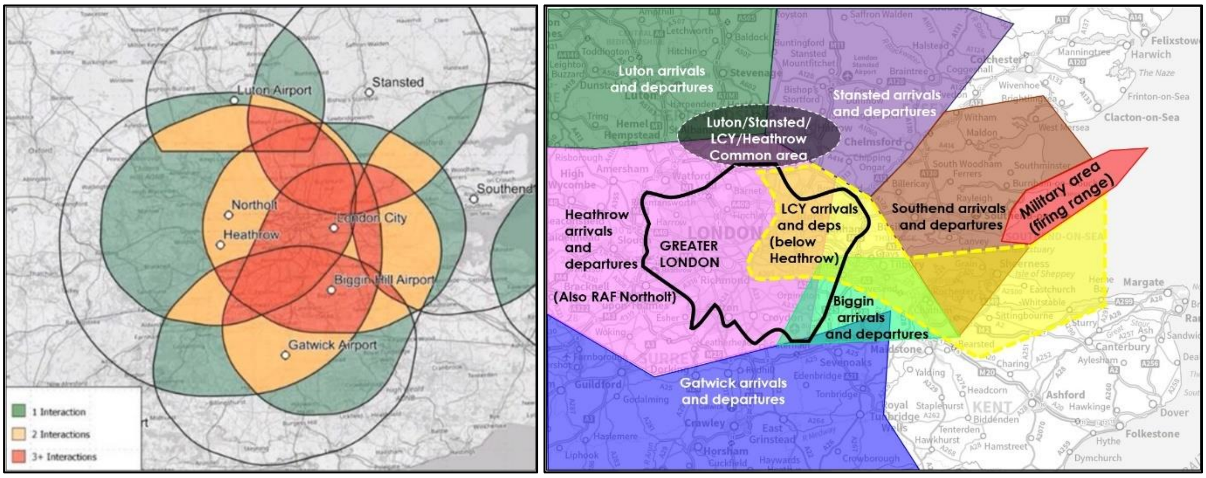


Figure 4 (Left) Early illustration of LCY's location amongst London airports, (right) updated illustration of current usage

3.1.1 LCY is in the airspace region known as the London Terminal Manoeuvring Area (LTMA), along with the other London airports. Biggin Hill is only 19km away from LCY. LCY is 35km from Heathrow (noting that the runways for both airports are aligned), and 35km from RAF Northolt. Gatwick, Southend and Stansted are all about 44km away, and Luton is about 50km away. There are many interacting flightpaths to and from all these airports, along with the influence of the higher route network operated by NERL, and it is an area of high air traffic control complexity as illustrated in Figure 4 above. These 8 ANSPs are formally identified as sponsoring ACPs that have the potential for airspace design interdependencies within this regional cluster.

Future flightpath design should strive to deconflict from those of other airports, laterally and/or vertically.

This may result in conflicts between these ACPs that may lead to compromises and/or trade-offs.

Not all ACPs in this cluster are at the same stage of the process, and the importance of an efficient overall system takes precedence over individual airport requirements.

3.1.2 As all adjacent ACPs progress through the process, new options not covered here may present themselves, or options discounted at Stage 2 may be reconsidered later under Stage 3 as the region's ACPs integrate into wider route systems.

3.1.3 Currently, the majority of the arrival routes to LCY are shared with Biggin Hill airport, c.19km away. Biggin Hill's arrivals generally follow LCY's arrival route until between Gravesend and Bluewater, where they peel off and head south to their runway. This means that Biggin Hill arrivals have a route to fly to their airport, but space in the shared arrival system is limited.

Future arrival designs should consider whether the continued use of shared routes is appropriate.

3.2 Runway approach angle

3.2.1 Closer to the arrival runway, the approach descent angle (known as the glidepath) for LCY is set at 5.5° which is much steeper than most airports, and is needed to ensure adequate safety margins against the surrounding buildings. (In aviation this is known as 'obstacle clearance'). This steep glidepath is the same 5.5° for both Runway 09 and Runway 27, minimising the noise impacts directly under the final approach track. Once established on the glidepath, they descend at about 315ft/km, which is 9.6%. The industry standard glidepath is 3° (5.2%), and it is unusual for a glidepath to be steeper than 3.2° (5.6%). A standard 3° glidepath, for comparison, is a descent rate of 172ft/km.

Today's steep approaches already require special aircraft requirements and flight crew certification, and they cannot be made steeper.

Future final approaches must not make the glidepath any shallower, for obstacle clearance.

3.3 Densely populated areas

3.3.1 LCY is situated in a densely populated area. There are relatively unpopulated areas such as the River Thames itself, the valley of the River Lea (also known as the Lee Valley), parks, marshes and industrial areas, but these are all adjacent to (and interspersed between) residential areas.

There is limited scope to create future arrival and departure flightpaths that avoid populated areas, especially at the lowest altitudes.

3.3.2 Currently, all arrivals to Runway 09 must stay at least 1,000ft beneath Heathrow's flights, as LCY's arrivals get closer to Heathrow's airspace. This results in flights at 3,000ft and also at 2,000ft over the same areas whenever Runway 09 is in use.

LCY's relative geography to Heathrow's runways cannot be changed. This creates challenges in applying the noise mitigation 'avoid overflying communities with multiple routes, including from other airports'. LCY will, however, work with Heathrow on this subject, and seek improvements where possible.

Future arrival designs for Runway 09 should strive for a higher altitude. Continuous descent operations (CDO) is an aspiration, but the previous statement regarding relative geography to Heathrow also applies.

Future arrival designs for Runway 09 should also consider the provision of different, additional flightpaths. The same communities would be less likely to be overflown by Runway 09 arrivals all the time, though this would also mean that new communities would be regularly overflown See Section 5 for a summary of stakeholder engagement, and Section 10 for a recap of the Design Principles (DP4 lists noise mitigation options that came from early engagement with local communities).

One of Heathrow's design principles is "should enable the efficiency of other airspace users' operations" and several of their Stage 1 workshops scored highly when researching the statement "there should be steeper climbs for aircraft to get higher quicker and for arrivals to stay as high as possible, for as long as possible". Achieving LCY's altitude aspiration is dependent on how Heathrow progresses its own ACP, and the outcome of mutual negotiations as part of FASI-S. Heathrow was, at time of writing this document, at an earlier stage of their airspace change process, unable to share designs and constraints, however Heathrow's Stage 1 design principle work is encouraging.

3.4 Operational efficiency

3.4.1 The current high-level arrival system is already very efficient for arrivals from the northeast, east and southeast. Figure 11 on p.19 illustrates the higher-level arrival routes from all directions. This upper network links to what is known as a Point-Merge airspace structure, a pair of invisible arcs north of Margate and Birchington, mostly over the sea at high level. Arrivals to both runways from the northwest, southwest and south are disadvantaged because they must follow routes past the airport at high level, then descend and turn back to join the Point-Merge arrival structure from the east, resulting in additional distance flown and fuel burnt.

Any reduction in distance flown would improve flying time and fuel/emissions efficiency for arrivals from those less-efficient directions.

Future high-level arrival designs from the northeast, east and southeast should consider following the same or similar efficient arrival flightpaths as today, but should also consider a more continuous descent profile where possible.

Future high-level arrival designs from the northwest, southwest and south should consider building in a shortcut to minimise the need for extended routing past the airport and back again. Note that LCY's relative geography to Heathrow's runways constrains where these flows could go – for example, it would be radical to propose flying low overhead Heathrow in order to make an approach at LCY.

3.4.2 Bearing in mind paragraph 3.4.1 above re: high-level arrivals from the northwest, southwest and south, currently lower-altitude arrivals to both runways are efficient from the northeast, east and southeast. Arrivals to Runway 27 are already almost fully optimised. The Runway 27 arrival track is designed to fly primarily over the Thames Estuary and is already as direct as possible. It is, essentially, a long straight final approach from the vicinity of the Point-Merge airspace structure to the runway.
The Point-Merge structure was introduced in 2016 as part of LAMP1A (see paragraph 2.1.2 above). Other benefits of LAMP1A include:

- ATC systemisation – safety, consistency, predictability and resilience.
- Significant net reduction of people overflown, including arrivals staying over the sea for longer

Future arrival designs for Runway 27 should consider following the same or similar efficient arrival flightpaths as introduced in LAMP1A, but should also consider a more continuous descent profile where possible.

Future arrival designs for Runway 09 from the northeast, east and southeast should consider following the same or similar efficient arrival flightpaths as today until reaching the point where they need to turn downwind and fly parallel to the runway.

3.4.3 LCY's Standard Instrument Departure routes (known as SIDs) are programmed to follow several tracks (depending on the runway in use and the desired destination). Currently LCY's SIDs climb rapidly to 3,000ft (between 7.95%-8.54% gradient; this is a relatively steep climb for commercial aircraft).
The SIDs are programmed to level the aircraft at 3,000ft. Higher climb is given manually ('tactically') by the controller, most of the time. However, this tactical climb is not always given to every aircraft immediately, so some flights stay level at 3,000ft for a short distance until the controller is able to issue the climb instruction.

Future SID designs should consider programming climbs to a higher initial altitude, minimising the need for controller intervention, reducing or removing level flight at low altitudes on departure. This is known as continuous climb operations or CCO.

Future SID designs should continue using a similarly steep climb gradient of about 8% beyond 3,000ft where possible, understanding that this aim may be limited by adjacent flightpaths.

In addition to systemising[8] the departure altitudes, this would improve operational resilience, noise and fuel/emissions efficiency.

3.4.4 The majority of the current LCY SIDs follow the same track used by much older routes. One of the original aims of the 2016 airspace change was to 'replicate' these legacy routes as far as possible, which were originally based on positions defined by radio navigation beacons – some routes zigzag between these positions.

Under newer navigation standards known as Performance Based Navigation (PBN) and Area Navigation (known as RNAV, also part of the wider PBN standard), it is no longer necessary to fly between positions originally defined by radio navigation beacons.

Future departure designs should consider removing this dependency and achieve more efficient routings, via a shorter distance to fly, improving fuel/emissions efficiency.

3.4.5 Currently, all departures turn north soon after take-off, regardless of their final destination. The air traffic safety 'waiting time' needed between two departures in similar directions is twice as long as the time needed between two departures in different directions. This restricts the air traffic controllers' abilities to efficiently manage the airport operation, keeping aircraft on the ground running their engines for longer, ready for take-off. It also leads to a lack of resiliency during poor weather.

Future departure designs should consider creating routes that diverge more quickly after take-off, based on desired destinations. This could include turns to the north and south, instead of all turns to the north. There would be noise implications, and these would be considered as the design continues to mature.

Future departure designs should also consider providing more than one route from the same runway to the same desired destination, potentially allowing for managed dispersal or a timed schedule per route.

The same communities could be less likely to be overflown by departures all the time, though this means that new communities would be regularly overflown.

Divergent routes could reduce the spacing between departures, in turn reducing aircraft waiting time with engines running (unnecessary noise and CO_2), and would make more efficient use of existing airport infrastructure such as taxiways and aircraft parking stands.

This may also allow for a reduction in spacing between arrivals. Typically, the space between subsequent LCY arrivals is set so that, when the first arrival lands, there is enough space before the second arrival for a departure to enter the runway and prepare for take-off. Currently this arrival spacing is about 7 nautical miles (13km). As soon as the first arrival has landed (and safely vacated the runway onto the taxiway), the departure

[8] Systemising means minimising the need for air traffic controllers to intervene in the aircraft's pre-programmed flight. Currently, controllers need to issue radio instructions to change altitude (climb or descent) or compass heading direction and speed (known as vectoring), in order to achieve a more efficient flight or to ensure safety against another flight in the vicinity. This can be an intense manual task and is known as a tactical controlling environment. A more systemised environment requires fewer controller-pilot interactions. Each interaction consists of a controller issuing a radio instruction, with the pilot immediately repeating it back to the controller to ensure safety. If the pilot makes a mistake, the controller repeats the instruction until the pilot's reply matches.

can be cleared for take-off, in the gap before the next approaching aircraft is close to landing. The more efficient the departures, the smaller the gap can be, between arrivals, and the more resilient the air traffic operation should any disruption occur.

3.5 Tranquillity impacts

3.5.1 This proposal has the potential to change flightpaths over the Kent Downs Area of Outstanding Natural Beauty (AONB) below 7,000ft. The Surrey Hills AONB is adjacent the Kent Downs to the west, however none of the designs in this proposal overfly Surrey Hills.

3.5.2 From an airspace change point of view, AONBs and National Parks are the references defined in the process[9] because they may be valued for their tranquillity, and impacts should be considered.

3.5.3 There will be a design balance to be struck between overflight of less densely populated areas such as an AONB, and the impacts on tranquillity this may cause.

3.5.4 At this early design stage it is appropriate to provide maps that illustrate the indicative design options' relationship below 7,000ft with the Kent Downs AONB boundary – the map of each indicative design option in Section 6 Arrivals and Section 7 Departures shows the Kent Downs AONB where relevant. Brief qualitative statements on potential impacts are provided in those sections. In the next stage of the airspace change process we will be able to provide greater information and detail on the balance of those potential impacts.

3.6 Biodiversity impacts

3.6.1 Airspace changes are unlikely to have an impact on biodiversity because they do not normally involve changes to ground based infrastructure[10] (habitat disturbance).

3.6.2 No such ground based infrastructure changes are associated with this proposal, therefore this proposal is not predicted to impact biodiversity.

3.6.3 Biodiversity was not part of a Design Principle in Stage 1. During our engagement, stakeholders did not identify biodiversity concerns in any specific region.

9 CAP1616 Edn 4 Appendix B paragraphs B76-B78
10 CAP1616 Edn 4 Appendix B paragraphs B79-B80

4 LCY's Current Airspace and Operations (the 'do nothing' option)

4.1 Charts and diagrams

4.1.1 The charts and diagrams on the following pages illustrate the typical flight operation at LCY, and should be considered the 'do-nothing' option if no airspace change was to take place.

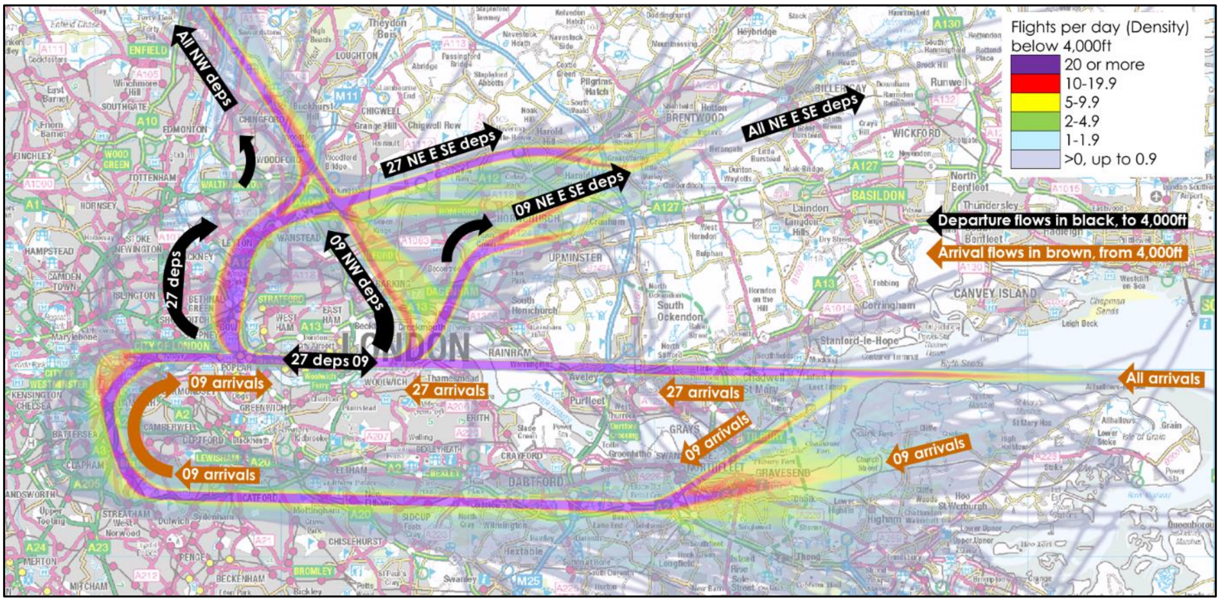


Figure 5 A zoomed in illustration of the flight density patterns for all LCY traffic below 4,000ft. Data sample is 10 days in Aug 2016, 1,177 arrivals, 1,185 departures. Contains Ordnance Survey data © Crown copyright/database right 2021

4.1.2 Figure 5 above illustrates arrivals to, and departures from, both Runways 09 and 27. The altitude cut-off is set at 4,000ft, to provide more map detail for those regularly overflown at the lowest altitudes.

4.1.3 The maps below illustrate the following:

Figure 6: Runway 09 flight density patterns for all LCY air traffic below 7,000ft

Figure 7: Runway 09 schematic of flightpath flows & typical altitudes for all LCY air traffic below 7,000ft

Figure 8: Runway 27 flight density patterns for all LCY air traffic below 7,000ft

Figure 9: Runway 27 schematic of flightpath flows & typical altitudes for all LCY air traffic below 7,000ft

Figure 10: Runway 09 and 27 combined schematic illustrating flightpath flow proportions from, and to, each major direction, including number of flights per average, and per peak, summer day

Figure 11: A wider, higher overview of the arrival and departure flight procedures

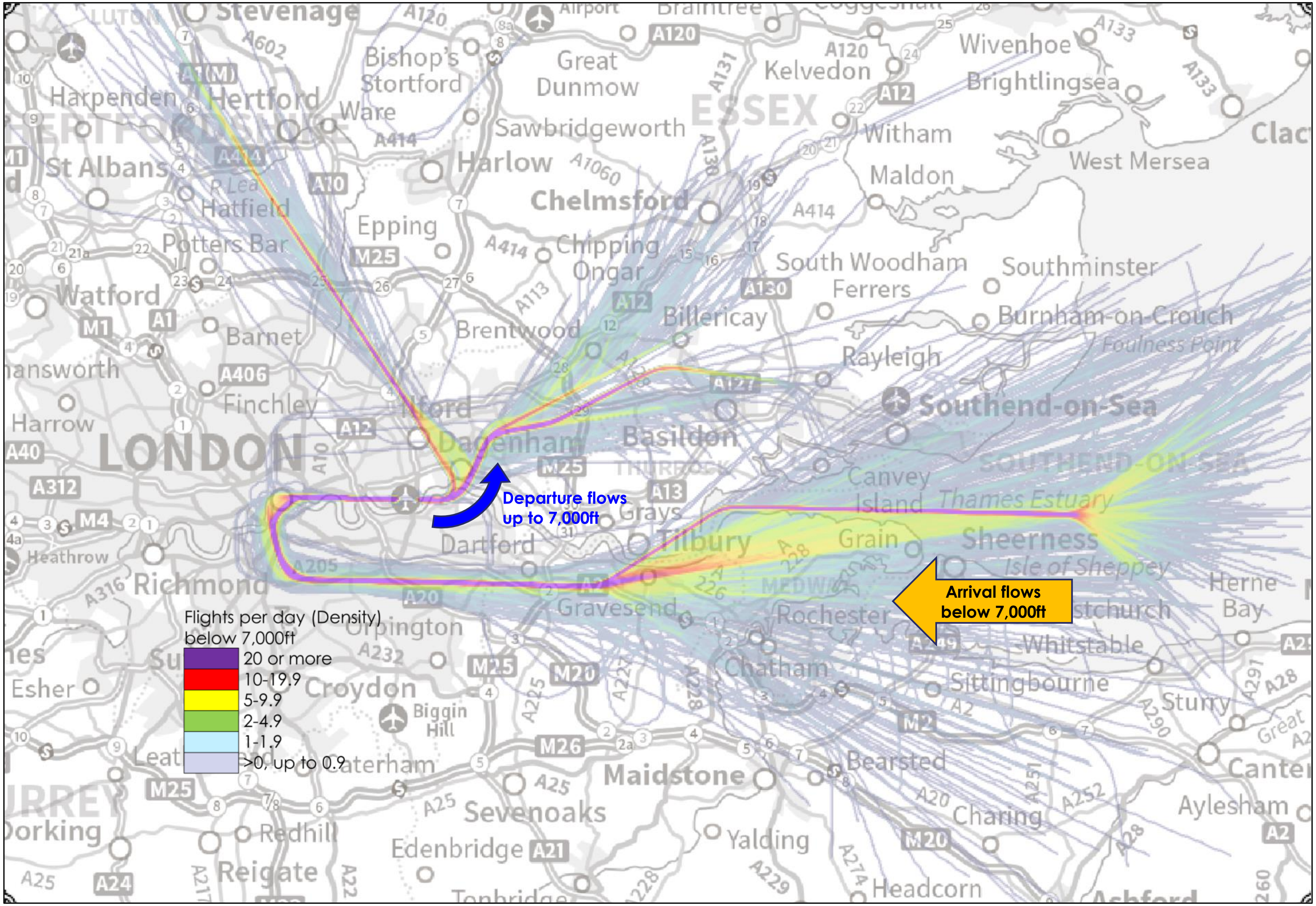


Figure 6 Runway 09 flight density, below 7,000ft (5 days in Aug 2016, 584 arrivals, 595 departures) (Contains Ordnance Survey data © Crown copyright and database right 2021)

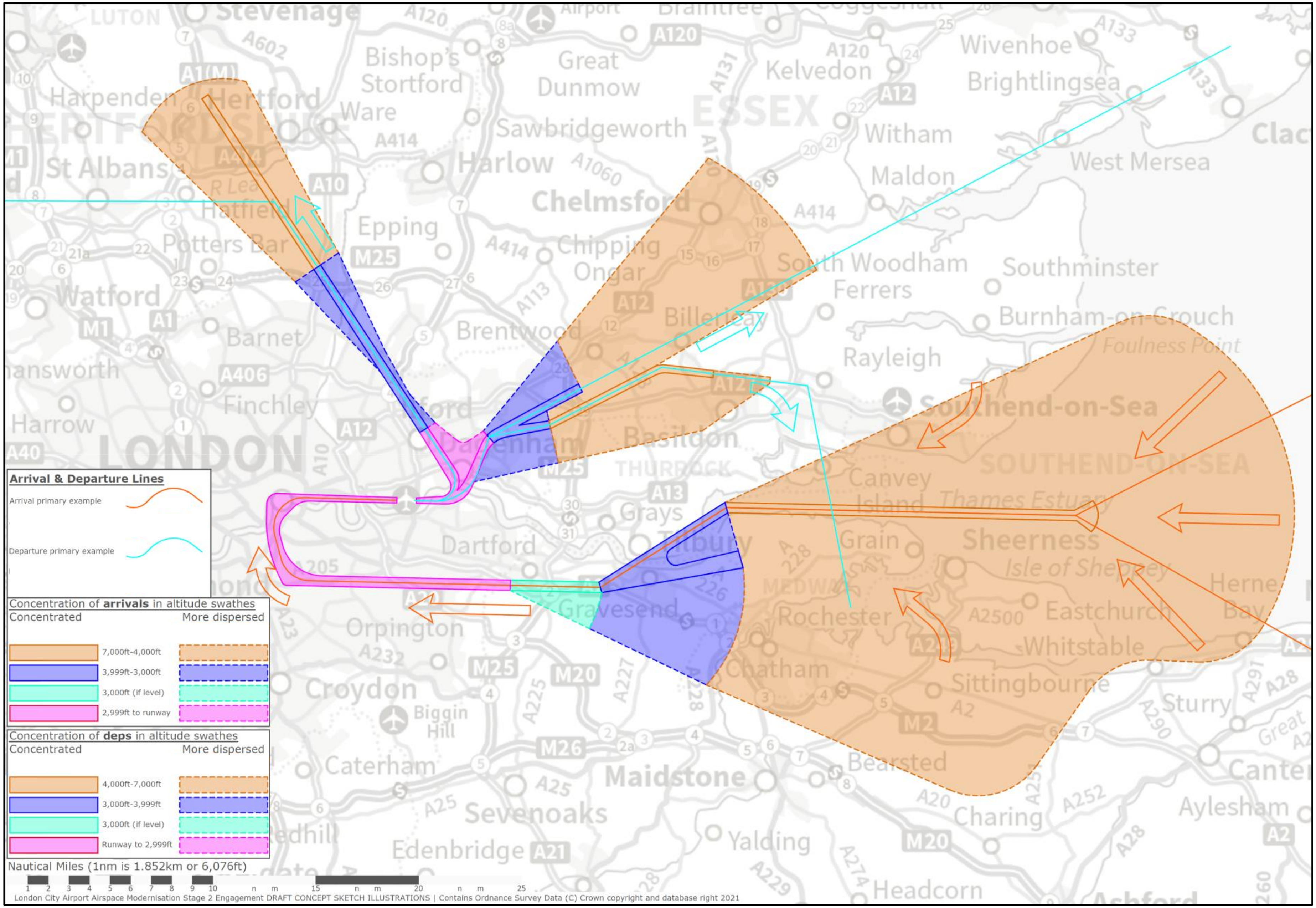


Figure 7 Runway 09 schematic of flightpath flows & typical altitudes for all LCY air traffic below 7,000ft

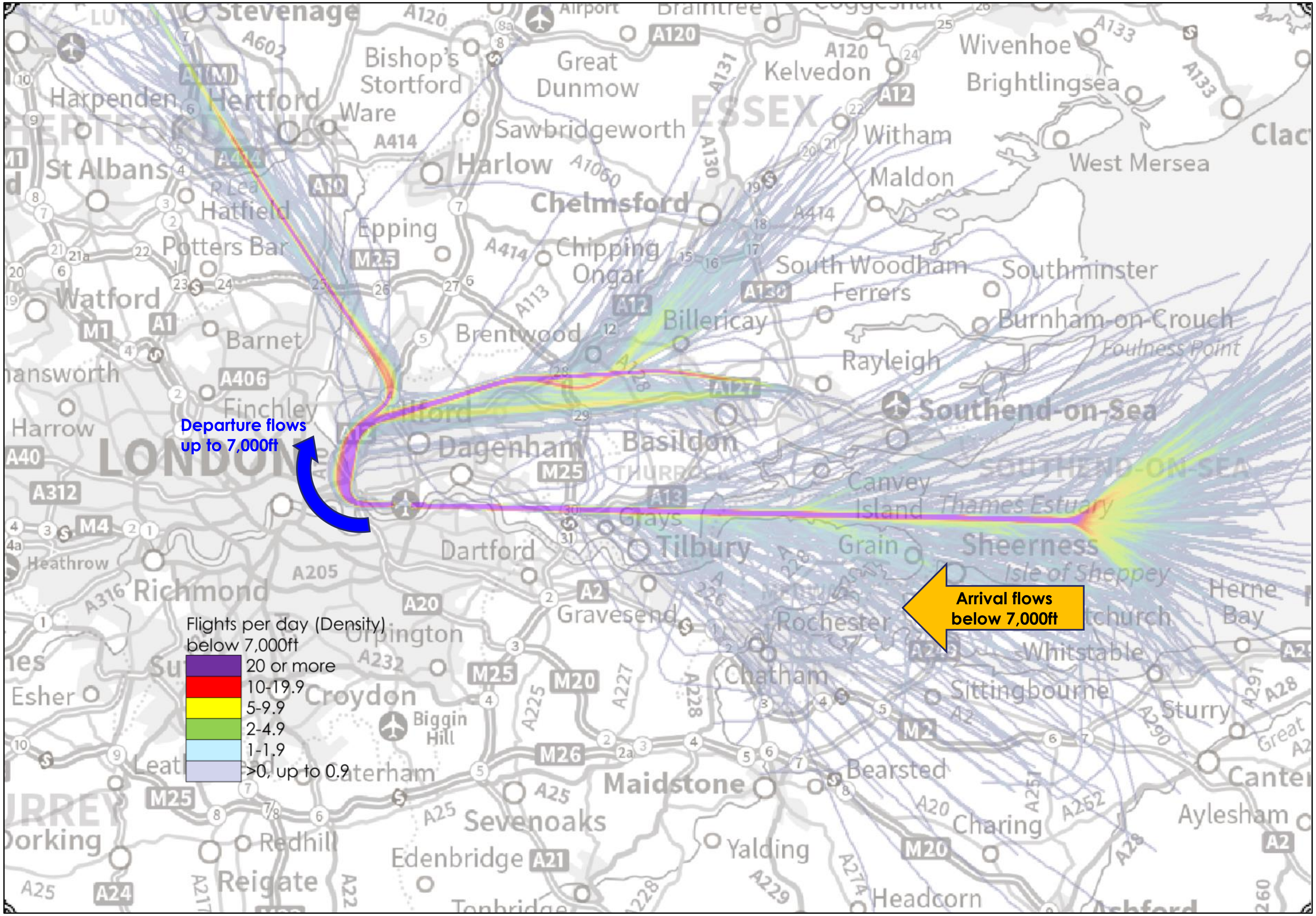


Figure 8 Runway 27 flight density, below 7,000ft (5 days in Aug 2016, 593 arrivals, 590 departures)

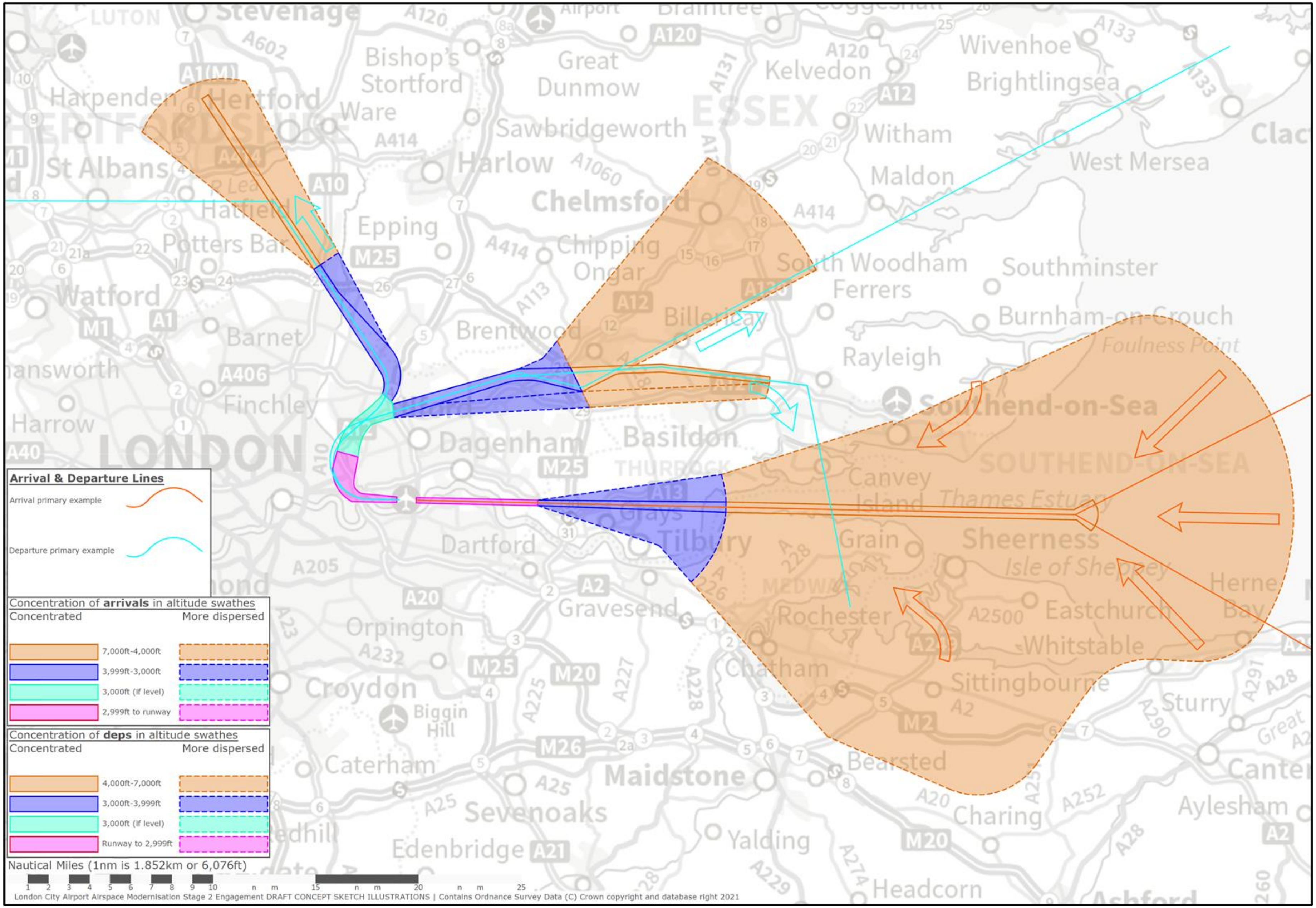


Figure 9 Runway 27 schematic of flightpath flows & typical altitudes for all LCY air traffic below 7,000ft

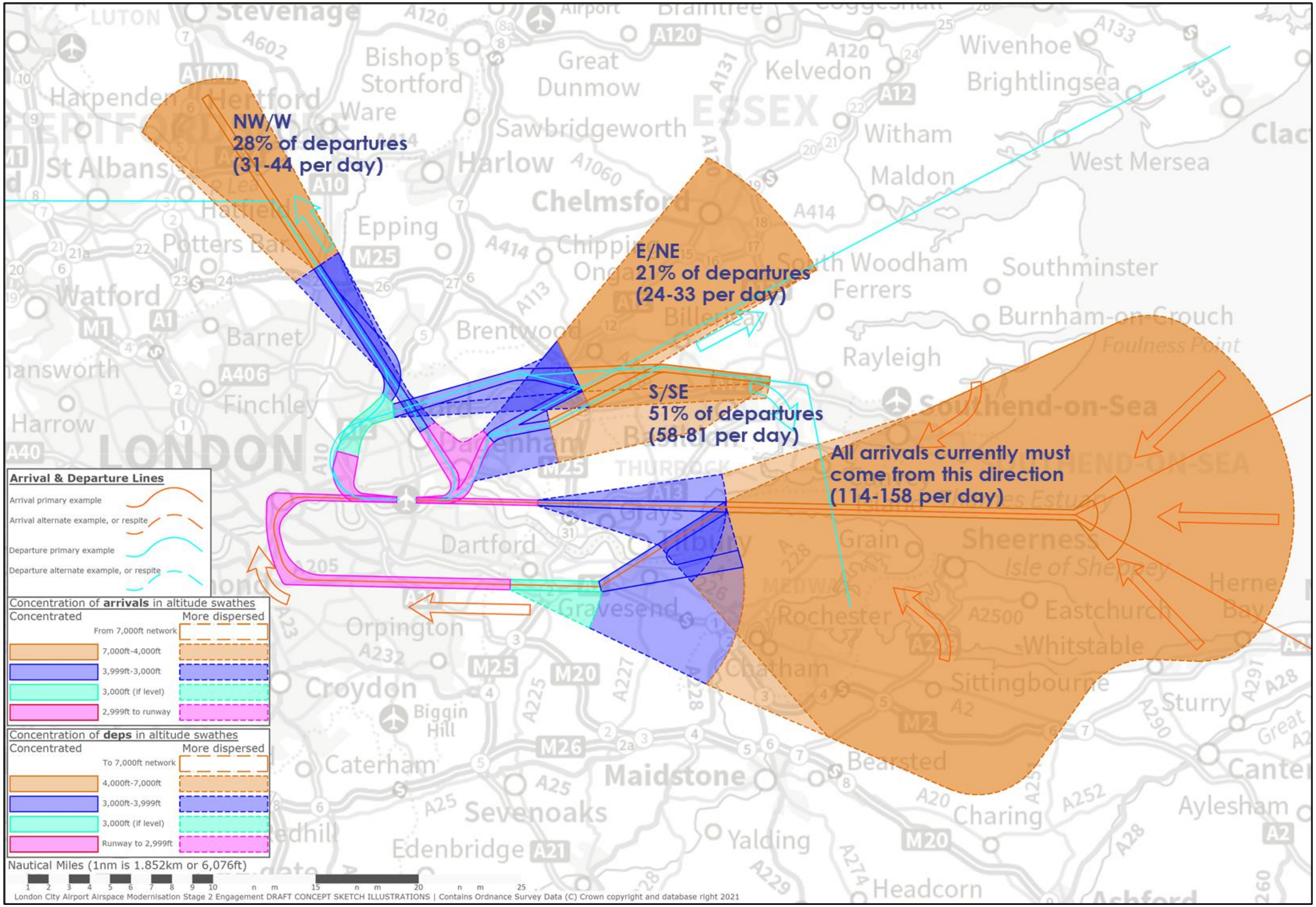


Figure 10 Both runways, flow proportions illustrating average, and peak, flights per summer day 2019

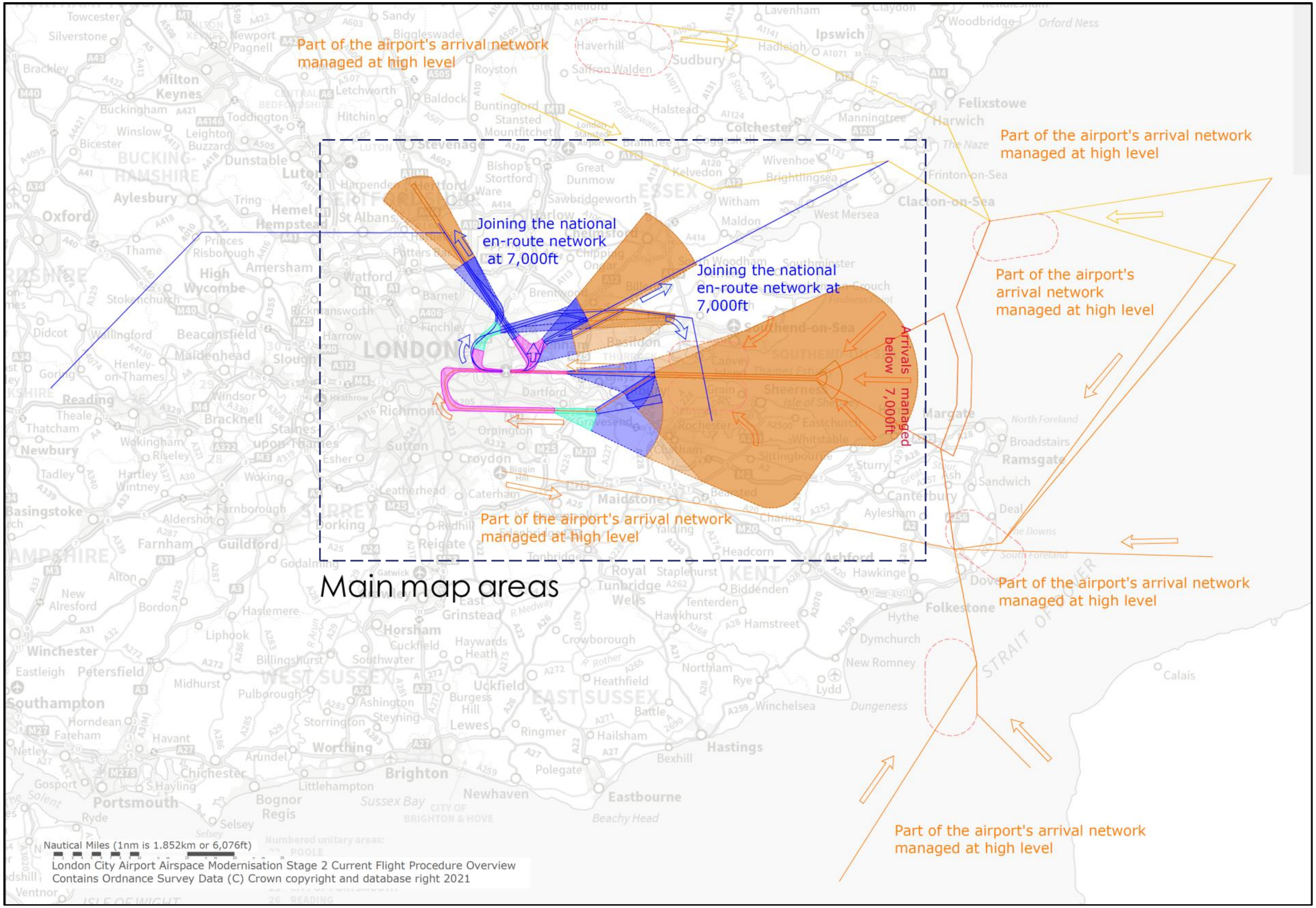


Figure 11 Overview of arrival and departure flight procedures to and from the high level NERL route network, and swathe indications of where flights are typically below 7,000ft

5 Design Development, and Addressing Stakeholder Feedback

5.1 Initial general concepts

5.1.1 Subject matter experts from LCY air traffic control, the airport operations and sustainability department, project management, safety, data analytics and the airspace change process attended an Ideas Generation Workshop.

5.1.2 This workshop resulted in arrival and departure design concept illustrations, to address the SoN and align with the DPs. These were broad and generalised. In this proposal, references to 'radical' concepts mean those that were considered extremely challenging from a technical, operational, or safety point of view ('radical options' are mentioned in the airspace change process document CAP1616). They considered LCY unrealistically as an airport in total isolation with no neighbouring airports, or they disregarded normal aircraft flight characteristics. These radical concepts were internally developed within the LCY airspace change team, and used to understand the parameters to allow the design of more feasible solutions as presented in the stakeholder engagement sessions. It is not proportionate to detail these radical unviable options in this comprehensive list of viable options.

5.1.3 Those broad early concepts were not, at that time, developed to a state suitable to present to our stakeholders from Stage 1. We sought initial advice from expert representatives at the London Terminal Control radar centre (LTC), who provided technical feedback on the viability of our initial concepts from an air traffic management (ATM) point of view. We also spoke with Heathrow and Biggin Hill airports in order to sound out our broad concepts and constraints at a high level.

5.1.4 We used that technical feedback to further develop and refine the granularity of concepts, agreeing them within the airspace change team.

5.1.5 We prepared engagement packages for our stakeholders.

5.2 Development through Engagement

5.2.1 We arranged engagement sessions with the same stakeholders from Stage 1[(11)]. At each session we explained that the design information was still early and draft, subject to change as we move through the process.

5.2.2 We explained how the current arrival and departure flows worked as systems per runway, and then described example systems of proposed potential arrival and departure flows.

5.2.3 We asked for feedback, either directly at the end of the session during Q&A or to be provided separately by email later.

5.2.4 We asked for the feedback to be framed using the design principles where possible. We provided template feedback forms organised by DP to assist stakeholders in providing their feedback, and also provided a video describing the design options.

5.2.5 We summarised the feedback and identified key priorities. We used that feedback to further develop and refine the design options.

[11] Section 11 Annexe from p.48 summarises the engagement activities and lists the representative stakeholder organisations engaged – it is normally a process requirement to use the same stakeholders as Stage 1. However for Stage 2 we included the Kent Downs Area of Outstanding Natural Beauty and London Luton Airport as new, relevant stakeholders. The separately-published Stage 2 Example Engagement Pack provides an example of the typical slides presented to stakeholders (either via live virtual presentation or via email for self-briefing). The separately-published Stage 2 Technical Map enables the reader to view illustrations of the current flightpath systems, the proposed draft flightpath systems as engaged upon, and the developed indicative design options for this document.

5.3 Feedback Themes from Stakeholder Engagement

5.3.1 Collating and summarising, the six main topics of feedback were:

- Mitigate, and potentially share, impacts of aircraft noise at low altitudes, including use of respite route(s)
- Keep aircraft higher for as long as possible, get departures higher more quickly (depending on other airports' airspace)
- Reduce fuel burnt, flight time, enhance network performance and CO_2 savings
- Flexibility of design envelopes to allow for more solutions to minimise interactions with other sponsors' routes
- Collaboration with airports post-Stage 2 for Stage 3 to refine and identify efficiencies and deconflictions
- Minimise impacts on other airspace users

5.3.2 We took this feedback and, where possible, updated the engagement designs to become the comprehensive list of design options in this document.

5.3.3 Table 1 below provides more details of the feedback received. It explains how the feedback topics were combined into specific items, how it influenced the options, and sets out how the design decisions we have taken relate to stakeholder feedback. Each item has a reference number that links to the stakeholder engagement summary activities in Section 11.

Primary feedback 1: Mitigate, and share, noise impacts between communities	
Ref num and details:	***LCY Response:***
PF1A Share noise impacts, even if new communities become overflown	*The design options include a variety of routes, some of which would overfly new communities, and some which would overfly the same communities as today. Some design options have also been designed to overfly less densely populated areas.* *The network of routes selected (and therefore the extent to which noise impacts are shared) will be consulted on in Stage 3.*
PF1B Introduce more than one route (respite) or other dispersal mechanism	*Where possible, each route grouping has multiple indicative design options where some or all may be used in combination to provide respite or dispersal. However at this stage it would be disproportionately complex to attempt to describe every permutation of which option could be used with which other option.*
PF1C Aircraft are too concentrated in some areas, especially shortly before the base leg turn for Runway 09 ('Base leg' is the arrival route segment normally approximately perpendicular to the final approach track, before the aircraft turns onto final approach)	*For Runway 09 arrivals we provide alternate designs for base leg, from both south and north of final approach, and also different turn-types onto final approach. These are, however, constrained by the aircraft navigation specification (and associated flight procedure design technical criteria) and interactions with flights from other airports.*
PF1D Avoid the overflight of an area by both LCY arrivals and departures, and by LCY flights and those to/from other airports (including Heathrow and Biggin Hill)	*LCY's relative geography to Heathrow's runways cannot be changed. This creates challenges in applying the noise mitigation 'avoid overflying communities with multiple routes, including from other airports'. LCY will, however, work with Heathrow on this subject, and seek improvements where possible.* *LCY will also work with Biggin Hill and other sponsors bilaterally and collectively.*
PF1E Achieve continuous descent for Runway 09 arrivals	*Future arrival designs for Runway 09 should strive for a higher altitude. Continuous descent operations (CDO) is an aspiration, but the previous statement regarding relative geography to Heathrow also applies.*
PF1F Make departure climbs more continuous	*We updated our indicative departure designs to an aspirational 8% climb gradient (consistent with paragraph 3.4.3 above) while allowing for a short period of levelling off to minimise potential interactions with other airports' flightpaths*
PF1G A quicker climb is preferred even if it means an overall longer track length at higher altitudes	*Some indicative departure routes were designed not to head in the desired direction initially, partly in order to gain altitude before turning towards the desired direction, partly to overfly less densely populated areas, both of which result in a longer overall track*
PF1H Will flightpaths avoiding populated areas impact tranquil areas?	*Indicative arrival and departure routes were designed considering impacts on populated areas and improved flight efficiency. Routes could be used in combinations for respite and/or dispersal as noted in PF1B above.* *There is a balance of impacts to be struck between overflying populated areas and overflying areas which may be valued for their tranquillity. At this stage it would be disproportionate to attempt to*

	strike this balance when it is not yet clear how each route may be used in combination with other routes.
PF1i Tight turns on westerly departures could prevent certain areas from getting respite	*LCY's relative geography to Heathrow cannot be changed, as previously discussed. For air traffic safety reasons, all Runway 27 departures must turn away from Heathrow's runways as soon as possible – consistent with PF1D above. A significantly wider turn, or a straight-ahead departure, would cause unsafe conflictions between LCY and Heathrow aircraft. Delaying (or widening) the turn may be possible to a very limited extent; this will be considered as part of the continued development of this proposal under Stage 3 via discussions with Heathrow. This statement primarily applies to Runway 27 right-turn-out (RTO) departure options, all of which were designed to mimic the current turn radius. Runway 27 departures with a left-turn-out (LTO) using the same/similar turn radius would naturally allow for dispersion if used in combination with RTO options. As per PF1B, at this stage it would be disproportionately complex to attempt to describe every permutation of which option could be used with which other option.*

Primary feedback 2: Make the routes more direct	
Ref num and details:	***LCY Response:***
PF2A Reduce fuel burnt and flying time, enhance network performance	*We added two more indicative departure route design options to the southeast and south, that turn south from the departure runway rather than turn north first.* *We updated some indicative departure route options to illustrate the most direct route possible in the desired direction.* *We updated our indicative arrival route design options from the northwest, north and south to make them more practically achievable should they progress.*

Primary feedback 3: Increase the flexibility of design envelope swathes to allow more collaboration and coordination between airports/ANSPs	
Ref num and details:	***LCY Response:***
PF3A Avoid excluding potentially viable routes that may be integrated/reintegrated later in the process	*We widened the design envelope swathes and added indicative route design options to illustrate more extreme options within those envelopes. Each design option line is an indicative illustration, and any future route may not match the routes shown depending on the collaboration and deconfliction of routes between adjacent airports and network traffic flows. This is consistent with the Airspace Change Organising Group (ACOG)'s guidance within the meaning of the AMS.*

Primary feedback 4: Minimise new impacts on other airspace users	
Ref num and details:	***LCY Response:***
PF4A For example, on sports and leisure flying, or London helicopter routes	*Due to the indicative nature of the design options, it is not possible to illustrate the controlled airspace (CAS) requirement for each option. CAS design would be included as part of the next stage in the airspace change process once the design options are fully mature and their containment can be analysed.* *We do not expect any of the route designs to increase the impacts on helicopter operators flying over London.*
PF4B Interaction with flights from other airports in the vicinity of Brookmans Park could limit free flow and operational resilience.	*LCY acknowledges this issue. Design envelope swathes were widened in order to maximise flow flexibility. Deconfliction of traffic flows in this area will be discussed in more detail with sponsors of adjacent ACPs during Stage 3.*

Table 1 Stakeholder feedback subjects, combined, summarised and addressed

In the table above, PF1D raises particular challenges. As previously noted, Heathrow Airport's runways are nearby and aligned with LCY's runways – paragraph 3.3.2 above describes this relative geography. The requirement for bilateral discussions, negotiations and collaborations is especially important. The independent Airspace Change Organising Group already attends (or is aware of) these bilateral meetings (for more about ACOG, see paragraph 9.1.5 on p.45 – ACOG coordinates the entire regional airspace change programme). These bilateral meetings are regular and ongoing throughout the entire coordinated regional airspace change programme. We commit to continue these discussions with Heathrow. At time of writing, Heathrow was at an earlier part of the airspace change process; in due course LCY and Heathrow will, with ACOG's coordinating assistance, be able to work together in greater technical detail with the aim of addressing this situation.
ACOG is also responsible for future iterations of the UK's Airspace Masterplan which are anticipated to include guidance on the assessment of cumulative impacts and coordinated formal consultation exercises.

5.4 Other feedback received

5.4.1 We received comments regarding:

- The design principles
- Capacity restrictions imposed through LCY's planning approval
- Visibility of collaboration between airports

5.4.2 LCY acknowledges the feedback, however the design principles are already set and cannot be revised. The other items are outside the scope of this document.

5.4.3 We also received comments regarding:

- Quantifying the benefits that will be delivered through the ACP
- Defining how respite will be achieved
- The metrics and methodology used for noise assessment, including topography
- The type of aircraft flown at LCY

5.4.4 LCY acknowledges the feedback, however these points will be addressed during the formal consultation period (part of Stage 3 of the airspace change process).

5.5 Notes on design maturity

5.5.1 Each design option is an indicative illustration.

5.5.2 We have identified all viable options, noting that the Masterplan is a high-level coordinated implementation plan of a series of individual airspace design changes that need to be developed in coordination to achieve the range of benefits that modernisation can deliver.

5.5.3 Stage 2 of the process is still early, in airspace design terms – it is the first part of the process where example maps and charts are drafted and shown to stakeholders. The lines and regions illustrated in the following sections are as mature as possible having addressed feedback from stakeholders and based on the information available at the time we engaged them.

5.5.4 Finalised future routes may not match the routes shown, depending on the collaboration and deconfliction of routes between adjacent airports and network traffic flows as each airport progresses through their ACP process.

5.5.5 Evidence of options development activities in coordination with stakeholders, which includes sponsors of interdependent ACPs carried out under the Masterplan programme, is included at Section 11 Annexe: Stakeholder Engagement Summary (Activities), Stakeholder List.

5.5.6 A formal consultation will take place as part of the next stage, with developed route systems and associated detailed material.

6 Arrival design options: comprehensive list

6.1.1 As per Section 5 above, we used stakeholder engagement feedback to develop this comprehensive list.

6.1.2 We rationalised and combined the engagement concepts into groups of Outer routes (leaving the upper-level en route network, descending from 7,000ft to 4,000ft) and Inner routes (from 4,000ft descending to the runway).

6.1.3 We separated the Outer routes from the Inner routes because most of the Outer routes could combine with most of the Inner routes.

6.1.4 The arrival route design options described in this section are known as 'transitions', which are pre-programmed systemised flightpaths that link the exit from the higher holding area to the final approach path for the runway.

Typically they are followed accurately in three dimensions by an aircraft's flight management system with minimal pilot or controller intervention.

6.1.5 Transitions using the navigation standard known as RNAV1 are currently already used for all arrivals at LCY, though at the higher (outer) areas controllers often tactically instruct aircraft to bypass the full length of the route and take a shortcut to rejoin the transition closer to the airport.

6.1.6 Unless stated otherwise, the indicative design options are consistent with the RNAV1 navigation standard. The fleet using LCY all comply with RNAV1.

6.1.7 Outer Routes: The horseshoe-shaped long- dashed area is where arrivals pass from the end of NERL's en route network and the start of LCY's arrival routes. This includes higher-level delay absorption areas[(12)], all managed above 7,000ft by NERL.

6.1.8 The main orange shaded area is where arrival traffic descends from 7,000ft-4,000ft. At this stage we are not certain how high flights would be at any given place along the indicative route lines apart from being lower towards the centre, and subject to other airports' flightpaths.

6.1.9 Solid orange lines illustrate the most direct indicative option from each main arrival direction, with dashed lines indicating alternate options.

6.1.10 Inner Routes: The shaded areas indicate how high aircraft are predicted to be during their descent from 4,000ft to the runway, subject to other airports' flightpaths.

6.1.11 Solid orange lines illustrate the most direct indicative option from each main arrival direction, with dashed lines indicating alternate options.

Note References to Heathrow also include RAF Northolt, due to their proximity.

6.1.12 It may be possible to organise arrival design options from each main direction into systems for respite, or that disperse traffic in another way. However at this stage in the process it would be disproportionate to describe every possible permutation of which route works with which other route, while also considering the equivalent permutations of departure options and how they work with arrivals as part of the same system.

6.1.13 The proposed arrival design options are divided into four groups:

- Outer Routes (from 7,000ft-4,000ft) common to both runways
- Outer Routes (from 7,000ft-4,000ft) specifically for Runway 09
- Inner Routes (from 4,000ft to the ground) specifically for Runway 09
- Inner Route (from 4,000ft to the ground) specifically for Runway 27

6.2 Outer Routes (from 7,000ft-4,000ft) common to both runways

(Opposite page)

[12] Any airspace structure used to contain and organise simultaneous arrivals into a manageable sequence to land. This includes traditional racetrack-shaped holding patterns, Point-Merge structures (which LCY uses), and others.

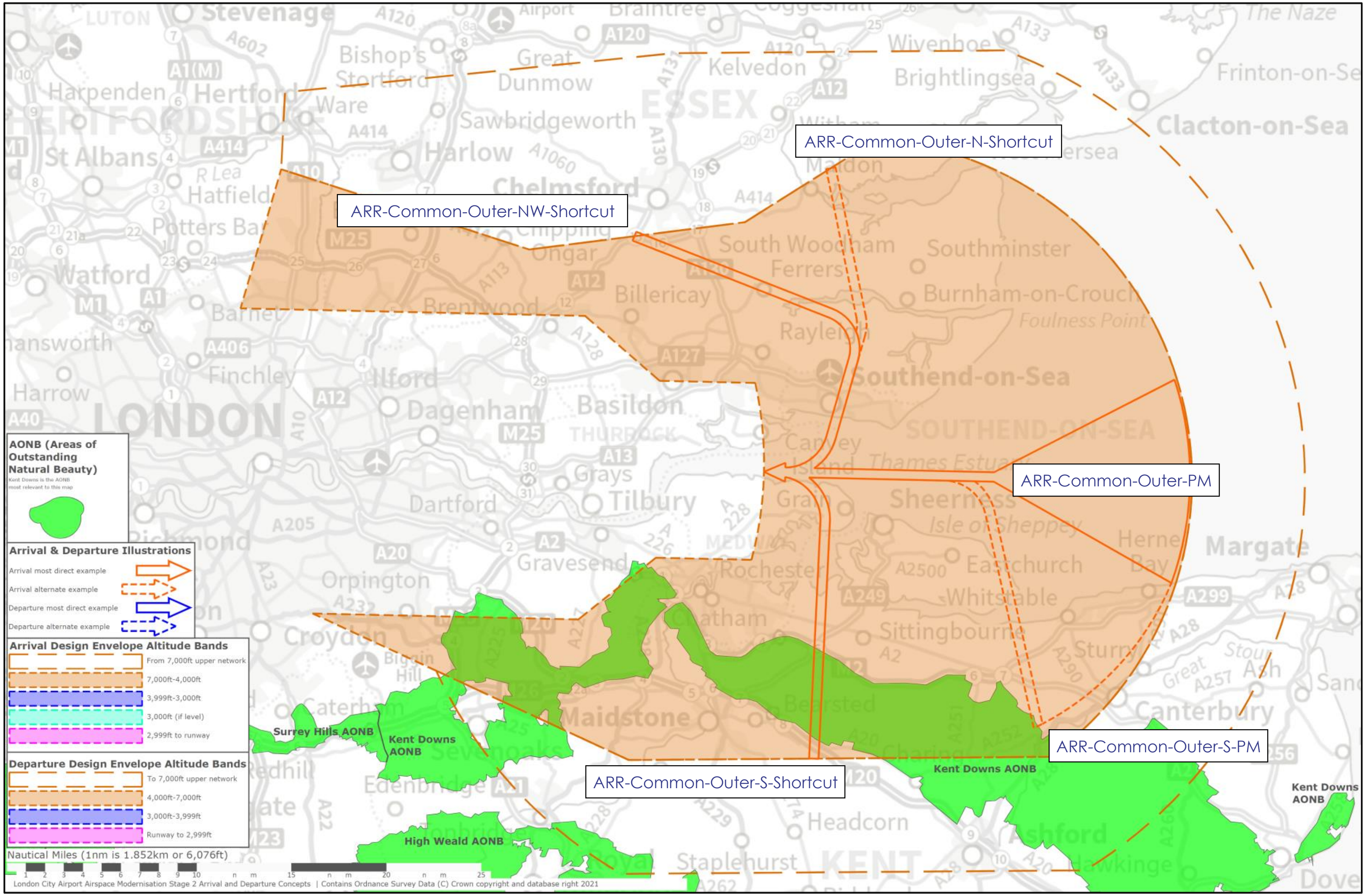


Figure 12 Outer Routes (from 7,000ft-4,000ft) common to both runways

6.2.1 ARR-Common-Outer-NW-Shortcut

This design option would provide a significantly shorter arrival route from the northwest while joining the existing arrival flow over the Estuary. It would need to cross the city of Southend to do so. It stays away from the vicinity of Heathrow, may need to consider Stansted, and would need to deconflict from Southend Airport's air traffic flows.

A delay absorption structure in the upper network would be required. There can be operational complexities to integrate arrival flows from more than one direction.

6.2.2 ARR-Common-Outer-N-Shortcut

This design option would provide a shorter arrival route from the northwest while joining the existing arrival flow over the Estuary. It would need to cross the city of Southend to do so. It stays away from the vicinity of Heathrow, may need to consider Stansted, and would need to deconflict from Southend Airport's air traffic flows.

A delay absorption structure in the upper network would be required. There can be operational complexities to integrate arrival flows from more than one direction.

6.2.3 ARR-Common-Outer-PM

This design option is the same as the baseline Point-Merge structure. It efficiently links the Point-Merge delay absorption area with a route along the Thames Estuary, not making landfall until Tilbury.

6.2.4 ARR-Common-Outer-S-PM

This design option would provide a shorter arrival route from the south and southeast. It uses the gap between Faversham & Canterbury to join the existing arrival route along the Thames Estuary. It may cross the edge of the Kent Downs Area of Outstanding Natural Beauty (AONB) at higher altitudes. It stays away from the vicinity of Heathrow and Gatwick.

It expands the existing higher-level Point-Merge airspace structure clockwise further south, keeping operational flow integration relatively simple.

6.2.5 ARR-Common-Outer-S-Shortcut

This design option would provide a significantly shorter arrival route from the southwest and south. It uses the gap between Maidstone, Gillingham and Sittingbourne and joins the existing arrival route along the Thames Estuary. It would cross the Kent Downs Area of Outstanding Natural Beauty (AONB) between the M20 and M25. It stays away from the vicinity of Heathrow, and would need to deconflict from Gatwick air traffic flows.

A delay absorption structure in the upper network would be required. There can be operational complexities to integrate arrival flows from more than one direction.

6.2.6 Note that greater complexity may require greater safety assurance (see Step 2A(ii) document for assessment, and Step 2B document for safety considerations).

6.3 Outer Routes (from 7,000ft-4,000ft) specifically for Runway 09

(opposite page)

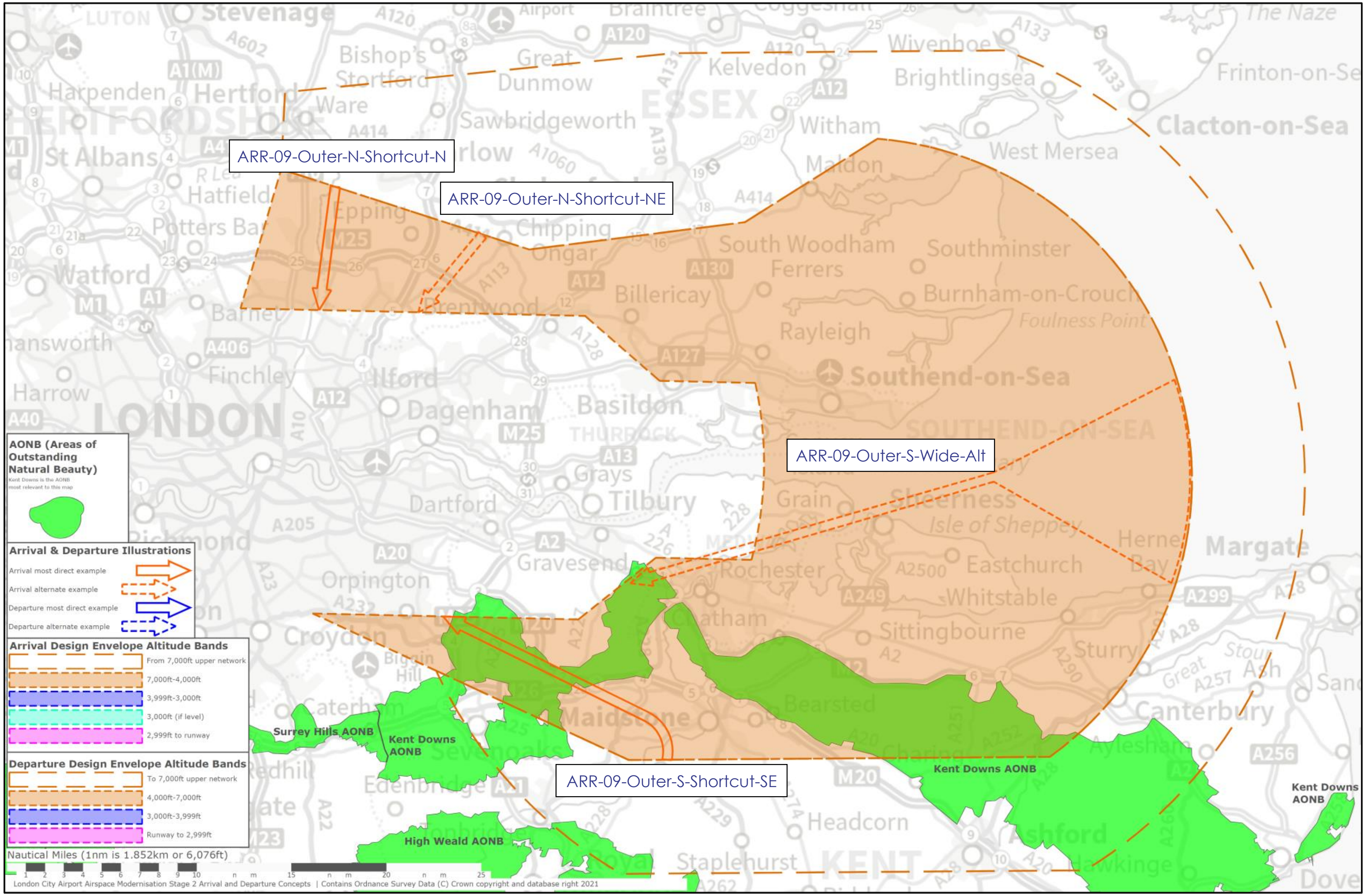


Figure 13 Outer Routes (from 7,000ft-4,000ft) serving Runway 09 only

6.3.1 ARR-09-Outer-N-Shortcut-N

This design option would provide a significantly shorter arrival route from the northwest. It would follow approximately the Lee Valley between Cheshunt and Waltham Abbey. It may be complex to deconflict from Heathrow, Luton and Stansted air traffic flows.

A delay absorption structure in the upper network would be required. There can be operational complexities to integrate arrival flows from more than one direction.

6.3.2 ARR-09-Outer-N-Shortcut-NE

This design option would provide a shorter arrival route from the northwest while staying east of Epping, Theydon Bois and the M11. It may be complex to deconflict from Heathrow and Stansted air traffic flows.

A delay absorption structure in the upper network would be required. There can be operational complexities to integrate arrival flows from more than one direction.

6.3.3 ARR-09-Outer-S-Wide-Alt

This design option would use the existing Point-Merge structure, but leave in an alternate direction, heading to Sheerness and Grain rather than following the Estuary. It reaches land sooner than the Estuary flow, hence earlier overflight of populated areas, and under some circumstances would slightly shorten arrivals from the east. It would cross the northern tip of the Kent Downs AONB near Rochester.

This track could enable some departures to climb more quickly by staying out of their way for longer.

6.3.4 ARR-09-Outer-S-Shortcut-SE

This design option would provide a significantly shorter arrival route from the southwest and south. It would cross the Kent Downs AONB between the M26 and M25. It would need to deconflict from Heathrow, Gatwick and Biggin Hill air traffic flows.

A delay absorption structure in the upper network would be required. There can be operational complexities to integrate arrival flows from more than one direction.

6.3.5 Note that greater complexity may require greater safety assurance (see Step 2A(ii) document for assessment, and Step 2B document for safety considerations).

6.4 Inner Routes (from 4,000ft to final approach) specifically for Runway 09

(opposite page)

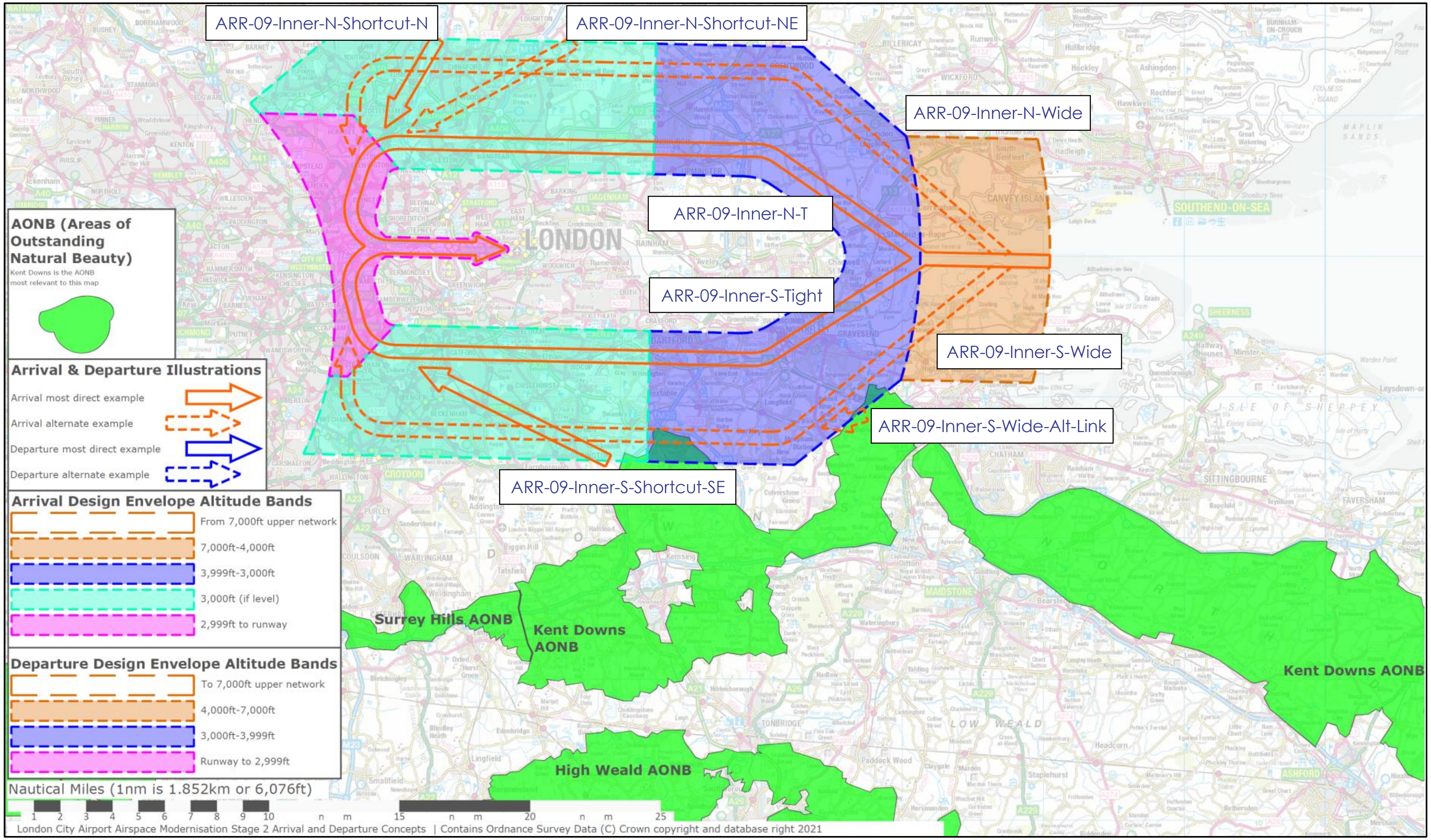


Figure 14 Inner Routes (from 4,000ft to final approach) serving Runway 09 only

6.4.1 ARR-09-Inner-N-Shortcut-N

This design option would provide a significantly shorter arrival route from the northwest and links from 6.3.1 ARR-09-Outer-N-Shortcut-N. It would follow approximately the Lee Valley before turning onto final approach. The northernmost section may be complex to deconflict from Heathrow flows.

6.4.2 ARR-09-Inner-N-Shortcut-NE

This design option is an alternate shortcut option for Runway 09 arrivals from the northwest. It links from 6.3.2 ARR-09-Outer-N-Shortcut-NE. The northernmost section may be complex to deconflict from Heathrow flows.

6.4.3 ARR-09-Inner-N-Wide

This design option is a northern mirror of 6.4.6 ARR-09-Inner-S-Wide and links from the Estuary westbound arrival routes described previously. It runs parallel and 5.5km north of 6.4.4 ARR-09-Inner-N-T, and is a longer route. It would overfly different communities, but a broadly similar number of people to the southern mirror route. The northwestern-most section may be complex to deconflict from Heathrow flows due to the perpendicular base leg as it turns from heading west to south.

6.4.4 ARR-09-Inner-N-Tight

This design option is a northern mirror of 6.4.5 ARR-09-Inner-S-Tight, which is the same track as today's baseline route. It links from the Estuary westbound arrival routes described previously. It would overfly different communities, but a broadly similar number of people to the southern mirror route (baseline). If this proposed route is higher than the equivalent southern baseline route flown today, then the westbound section may be complex to deconflict from Heathrow flows.

6.4.5 ARR-09-Inner-S-Tight

This design option is the same track as today's baseline route. It links from the Estuary westbound arrival routes described previously. It would overfly the same communities as today. If this proposed route is higher than flown today, then the westbound section may be complex to deconflict from Heathrow flows.

6.4.6 ARR-09-Inner-S-Wide

This design option runs parallel and 5.5km south of 6.4.5 ARR-09-Inner-S-Tight. It links from the Estuary westbound arrival routes described previously. It would overfly different communities, likely fewer people, and is a longer route. It partially overflies the Kent Downs AONB between the M20 and M25. The southwestern-most section may be complex to deconflict from Heathrow flows due to the perpendicular base leg as it turns from heading west to north. Biggin Hill flows would also need deconfliction.

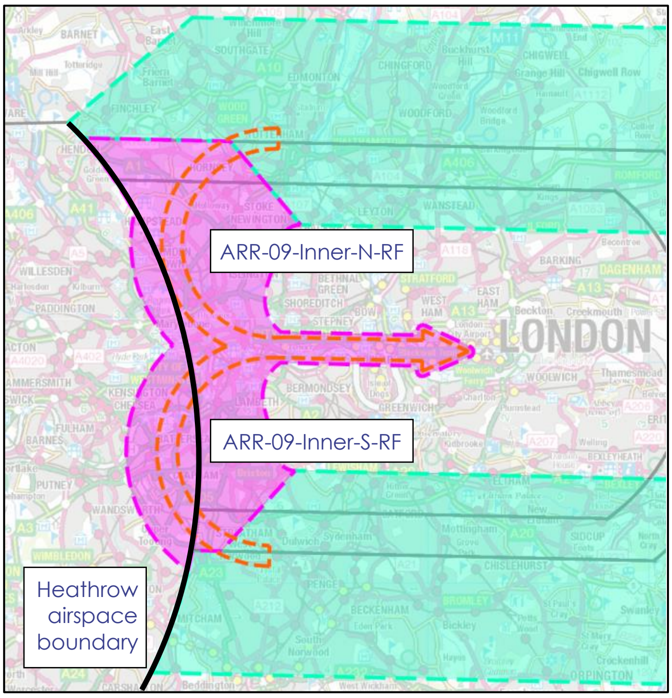
6.4.7 ARR-09-Inner-S-Wide-Alt-Link

NB this is a short link at the parallel track's easternmost point. It is included for completeness but will not be evaluated because 6.3.3 ARR-09-Outer-S-Wide-Alt covers the main alternate route, and the inner route is otherwise identical to 6.4.6 ARR-09-Inner-S-Wide above.

6.4.8 ARR-09-Inner-S-Shortcut-SE

This design option would provide a significantly shorter arrival route from the southwest and south, and links from 6.3.4 ARR-09-Outer-S-Shortcut-SE. It may be complex to integrate with Heathrow, Gatwick and Biggin Hill air traffic flows.

Turns to final approach designed with different navigation standard (RNAV1-RF)



There is a technical opportunity which allows for improved automation of the last turn onto final approach, using the navigation standard known as RNAV1-RF. This navigation standard is currently not mandated at LCY. There are technical design criteria that set the minimum turn radius, and the subsequent mandatory straight and level distance. Applying these criteria results in the turns illustrated here, versions of which could be applied to any of the inner Runway 09 arrival routes described in this subsection, with corresponding track adjustments.

Figure 15 Runway 09 alternate turns to final approach designed using RNAV1-RF

6.4.9 ARR-09-Inner-N-RF

This design option is the result of increasing the automation of the final base leg turn to final approach. The wider turn means a longer route. It would overfly different communities, but a broadly similar number of people.

It would be challenging and complex to deconflict from Heathrow flows due to the proximity with Heathrow controlled airspace as it turns southeast.

6.4.10 ARR-09-Inner-S-RF

This design option is similar to, but a greater challenge than, the northern version above. Deconfliction from Heathrow flows is more complex due to the southern route entering and then leaving Heathrow controlled airspace as it turns northeast.

6.4.11 Note that greater complexity may require greater safety assurance (see Step 2A(ii) document for assessment, and Step 2B document for safety considerations).

Note on using northern and southern 'mirror' arrival options as a potential system

6.4.12 As previously mentioned, these routes are all indicative illustrations. Feedback from NERL states that there would be safety concerns should future routes include a system that switches between northern and southern inner arrival routes to Runway 09, due to the significant difference in ATC operations this would entail. However, the possibility remains, subject to detailed safety analysis and collaboration with adjacent airports.

6.5 Inner Route (from 4,000ft to final approach) specifically for Runway 27

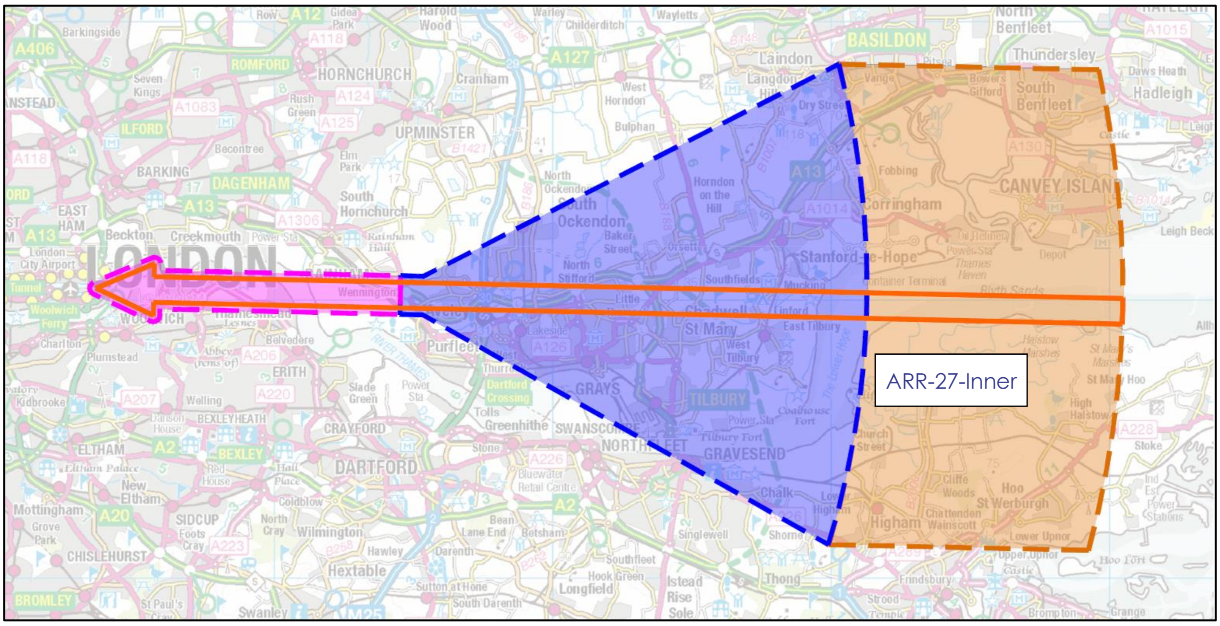


Figure 16 Inner Route (from 4,000ft to final approach) serving Runway 27 only

6.5.1 ARR-27-Inner

This design option is the same as the baseline because the route is already as short, direct and efficient as possible. It is also as high as possible, and the final approach is already very steep as described in paragraph 3.2.1.

7 Comprehensive list: Departure design options

7.1.1 As per Section 5 above, we used stakeholder engagement feedback to develop this comprehensive list.

7.1.2 We rationalised and combined the engagement concepts into groups of SIDs (Standard Instrument Departure routes) per main departure flow direction.

7.1.3 As previously mentioned, our runway aligns with Heathrow, therefore it would be radical and unviable to propose a departure route due west. The main departure flows in this comprehensive list do not include a due west departure. However, we developed the indicative design options and used feedback to understand the parameters for more feasible solutions.

7.1.4 Within those groups, we identified where the indicative design options allowed for the choice of a left turn out (LTO) or a right turn out (RTO) to head in the main flow direction.

7.1.5 We increased the aspirational climb gradient to get aircraft higher more quickly, as per stakeholder feedback.

7.1.6 As described in paragraph 3.4.3 above, currently all our departures must be capable of flying a gradient of at least 8% to 3,000ft. Our updated designs take that 8% gradient and continue it to 7,000ft.

- This gradient is the equivalent to climbing 1,000ft for every 3.8km travelled.
- All the indicative departure design options assume a climb to 7,000ft with one 'level-off' for 3.8km, at or above 4,000ft, assuming one flightpath interaction with another airport can be resolved in this way.
- Should there be no need for a level-off and the climb could be entirely continuous, the indicated track length could be shortened by 3.8km.
- Should there be a need for a longer level-off (or for more than one), the indicative SID track would need to be lengthened by 3.8km in the direction of the long- dashed area at the end of the design envelope. This region is where we expect the departure route to join the main air route network at 7,000ft and above, using the 8% climb gradient.

7.1.7 The need for a level-off is not yet known, and the assumptions above illustrate how the indicative tracks might shorten or lengthen under certain circumstances.

7.1.8 Solid blue lines illustrate the most direct indicative option to each main departure direction, with dashed blue lines indicating alternate options.

7.1.9 Typically, two 'extreme' indicative design options define the width of the design envelope, per main departure direction.

7.1.10 The colour-shaded areas indicate how high aircraft are predicted to be during their climb to 4,000ft, and from 4,000ft-7,000ft, noting the assumptions that a level-off may occur (and has been included in the track length) between 4,000ft-7,000ft.

7.1.11 It may be possible to organise departure design options to each main direction into systems for respite, or to disperse traffic in another way. However at this stage in the process it would be disproportionate to describe every possible permutation of which route works with which other route, while also considering the equivalent permutations of arrival options and how they work with departures as part of the same system.

Additional information about current SIDs

7.1.12 LCY currently has available two sets of SIDs, one set designed for the RNAV1 navigation standard (modern, and mandatory at LCY) and one set for 'Conventional' navigation (a legacy standard, based on radio navigation beacons – see also paragraph 3.4.4 above).

- Both sets result in a flightplan with identical flightpaths and altitudes.
- In summer 2019, the set of RNAV1 SIDs was flightplanned and flown by 98.8% of LCY departures.
- The set of Conventional SIDs was flightplanned by 1.2% of LCY departures. It is also likely that those flights actually used elements of RNAV1 navigation technology for part, or all, of their departure.
- There is a case for removing the redundant Conventional SIDs because it would be a purely technical exercise. There would be no change of impacts – noise, fuel or CO_2.

7.1.13 Also, LCY's SIDs currently contain final segments that are never flown at low altitudes. Those low-altitude route segments are redundant because the flights have already joined the air traffic route network at the correct altitude much earlier along the SID.

- The redundant segments can be safely truncated with no change in impacts – noise, fuel or CO_2, and it is possible that truncation causes a small fuel/CO_2 saving with no disbenefits.

7.1.14 Either of these two technical changes could occur at any time, and would be separate from this proposal. We mention it here to ensure the reader is aware that technical changes may occur to published SIDs before this wider proposal progresses, and that those technical changes will be essentially invisible and would not change current impacts.

Note References to Heathrow also include RAF Northolt, due to their proximity.

7.1.15 The proposed departure route design options are divided into six groups:

- Runway 09 SIDs to the northwest and west
- Runway 09 SIDs to the east and northeast
- Runway 09 SIDs to the southeast and south
- Runway 27 SIDs to the northwest and west
- Runway 27 SIDs to the east and northeast
- Runway 27 SIDs to the southeast and south

7.2 Runway 09 SIDs to the northwest and west

With a left turn out after take-off (LTO)

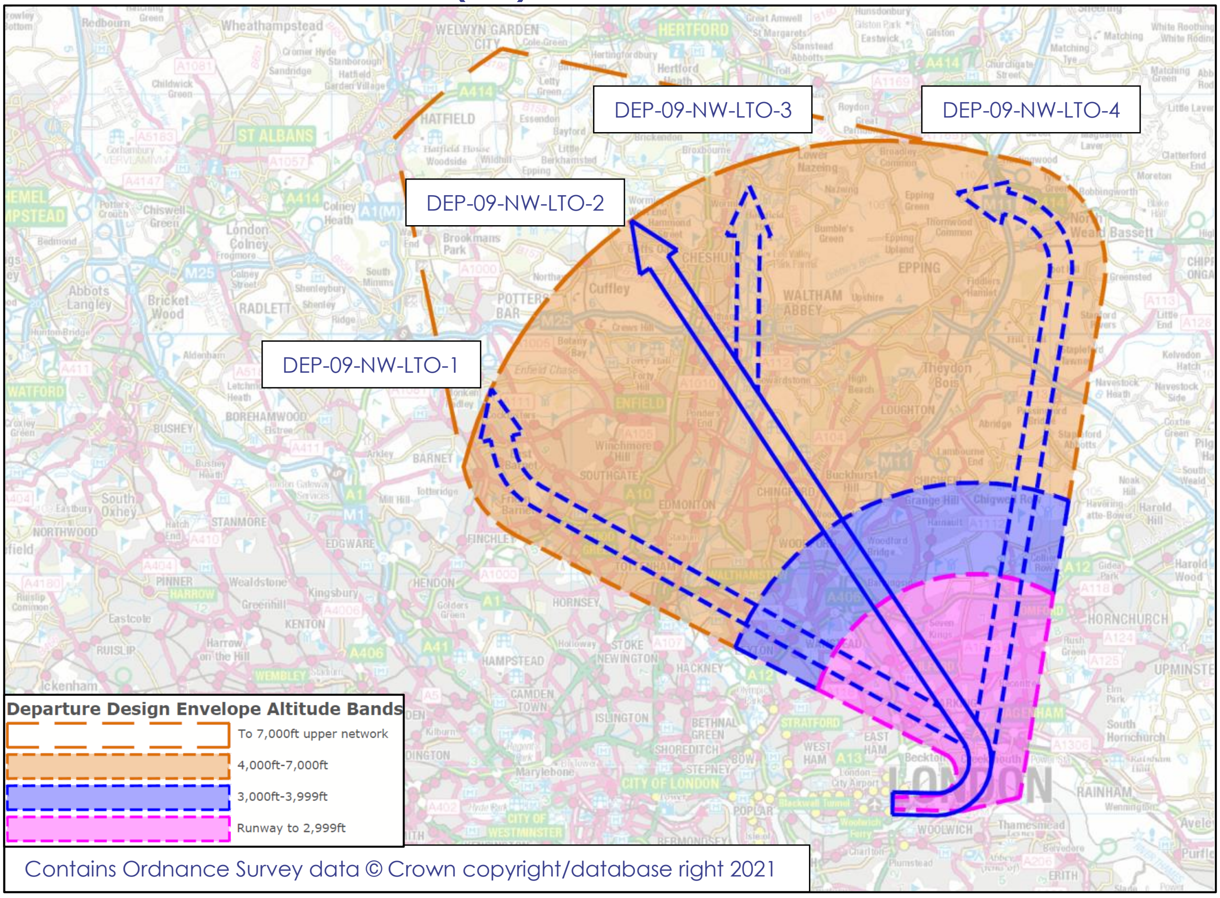


Figure 17 Runway 09 SIDs to the northwest and west with a Left Turn Out (LTO)

7.2.1 DEP-09-NW-LTO-1

This design option continues the left turn towards Heathrow's airspace, before turning north. It would overfly different communities, but a broadly similar number of people. It would need to deconflict from Heathrow, Luton and Stansted air traffic flows.

7.2.2 DEP-09-NW-LTO-2

This design option is the same track as today's baseline route. It would overfly the same communities, but aims to climb higher and more continuously. It would need to deconflict from Heathrow, Luton and Stansted air traffic flows.

7.2.3 DEP-09-NW-LTO-3

This design option is the same initial track as today's baseline route until reaching the Lee Valley, where it turns to follow the River Lea, which is less densely populated. It would need to deconflict from Heathrow, Luton and Stansted air traffic flows.

7.2.4 DEP-09-NW-LTO-4

This route may allow for quicker climbs by routeing initially away from the desired ultimate direction. It would overfly different communities, and is likely to overfly less densely populated areas. This route would be slightly longer overall due to the alternate initial departure direction. It would need to deconflict from Heathrow, Luton and Stansted air traffic flows.

With a right turn out after take-off (RTO)

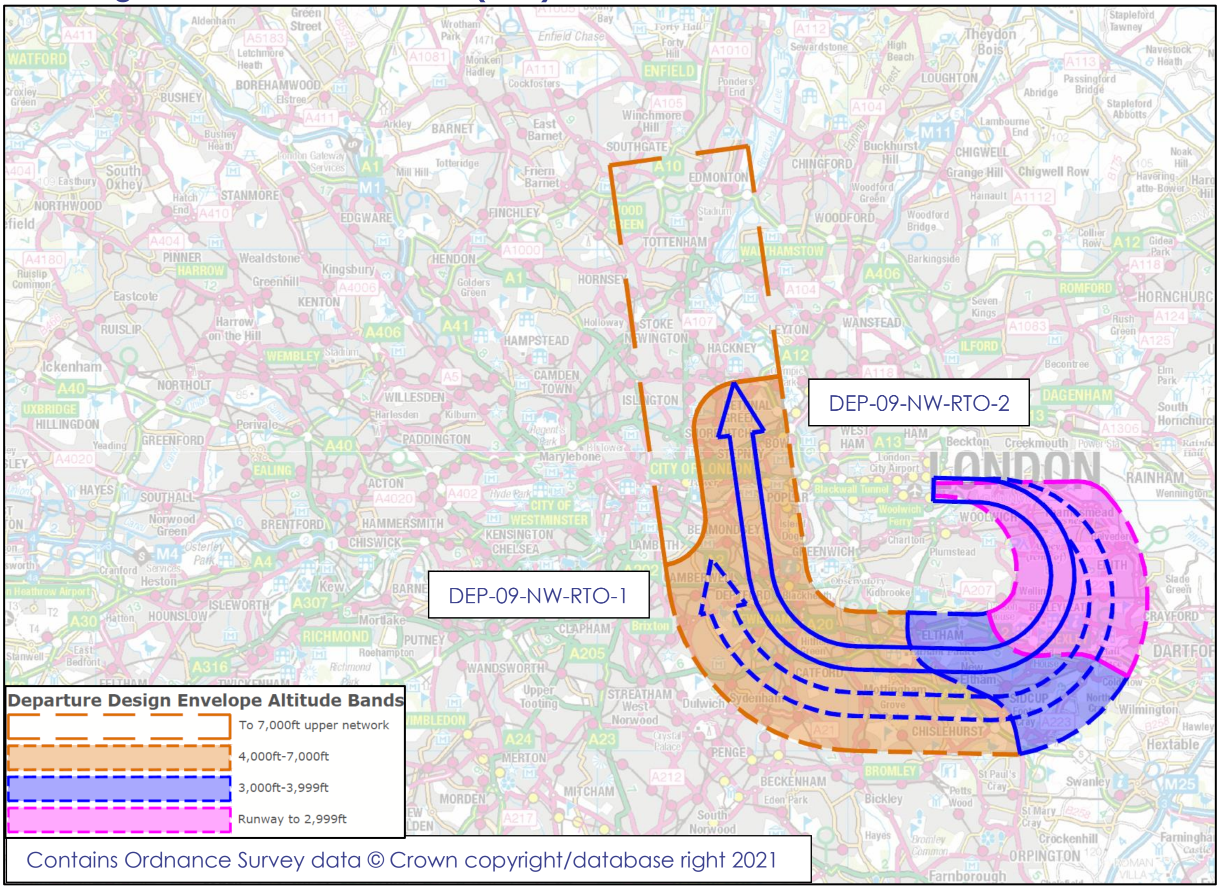


Figure 18 Runway 09 SIDs to the northwest and west with a Right Turn Out (RTO)

7.2.5 DEP-09-NW-RTO-1

This design option makes a wide turn to the right, towards Heathrow's airspace, before turning north, crossing final approach at network levels if climb was continuous. It would overfly different communities, but a broadly similar number of people. It is 1.8km south of, and parallel to, 7.2.6 DEP-09-NW-RTO-2. It would need deconfliction from Biggin Hill, and a challenging & complex deconfliction from Heathrow air traffic flows and our own arrivals. This may be less efficient from an air traffic departure management point of view.

7.2.6 DEP-09-NW-RTO-2

This design option makes a tight turn to the right, towards Heathrow's airspace, before turning north and crossing final approach. It would overfly different communities, but a broadly similar number of people. It would need deconfliction from Biggin Hill, and a challenging & complex deconfliction from Heathrow air traffic flows and our own arrivals. This may be less efficient from an air traffic departure management point of view.

7.2.7 Note that greater complexity may require greater safety assurance (see Step 2A(ii) document for assessment, and Step 2B document for safety considerations).

7.3 Runway 09 SIDs to the northeast and east

With a left turn out after take-off (LTO)

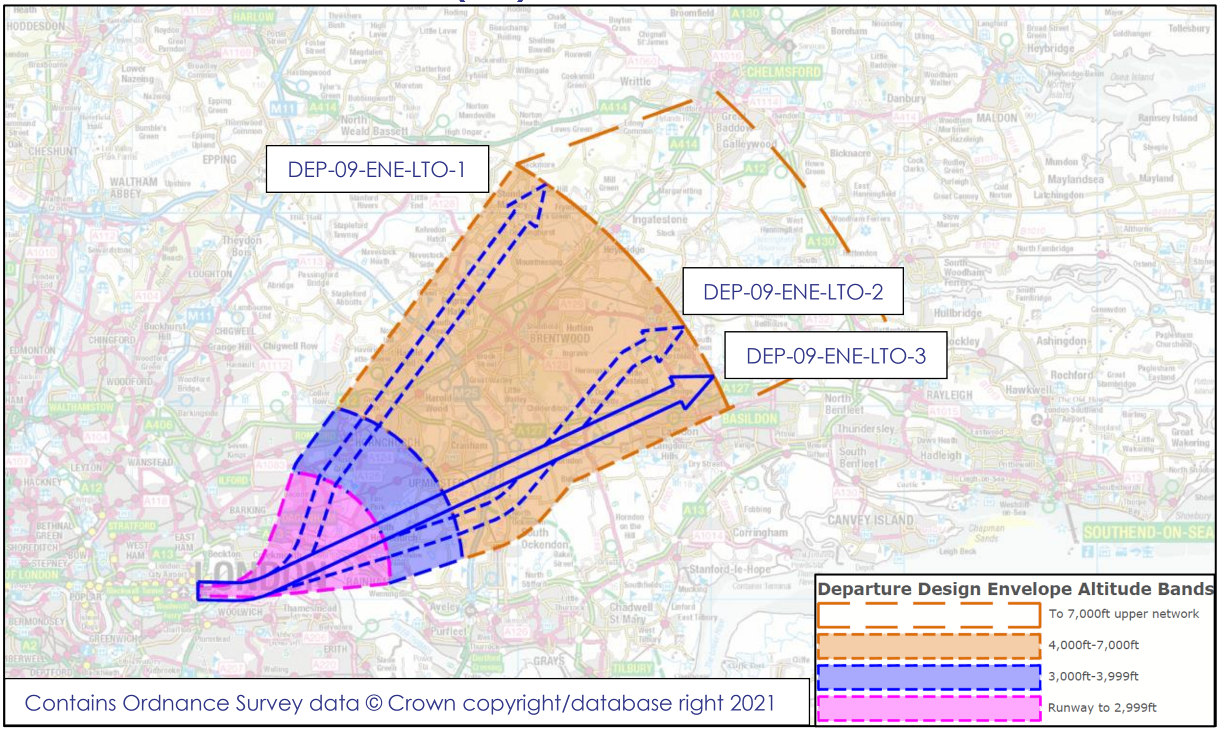


Figure 19 Runway 09 SIDs to the northeast and east with a Left Turn Out (LTO)

7.3.1 DEP-09-ENE-LTO-1

This design option follows today's baseline SID but continues further northeast, similar to today's tactical controlling. This means the departure crosses under Heathrow's arrival flow more quickly, and is then turned east once higher. It would overfly the same communities. It would need deconfliction from Heathrow, Stansted and Southend air traffic flows. This may be more efficient from an air traffic departure management point of view (see paragraph 3.4.5 on p.11).

7.3.2 DEP-09-ENE-LTO-2

This design option aims to avoid densely populated areas where possible, and removes the complex turns from today's baseline SID. It would overfly some of the same communities at lower altitudes, but would also overfly different communities (likely to be fewer people overall). It would need deconfliction from Heathrow, Stansted and Southend air traffic flows.

7.3.3 DEP-09-ENE-LTO-3

This design option is the shortest route to the UK exit point in the east. It removes the complex turns from today's baseline SID. It would overfly some of the same communities at lower altitudes, but would also overfly different communities (a broadly similar number of people). It would need deconfliction from Heathrow, Stansted and Southend air traffic flows.

With a right turn out after take-off (RTO)

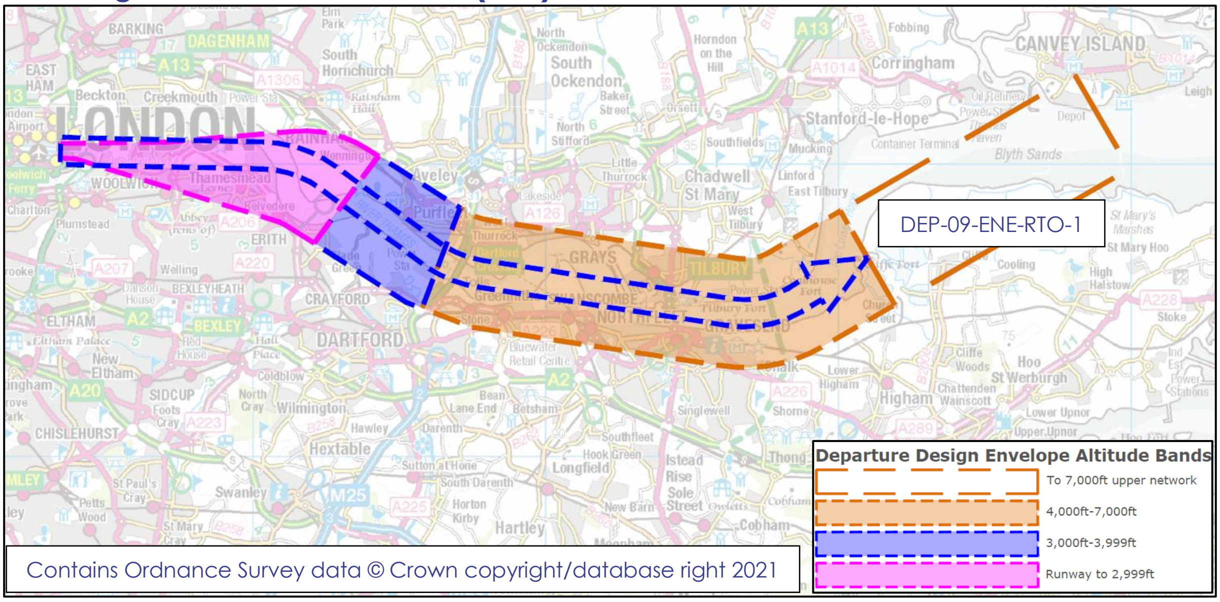


Figure 20 Runway 09 SID to the northeast and east with a Right Turn Out (RTO)

7.3.4 DEP-09-ENE-RTO-1

This design option aims to avoid densely populated areas where possible, by climbing straight ahead and then approximately following the River Thames eastwards. It would overfly some of the same communities at the lowest altitudes, but would also overfly different communities (likely to be fewer people overall). It would need deconfliction from Southend air traffic flows and our own arrivals, if they were to the south of the airport.

7.4 Runway 09 SIDs to the southeast and south

With a left turn out after take-off (LTO)

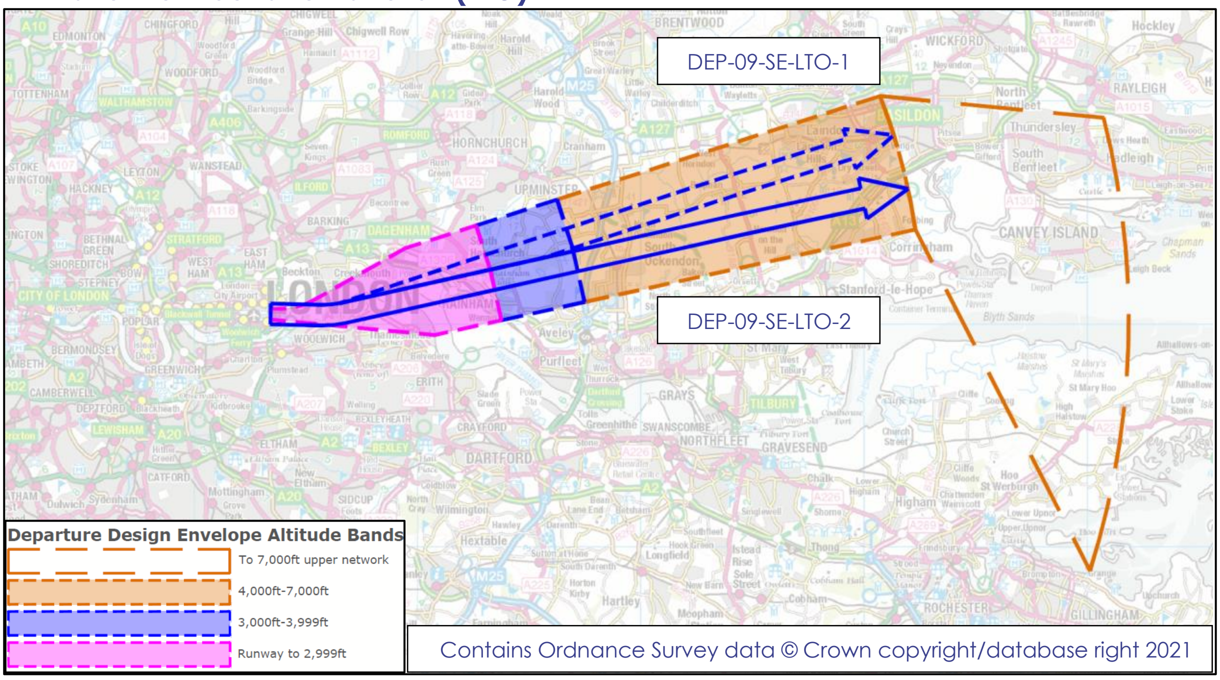


Figure 21 Runway 09 SIDs to the southeast and south with a Left Turn Out (LTO)

7.4.1 DEP-09-SE-LTO-1

This design option removes the complex turns from today's baseline SID but continues to route to one of its intermediate waypoints. The departure is then turned southeast once higher, at network levels. It would overfly some of the same communities more frequently at lower altitudes, and would also overfly different but less densely populated areas (likely to be fewer people overall). It would need deconfliction from Southend air traffic flows.

7.4.2 DEP-09-SE-LTO-2

This design option removes the complex turns from today's baseline SID and stays as south as possible before needing deconfliction from our own arrivals. The departure is then turned southeast once higher, at network levels. It would overfly some of the same communities more frequently at lower altitudes, and would also overfly different but less densely populated areas (likely to be fewer people overall). It would need deconfliction from Southend air traffic flows.

With a right turn out after take-off (RTO)

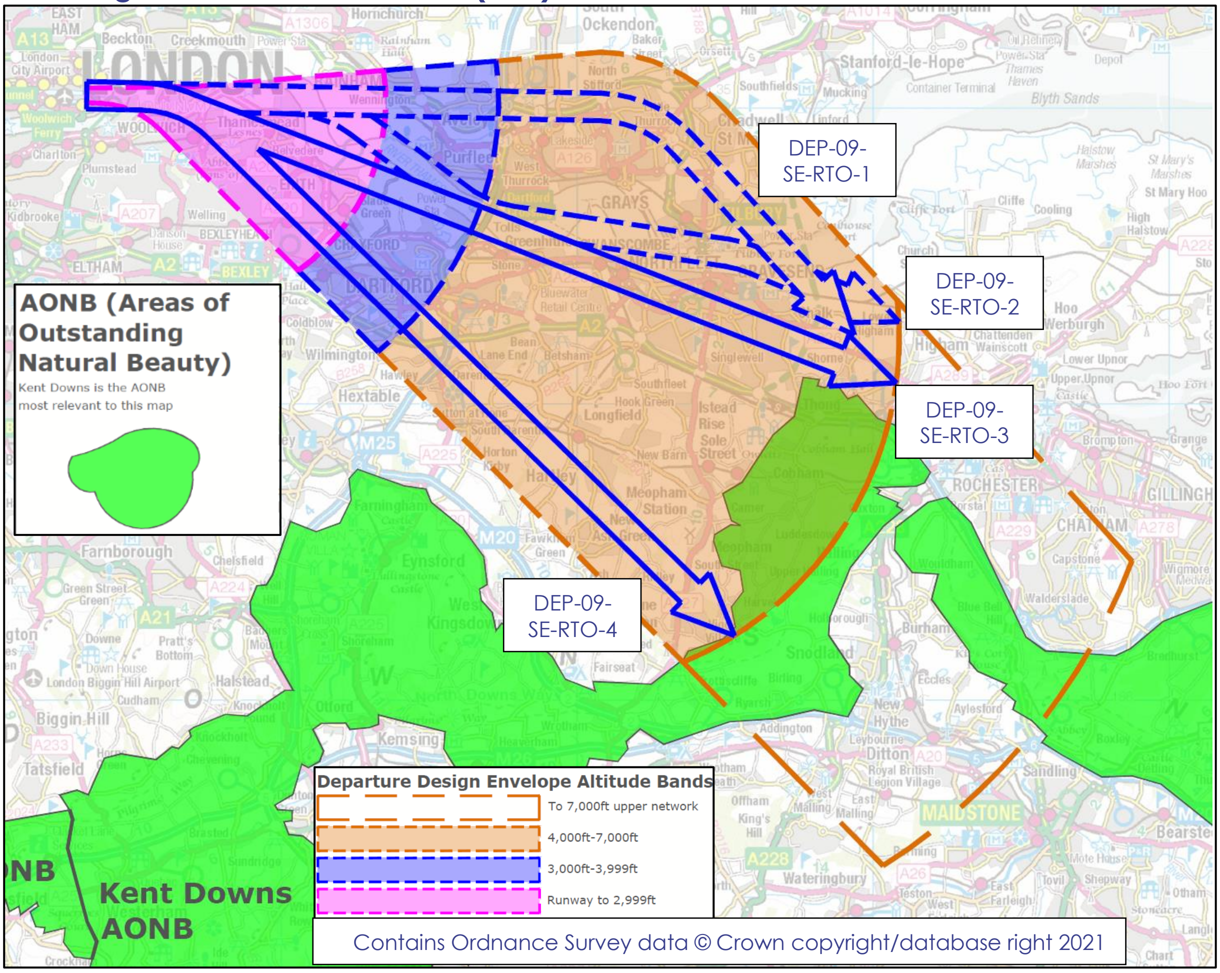


Figure 22 Runway 09 SIDs to the southeast and south with a Right Turn Out (RTO)

7.4.3 DEP-09-SE-RTO-1

This design option climbs straight ahead and then turns southeast. It would overfly some of the same communities at the lowest altitudes, but would also overfly different communities (likely to be fewer people overall). It would need deconfliction from Southend air traffic flows and from our own arrivals.

7.4.4 DEP-09-SE-RTO-2

This design option aims to avoid densely populated areas where possible, by climbing straight ahead and then approximately following the River Thames southeastwards. It would overfly some of the same communities at the lowest altitudes, but would also overfly different communities (likely to be fewer people overall). It would need deconfliction from Southend air traffic flows and our own arrivals, if they were to the south of the airport.

7.4.5 DEP-09-SE-RTO-3

This design option is the shortest route to the UK exit point in the southeast. It would overfly different communities (a broadly similar number of people). It would need deconfliction from Gatwick, Biggin Hill and Southend air traffic flows and our own arrivals, if they were to the south of the airport.

7.4.6 DEP-09-SE-RTO-4

This design option is the shortest route to the UK exit point in the south. It would overfly different communities (a broadly similar number of people). It would need deconfliction from Gatwick, Biggin Hill and Southend air traffic flows and our own arrivals, if they were to the south of the airport. This may be more efficient from an air traffic departure management point of view (see paragraph 3.4.5 on p.11).

7.4.7 Note: As previously mentioned, these routes are all indicative illustrations. Any future 'finalised' routes within the segment between 7.4.5 DEP-09-SE-RTO-3 and 7.4.6 DEP-09-SE-RTO-4 are likely to overfly the Kent Downs AONB at altitudes up to 7,000ft.

7.5 Runway 27 SIDs to the northwest and west

With a right turn out after take-off (RTO)

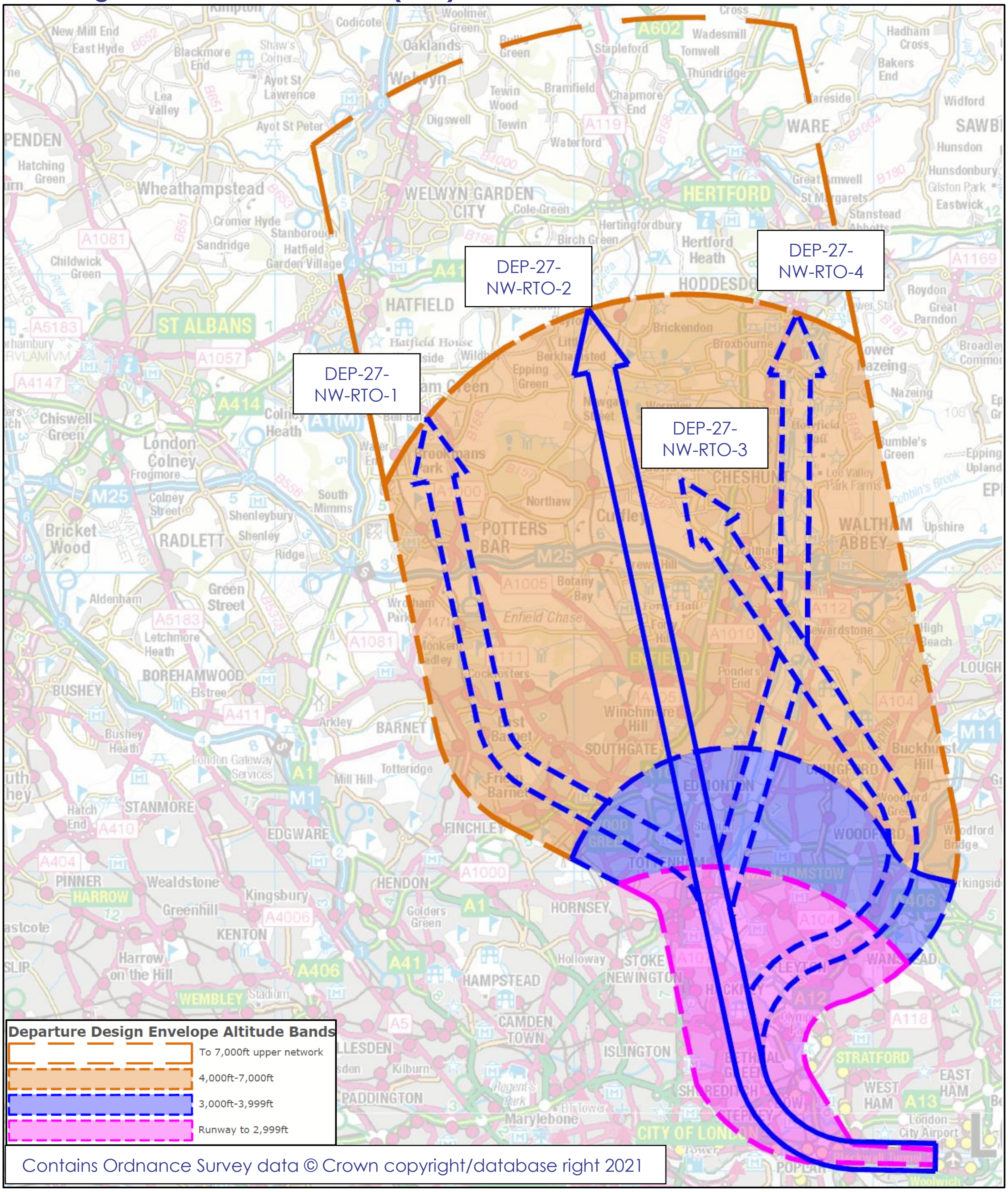


Figure 23 Runway 27 SIDs to the northwest and west with a Right Turn Out (RTO)

7.5.1 DEP-27-NW-RTO-1
This design option stays away from Heathrow airspace initially but then moves closer to provide an alternate route. It would overfly some of the same communities, and would also overfly different communities (a broadly similar number of people). It would need deconfliction from Heathrow, Luton and Stansted air traffic flows.

7.5.2 DEP-27-NW-RTO-2
This design option is the shortest route to the northwestern and western route network. It removes the complex turns from today's baseline SID. It would overfly some of the same communities, and would also overfly different communities (likely to be fewer people overall). It would need deconfliction from Heathrow, Luton and Stansted air traffic flows.

7.5.3 DEP-27-NW-RTO-3
This design option follows today's baseline SID but with a higher climb gradient. It would overfly the same communities, but likely to be fewer people overall due to faster climb shortening the track length to 7,000ft. It would need deconfliction from Heathrow, Luton and Stansted air traffic flows.

7.5.4 DEP-27-NW-RTO-4
This design option is the same initial track as today's baseline route until reaching the Lee Valley, where it turns to follow the River Lea, which is less densely populated. It would need to deconflict from Heathrow, Luton and Stansted air traffic flows.

7.5.5 Note There are no LTO equivalents for this group. They would be considered extremely radical, would not provide any benefit, nor would they be practical or viable from an air traffic management point of view.

7.6 Runway 27 SIDs to the northeast and east

With a right turn out after take-off (RTO)

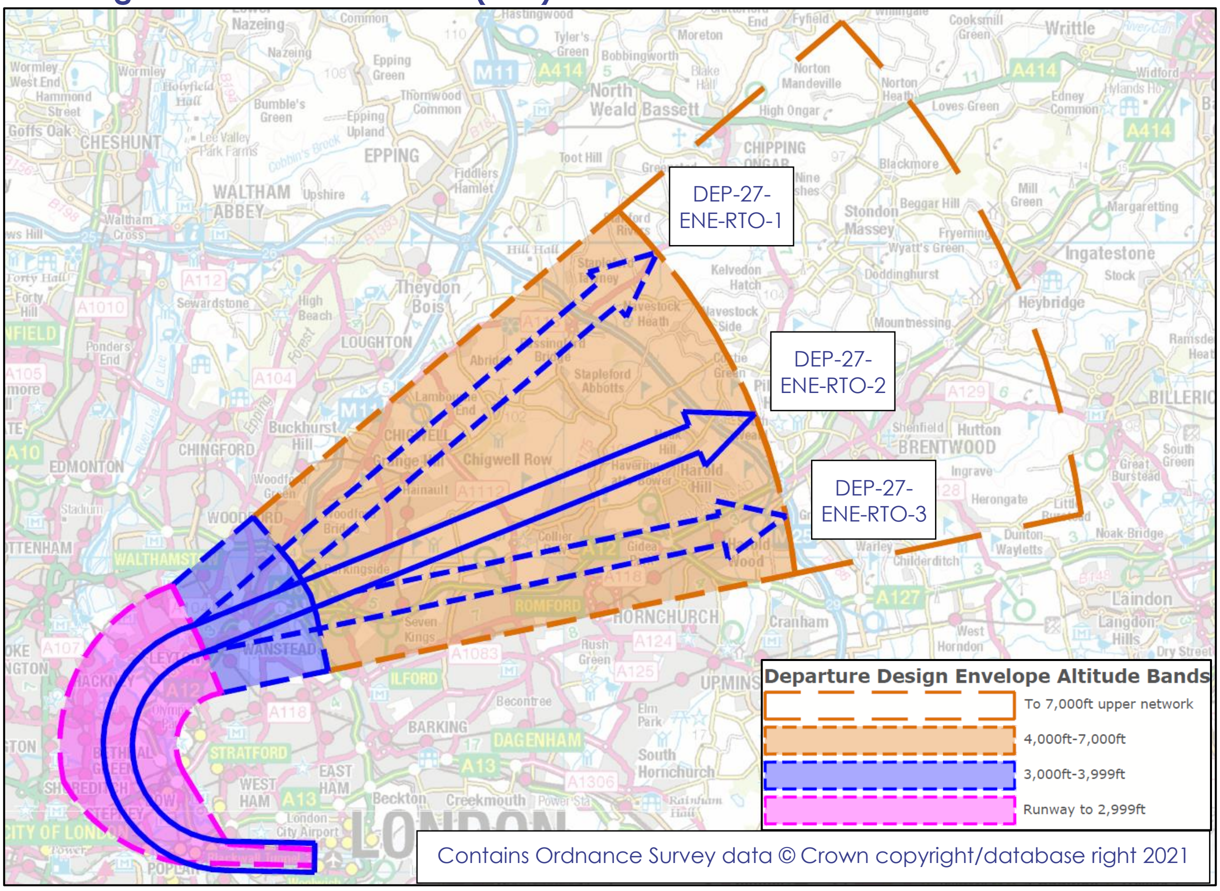


Figure 24 Runway 27 SIDs to the northeast and east with a Right Turn Out (RTO)

7.6.1 DEP-27-ENE-RTO-1

This design option follows today's baseline SID but continues further northeast, similar to today's tactical controlling. This means the departure crosses under Heathrow's current arrival flow more quickly, and is then turned east once higher. It would overfly the same communities. It would need deconfliction from Heathrow and Stansted air traffic flows.

7.6.2 DEP-27-ENE-RTO-2

This design option follows today's baseline SID then directly (shortest track) to the UK exit point in the east. It removes the complex turns from today's baseline SID. It would overfly some of the same communities, and would also overfly different communities (likely to be fewer people overall). It would need deconfliction from Heathrow, Stansted and Southend air traffic flows.

7.6.3 DEP-27-ENE-RTO-3

This alternate design option follows today's baseline SID and is as far south as reasonably practicable for departures heading northeast and east before needing deconfliction from our own arrivals. It would mainly overfly the same communities and some new communities, likely to be fewer people overall due to faster climb shortening the track length to 7,000ft. It would need deconfliction from Heathrow, Stansted and Southend air traffic flows.

7.6.4 Note: There are no LTO equivalents for this group. They would be considered extremely radical, would not provide any benefit, nor would they be practical or viable from an air traffic management point of view.

7.7 Runway 27 SIDs to the southeast and south

With a right turn out after take-off (RTO)

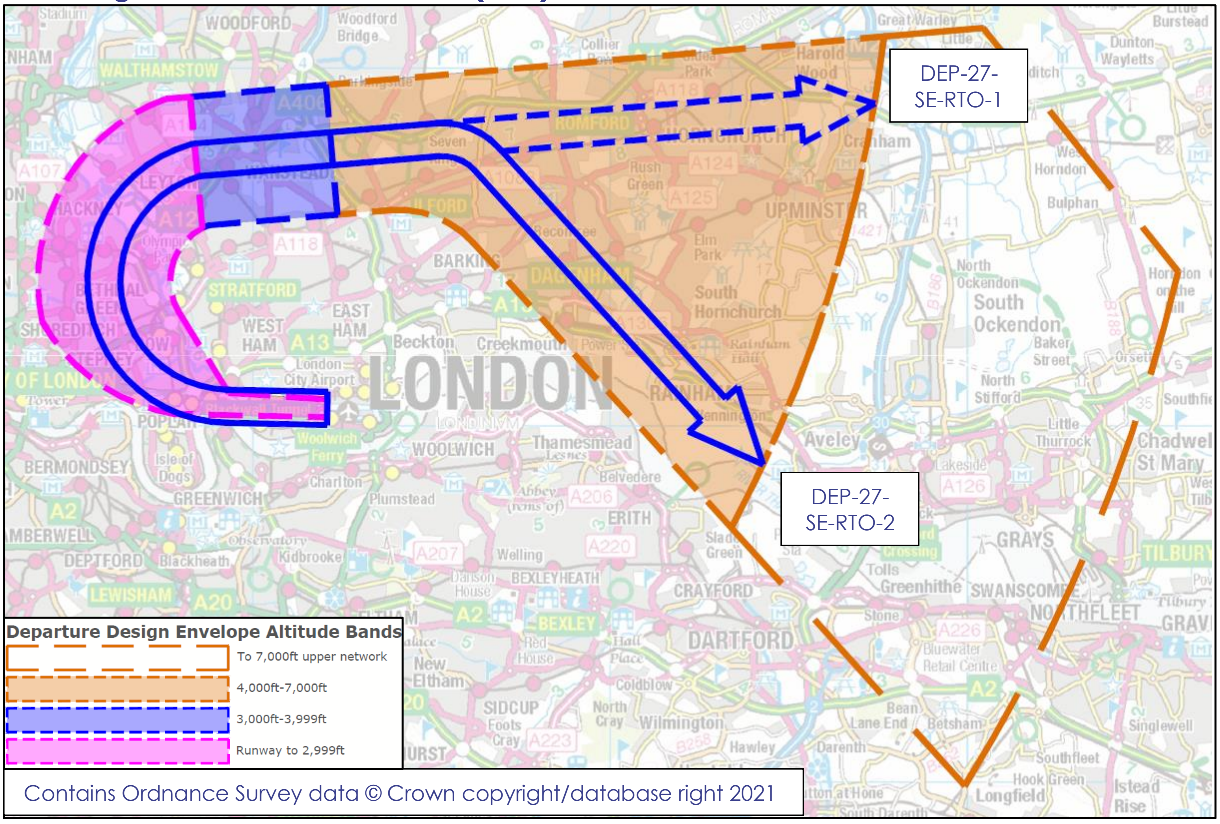


Figure 25 Runway 27 SIDs to the southeast and south with a Right Turn Out (RTO)

7.7.1 DEP-27-SE-RTO-1

This design option removes the complex turns from today's baseline SID but continues to route to one of its intermediate waypoints. The departure is then turned southeast once higher, at network levels. It would overfly some of the same communities, and would also overfly different communities (a broadly similar number of people). It would need deconfliction from Southend air traffic flows.

7.7.2 DEP-27-SE-RTO-2

This design option follows today's baseline SID then turns directly (shortest safe track) to a network point for traffic heading southeast and south, overflying our final approach track. It removes the complex turns from today's baseline SID. It would overfly some of the same communities, and would also overfly different communities (a broadly similar number of people). It would need deconfliction from Southend air traffic flows and our own arrivals.

With a left turn out after take-off (LTO)

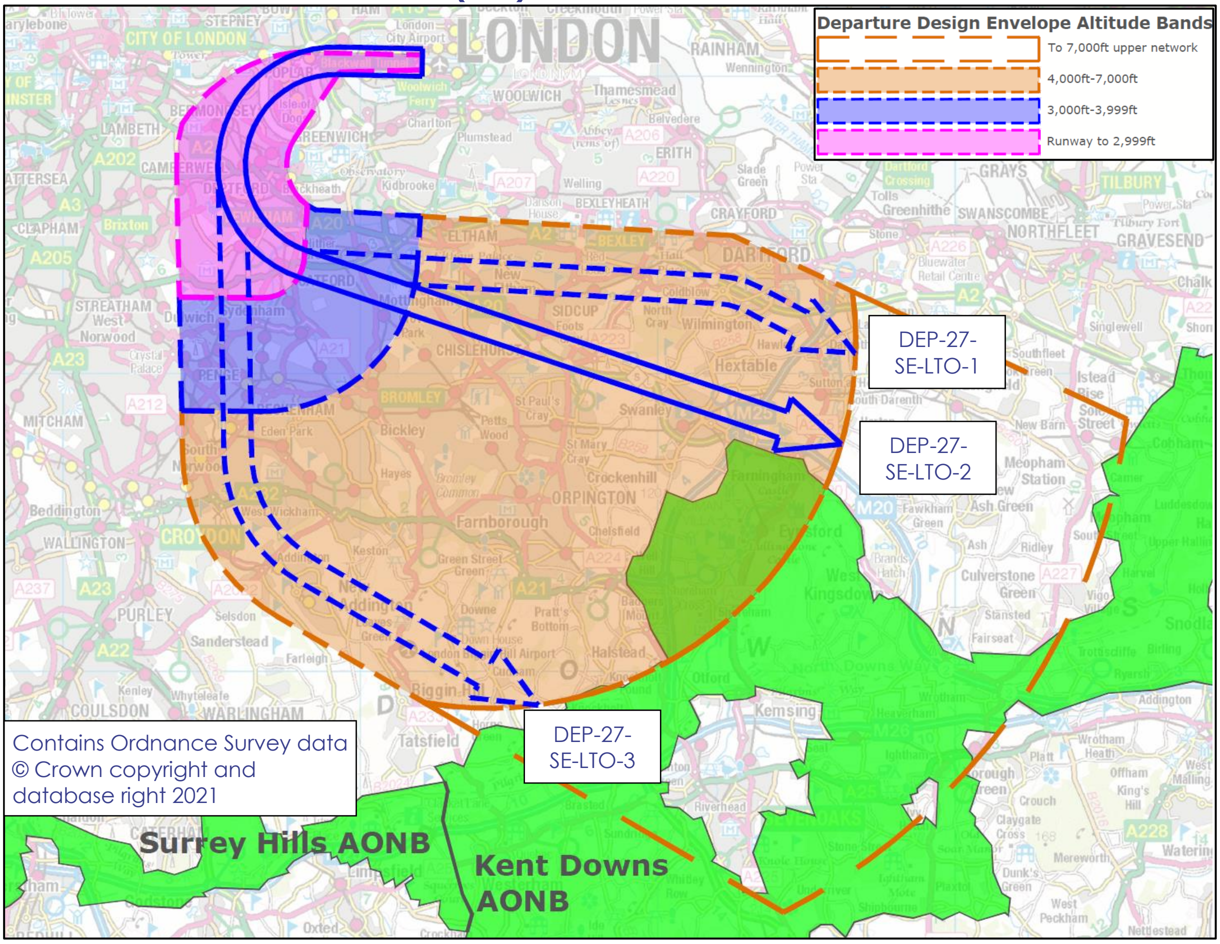


Figure 26 Runway 27 SIDs to the northeast and east with a Left Turn Out (LTO)

7.7.3 DEP-27-SE-LTO-1

This design option initially mirrors the RTO to the north and is as tight as reasonably practicable. It would overfly different communities (a broadly similar number of people). It would need deconfliction from Heathrow, Gatwick and Biggin Hill air traffic flows.

7.7.4 DEP-27-SE-LTO-2

This design option initially mirrors the RTO to the north and then routes directly (shortest track) to a network point for traffic heading southeast and south. It would overfly different communities (a broadly similar number of people). It would need deconfliction from Heathrow, Gatwick and Biggin Hill air traffic flows. This may be more efficient from an air traffic departure management point of view (see paragraph 3.4.5 on p.11).

7.7.5 DEP-27-SE-LTO-3

This alternate design option turns immediately south and then turns towards a network point for traffic heading southeast and south. It would overfly different communities (a broadly similar number of people). It would need deconfliction from Heathrow, Gatwick and Biggin Hill air traffic flows.

7.7.6 Note: As previously mentioned, these routes are all indicative illustrations. Any future 'finalised' routes within the segment between 7.4.57.7.4 DEP-27-SE-LTO-2 and 7.7.5 DEP-27-SE-LTO-3 are likely to overfly the Kent Downs AONB at altitudes up to 7,000ft.

8 Conclusions and Next Steps

8.1.1 In this document we have:

- Introduced the airspace change process CAP1616 and our part in the UK Government's Airspace Modernisation Strategy AMS
- Introduced the airport and its traffic movements
- Highlighted design constraints, current inefficiencies and opportunities for improvements
- Explained how flightpaths work today, for both runways
- Summarised the design development, including how we addressed feedback from stakeholders, and how the design decisions we have taken related to that feedback
- Provided a comprehensive list of indicative arrival and departure design options, with maps and a short narrative describing each one

8.1.2 In the annexes for this document we have:

- Provided more details of the AMS and CAP1616
- Recapped the Design Principles from Stage 1 of the process
- Summarised the stakeholder engagement activities, and listed the stakeholder organisations
- Provided a glossary of terms

8.1.3 This document contains 19(footnote 13) arrival options and 28 departure options, not including the overall 'do nothing' system option. This comprehensive list of indicative viable options was influenced by feedback from stakeholders during our engagement sessions.

8.1.4 The complementary documents Step 2A(ii) Design Principle Evaluation and Step 2B Options Appraisal (phase 1 Initial) including Safety Assessment should be read in conjunction with this document.

8.1.5 The three primary documents 2A(i), 2A(ii) and 2B, along with supporting material, were submitted to the Civil Aviation Authority (CAA) late May 2022 for their consideration at the CAA Gateway Assessment on Friday 24th June 2022.

8.1.6 Presuming success, we will move into Stage 3 of the process and can work even more closely with adjacent airports to develop our airspace designs.

8.1.7 As part of the publication process we informed stakeholders that these documents are available for review, thanked them for participating in Stage 2, and invited them to stay up to date on the next stage of the airspace change process.

8.1.8 The overall timeline for this ACP is consistent with Iteration 2 of the Masterplan for the regional cluster within which this ACP sits.

13 Twenty are listed, however one arrival 'option' is merely a short link route to an alternate arrival option. The two will be considered as a single arrival option.

9 Annexe: Airspace modernisation and the airspace change process

9.1 UK Airspace Modernisation Strategy

9.1.1 London City Airport (LCY) is participating in the UK Government's Airspace Modernisation Strategy (AMS).

9.1.2 The AMS aims to create an aviation infrastructure for the future to deliver quicker, quieter and cleaner journeys, and more capacity for those using (and affected by) UK airspace.

9.1.3 The Department for Transport (DfT) and the Civil Aviation Authority (CAA) are working together to act as co-sponsors for the modernisation of the UK's airspace.

9.1.4 Including LCY, there are 21 airports across the UK who are participating in the AMS, supported by other Air Traffic Management (ATM) organisations:

- The 20 other airports included are Heathrow, Gatwick, Stansted, Luton, Southend, Biggin Hill, Bournemouth, Southampton, Manston, RAF Northolt, Bristol, Cardiff, Exeter, East Midlands, Leeds-Bradford, Liverpool, Manchester, Aberdeen, Edinburgh and Glasgow.
- Each airport, including LCY, is responsible for modernising their own local route network to and from the runway, up to an altitude of 7,000ft.
- NATS En Route Ltd (NERL) is the licensed Air Navigation Services Provider (ANSP) for the UK's countrywide air route network. At and above 7,000ft, NERL is responsible for network modernisation across all regions of the UK's airspace.
- The Airspace Change Organising Group (ACOG) was established in 2019 as an independent organisation to coordinate the delivery of key aspects of the AMS, working with each airport and NERL in all regions of the UK.

The Airspace 'Masterplan', & Future Airspace Strategy Implementation South (FASI-S)

9.1.5 ACOG was commissioned by the DfT and CAA to create an airspace Masterplan(14). Its purpose is to identify where airspace changes are needed to support the delivery of the AMS. It identifies interdependencies and will help coordinate ACP work as each strand progresses.

9.1.6 ACOG also attends (or is aware of) bilateral meetings between FASI-S airports, to observe, provide advice and guidance on the coordinated programme of work.

9.1.7 FASI-S is the combined programme of airspace changes to the legacy air traffic route structures in the southern part of the UK. FASI-S is also subdivided into regional clusters. LCY is in the airspace region known as the London Terminal Manoeuvring Area (LTMA), along with the other London airports.

9.1.8 The LTMA is part of the South East regional cluster of FASI-S airports, and each airport is modernising its own local route network. Geographically, local routes serving individual airports often overlap and use the same volumes of airspace. From an ATM point of view, airports in the LTMA are relatively close to each other.

[14] Link to ACOG Masterplan web page: https://www.acog.aero/airspace-masterplan/masterplan/

9.2 The Airspace Change Process

9.2.1 All airspace changes must follow the CAA's process known as 'CAP1616'.

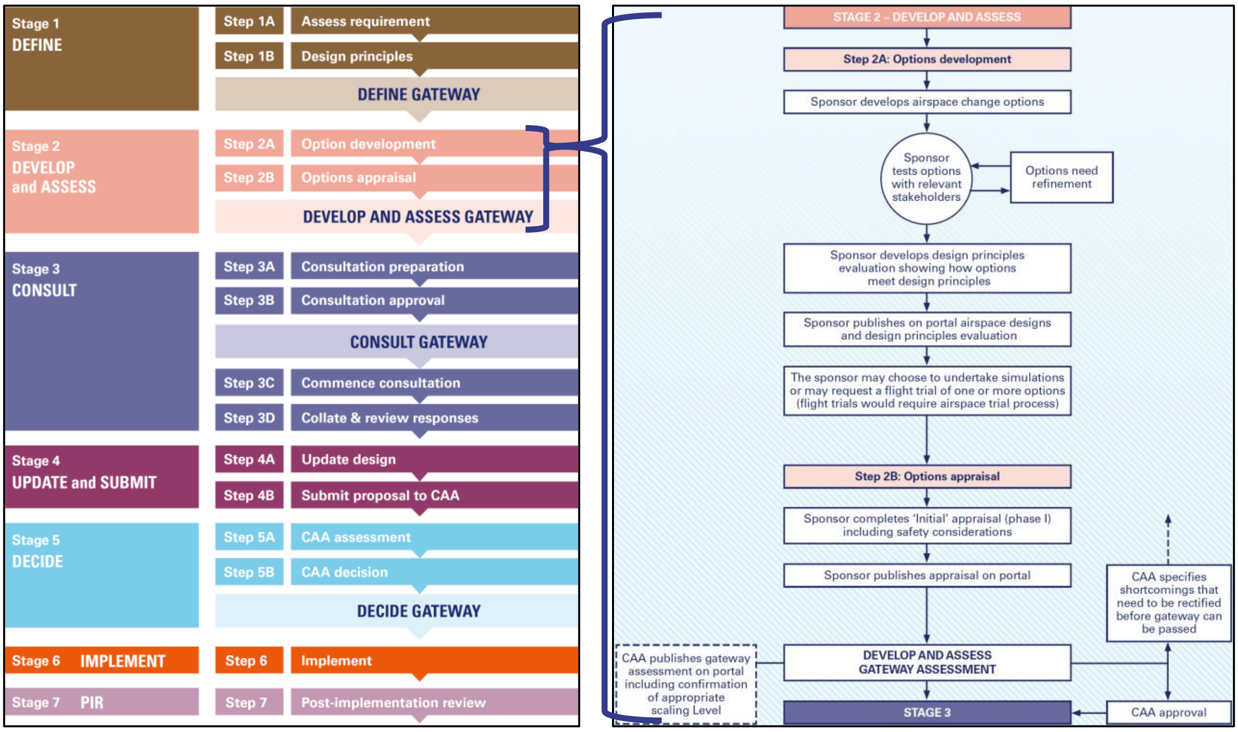


Figure 27 CAA Airspace Change Process CAP1616, summarised as a high level flow chart (L) and Stage 2 detail (R)

10 Annexe: Design Principles (DPs) Recap

Ref Num	Tier 1 Design Principles	Priority
DP0	Must maintain (and ideally enhance) current safety standards	A
DP1	Must be in compliance with all laws and regulations	A
DP2	Must enhance navigation standards by utilising modern navigation technology	A
DP3	Must be consistent with the CAA's Airspace Modernisation Strategy (CAP1711) and any current or future plans associated with it, including the provision of sufficient airspace capacity	A

Ref Num	Tier 2 Design Principles		Priority
DP4	Should limit and where possible reduce aircraft noise		A
	Group (i) noise mitigations	Use noise efficient operational practices	
		Provide predictable respite routes	
		Avoid overflying communities with multiple routes, including from other airports	
	Group (ii) noise mitigations	Minimise the number of people newly overflown	
		Provide managed dispersal	
		Minimise the total population overflown	
		Avoid overflying noise sensitive areas e.g. schools, hospitals, care homes	
DP5	Should minimise the amount of fuel used and the CO_2 subsequently emitted		B
DP6	Should minimise air pollution in the local area from aircraft		B
DP7	Should improve resilience during abnormal operating conditions		B
DP8	Should promote optimal network performance in collaboration with other airspace users		C

Table 2 Design Principles from Stage 1, encompassing the safety, environmental and operational criteria and the strategic policy objectives we seek to achieve in developing the airspace change proposal.

11 Annexe: Stakeholder Engagement Summary (Activities), Stakeholder List

Reference to 'feedback form' means a word document asking stakeholders for comments on the engaged design options, and also means responses to an equivalent online form in the same format. Some chose to email the completed word document, others chose the online form.

11.1 Engagement Activities: Representatives of Local Communities

Activity	Date	Representatives of Local Communities	Summary of engagement feedback [Square brackets are feedback references from Table 1 in para 5.3.3 page 21]
Virtual meeting (one main session, one supplemental session for those missing the main session, one brief update to provide a summary of the feedback received)	02 Dec 2021 12 Jan 2022 10 Mar 2022	London City Airport Consultative Committee (LCACC) Feedback received from: HACAN East A local resident Transport for London TfL Forest Hill Society	Presentation including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated de-duplicated discussion and feedback summary via meeting notes, via separately-supplied feedback form, or via online form: Noise impacts should alternate, overfly new areas and thus be diluted [PF1A, PF1B] Remove or re-coordinate Heathrow traffic to reduce Heathrow overflight, make LCY flights higher and allow for more LCY respite options [PF1B, PF1D, PF1E, PF1F] Overflight by LCY arrivals and departures [PF1D] Runway 09 base leg concentration [PF1C] and Runway 27 departure turns [PF1i] Impacts of Biggin Hill as well as LCY [PF1D] Impossible to avoid densely populated areas, suggest a range of respite routes [PF1B] Reduce carbon emissions [PF2A]
Virtual meeting (two sessions with same invitees considered as a single event)	13 Dec 2021 17 Dec 2021	Political stakeholders MPs, London Boroughs, District and Borough Councils, Greater London Authority, London Assembly Feedback received from: MP for Eltham Gravesham Borough Council Kent County Council LB Newham LB Waltham Forest London Assembly Member (Lib Dem) London Assembly Member (Green) Sevenoaks District Council Castle Point Borough Council	Presentation including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated de-duplicated discussion and feedback summary via meeting notes and/or via separately-supplied feedback form: Noise impacts concentrated at low altitude [PF1C, PF1E, PF1F], same areas overflown by Heathrow and other LCY flights [PF1D] Noise impact concentration at higher altitude and by other airports [PF1B, PF1D, PF1E, PF1F] Improve efficiency, shortening flightpaths would benefit fuel use, reduce pollution and CO_2 emissions [PF2A] Flightpaths should be extended over areas not currently overflown [PF1A]
Email request for engagement and feedback	24 Dec 2021 and 07 Jan 2022	Community organisations Plane Hell Action SE (PHASE), London Chamber, London First Feedback received from PHASE.	Emailed presentation of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Feedback summary: Share the noise impacts of LCY arrivals and departures, reduce concentration, consider Heathrow traffic, stay higher for longer [PF1A, PF1B, PF1C, PF1D, PF1E, PF1F, PF1i]
Email request for engagement and feedback	13 Jan 2022	Kent Downs Area of Outstanding Natural Beauty	Emailed presentation of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Feedback summary: Changes must consider noise impacts on tranquil AONB [PF1H]

11.2 Engagement Activities: Aviation Stakeholders

Activity	Date	Aviation Stakeholders	Summary of engagement feedback [Square brackets are feedback references from Table 1 in para 5.3.3 page 21]
Virtual meetings x2 and subsequent email feedback	06 Oct 2021 15 Dec 2021	Biggin Hill Airport	Initial meeting to briefly explain broad concepts and understand general constraints (no notes recorded at this preliminary step). Presentation including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via email: Ensure the design envelopes are wide [PF3A] Technical discussions on combining/separating traffic flows [PF1D], see also para 3.1.3 above. Dependencies noted on other airports and network sponsor.
Virtual meeting and subsequent feedback via online form	06 Dec 2021	Gatwick Airport	Presentation including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via online feedback form: Technical process and dependencies discussion. Raising altitudes [PF1E, PF1F] Interactions with neighbouring airports needs collaboration [PF3A, PF1D], some options may result in additional track miles [PF2A].
Virtual meetings x2	23 Sep 2021 12 Nov 2021	Heathrow (ACOG present)	Initial meeting to briefly explain broad concepts and understand general constraints. Presentation of draft engagement material subsequently refined. Discussion summary via meeting notes: Technical process and dependencies discussion. Raising altitudes [PF1E, PF1F] Interactions with neighbouring airports needs collaboration [PF3A, PF1D]
Virtual meeting	08 Dec 2021	Luton Airport	Presentation including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via feedback form: Technical process discussions. Interactions likely in BPK area and with Heathrow [PF3A, PF1D, PF1E, PF1F, PF4B] Increased climb minimised fuel/CO_2 [PF2A]
Virtual meetings x2 (DAATM and Northolt separately)	21 Dec 2021 14 Feb 2022	MoD DAATM and RAF Northolt (ACOG present)	Presentations including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via online feedback form: Technical process discussions. Interactions likely in BPK area requiring flexibility of route design between multiple airports and to improve altitudes [PF3A, PF1D, PF1E, PF1F, PF4B]

Activity	Date	Aviation Stakeholders	Summary of engagement feedback [Square brackets are feedback references from Table 1 in para 5.3.3 page 21]
Virtual meetings x3	07 Oct 2021 29 Nov 2021 10 Dec 2021	Air Navigation Service Provider ANSP NATS En Route Ltd (NERL) (ACOG present)	Initial meeting to briefly explain broad concepts and understand general constraints (no notes recorded at this preliminary step). Presentations with early draft engagement material subsequently refined, including talk-through of early design options. Collated discussion and feedback summary via meeting notes: Technical process discussions. New routes to shorten distance from west, north and south to the point-merge structure should it continue [PF2A] Ensure flexibility of route design considering other airfields [PF3A, PF1D, PF1E, PF1F, PF4B]
Virtual meeting	07 Dec 2021	Southend Airport	Presentation including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via online feedback form: Technical process discussions. Interactions likely in Southend vicinity requiring flexibility of route design [PF3A, PF1D, PF1E, PF1F]
Virtual meetings x2	06 Dec 2021 07 Feb 2022	Stansted Airport (ACOG present)	Presentations including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via online feedback form: Technical process discussions. Interactions likely require flexibility of route design [PF3A, PF1D, PF1E, PF1F, PF4B]
Virtual meetings x2	21 Dec 2021 11 Jan 2022	National Air Traffic Management Advisory Committee (NATMAC): Feedback received from: Light Aircraft Association LAA Low Fare Airlines LFA British Helicopter Association BHA Association of Remotely Piloted Aerial Systems ARPAS British Airline Pilots' Association BALPA	Presentations including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes and via online feedback form: Discussion on impacts on general aviation GA, helicopter operations, unmanned aircraft systems, airspace volumes [PF1E, PF1F, PF4A]. Interactions likely require collaboration and flexibility of route design [PF3A, PF1D, PF1E, PF1F]
Virtual meetings x3	07 Dec 2021 11 Jan 2022 12 Jan 2022	Airlines: Feedback received from: BA CityFlyer Swiss KLM Helvetic	Presentations including talk-through of early design options and encouragement to fill in and return a feedback form or otherwise reply with feedback. Collated discussion and feedback summary via meeting notes, via email feedback form and online feedback form: Navigation design specifications and speeds [PF1C] Interactions with adjacent airports likely require collaboration and flexibility of route design [PF3A, PF1D, PF1E, PF1F, PF1G] New routes to shorten distances [PF2A] Noise impacts and distribution [PF1B, PF1E, PF1F]

11.3 Stakeholder List

11.3.1 District and Borough Councils:

Barking and Dagenham	Gravesham District Council	Richmond upon Thames
Barnet	Hackney	Royal Borough of Greenwich
Basildon District Council	Hammersmith and Fulham	Royal Borough of Kensington and Chelsea
Bexley	Haringey	Royal Borough of Kingston upon Thames
Brent	Harrow	Sevenoaks District Council
Brentwood District Council	Havering	Southend-on-Sea District Council
Bromley	Hertfordshire County Council	Southwark
Broxborne District Council	Hertsmere District Council	Surrey County Council
Camden	Hillingdon	Sutton
Castle Point District Council	Hounslow	Tandridge District Council
Chelmsford District Council	Islington	Three Rivers District Council
City of Westminster	Kent County Council	Thurrock District Council
Croydon	Lambeth	Tower Hamlets
Dartford District Council	Lewisham	Waltham Forest
Ealing	Medway District Council	Wandsworth
Enfield	Merton	Watford District Council
Epping Forest District Council	Newham	Welwyn Hatfield District Council
Essex County Council	Redbridge	

11.3.2 Greater London Assembly Members:

Marina Ahmad	Leonie Cooper	Joanne McCartney
Elly Baker	Unmesh Desai	Sem Moema
Sian Berry	Tony Devenish	Caroline Pidgeon
Shaun Bailey	Len Duvall	Zack Polanski
Emma Best	Peter Fortune	Keith Prince
Andrew Boff	Neil Garratt	Nicholas Rogers
Hina Bokhari	Susan Hall	Caroline Russell
Anne Clarke	Krupesh Hirani	Onkar Sahota
Sakina Sheikh	Sadiq Khan (Mayor)	Heidi Alexander (Deputy Mayor for Transport)
Shirley Rodrigues(Deputy Mayor for Environment)		

11.3.3 Members of Parliament for these constituencies:

Ashford	Dagenham and Rainham	Harrow East	Poplar and Limehouse	Uxbridge and South Ruislip
Barking	Dartford	Harrow West	Putney	Vauxhall
Basildon and Billericay	Dover	Harwich and North Essex	Rayleigh and Wickford	Walthamstow
Battersea	Dulwich and West Norwood	Hayes and Harlington	Reigate	Watford
Beckenham	Ealing Central and Acton	Hemel Hempstead	Richmond Park	Welwyn Hatfield
Bermondsey and Old Southwark	Ealing North	Hendon	Rochester and Strood	West Ham
Bethnal Green and Bow	Ealing Southall	Hertford and Stortford	Rochford and Southend East	Westminster North
Bexleyheath and Crayford	East Ham	Hertsmere	Romford	Wimbledon
Braintree	East Surrey	Hitchin and Harpenden	Ruislip Northwood and Pinner	Witham
Brent Central	Edmonton	Holborn and St Pancras	Runnymede and Weybridge	Woking
Brent North	Eltham	Hornchurch and Upminster	Saffron Walden	
Brentford and Isleworth	Enfield North	Hornsey and Wood Green	Sevenoaks	
Brentwood and Ongar	Enfield Southgate	Ilford North	Sittingbourne and Sheppey	
Bromley and Chislehurst	Epping Forest	Ilford South	South Basildon and East Thurrock	
Broxbourne	Epsom and Ewell	Islington North	South Thanet	
Camberwell and Peckham	Erith and Thamesmead	Islington South and Finsbury	South West Hertfordshire	
Canterbury	Esher and Walton	Kensington	South West Surrey	
Carshalton and Wallington	Faversham and Mid Kent	Kingston and Surbiton	Southend West	
Castle Point	Feltham and Heston	Lewisham Deptford	Spelthorne	
Chatham and Aylesford	Finchley and Golders Green	Lewisham East	St Albans	
Chelmsford	Folkestone and Hythe	Lewisham West and Penge	Stevenage	
Chelsea and Fulham	Gillingham and Rainham	Leyton and Wanstead	Streatham	
Chingford and Woodford Green	Gravesham	Maidstone and The Weald	Surrey Heath	
Chipping Barnet	Greenwich and Woolwich	Maldon	Sutton and Cheam	
Cities of London and Westminster	Guildford	Mitcham and Morden	Thurrock	
Clacton	Hackney North and Stoke Newington	Mole Valley	Tonbridge and Malling	
Colchester	Hackney South and Shoreditch	North East Hertfordshire	Tooting	
Croydon Central	Hammersmith	North Thanet	Tottenham	
Croydon North	Hampstead and Kilburn	Old Bexley and Sidcup	Tunbridge Wells	
Croydon South	Harlow	Orpington	Twickenham	

11.3.4 Community Groups: Plane Hell Action SE (PHASE), London Chamber, London First

11.3.5 Aircraft Operators:

Aerowest	BA CityFlyer	KLM	NetJets EU	Sylt Air
Air Alsie	CAT Aviation	LOT	Saxon Air Charter	
Air Hamburg	Globe Air	Lufthansa	Shell Aircraft Ltd	
AirGo	Helvetic	Luxair	Swiss	

11.3.6 Airports and ANSPs (sponsors of ACPs for the AMS):

Biggin Hill	Gatwick	Heathrow	Luton	NATS NERL	Northolt	Southend	Stansted

11.3.7 National Air Traffic Management Advisory Committee (NATMAC)

Airlines UK	Airfield Operators Group (AOG)	Aviation Environment Federation (AEF)	British Balloon and Airship Club	British Helicopter Association (BHA)	British Model Flying Association (BMFA)	Guild of Air Traffic Control Officers (GATCO)	Heavy Airlines Representative	Defence Airspace and Air Traffic Management (MoD DAATM)
Airspace4All	Aircraft Owners and Pilots Association (AOPA)	BAe Systems	British Business and General Aviation Association (BBGA)	British Hang Gliding and Paragliding Association (BHPA)	British Parachute Association (BPA)	Honourable Company of Air Pilots (HCAP)	Light Aircraft Association (LAA)	PPL/IR (Europe)
Airport Operators Association (AOA)	Association of Remotely Piloted Aircraft Systems UK (ARPAS-UK)	British Airline Pilots' Association (BALPA)	British Gliding Association (BGA)	British Microlight Aircraft Association (BMAA) / General Aviation Safety Council (GASCo)	General Aviation Alliance (GAA)	Helicopter Club of Great Britain (HCGB)	Low Fare Airlines	

11.3.8 London City Airport Consultative Committee (invitations via the Chairman)

Several members of the LCACC are already listed in the Borough Councils table above. In addition:
Royal Docks Management Authority, Community representatives for West Silvertown, North Woolwich, Canary Wharf, Other community groups Richard House Hospice, Gallions Point Marina, Royal Docks Learning & Activity Centre, Kingsford Community School, ASTA Community Hub, HACAN East, Passenger representative, Crossrail representative, London Chamber of Commerce & Industry, East London Chamber of Commerce, Department for Transport DfT.

11.3.9 Areas of Outstanding Natural Beauty

Email request for engagement and feedback sent on 11 Jan 2022 and 07 March 2022 to Kent Downs AONB and Surrey Hills AONB
Response received from Kent Downs AONB.
No response was received from Surrey Hills AONB, however the designs in this proposal do not overfly that AONB.

12 Annexe: Glossary

Altitude	The distance measured in feet, above mean sea level. Due to variations in terrain, air traffic control measures altitude as above mean sea level rather than above the ground. If you are interested in the height of aircraft above a particular location to assess potential noise impact, then local elevation should be taken into account when considering aircraft heights; for example an aircraft at 6,000ft above mean sea level would be 5,500ft above ground level if the ground elevation is 500ft.
AMSL	Above Mean Sea Level
AONB	Area of Outstanding Natural Beauty
ATC	Air traffic control
ATC intervention (see also Tactical and Vector)	This is when ATC instruct aircraft off their planned route, for example, in order to provide a short cut, they may be instructed to fly directly to a point rather than following the path of the published route
CAA	Civil Aviation Authority, the UK Regulator for aviation matters
CAP1616	Civil Aviation Publication 1616, the airspace change process regulated by the CAA
Capacity	A term used to describe how many aircraft can be accommodated within an airspace area without compromising safety or generating excessive delay
CAS	See Controlled Airspace
Centreline	The nominal track for a published route (see Route)
CO_2	Carbon dioxide
Concentration	Refers to a density of aircraft flight paths over a given location; generally refers to high density where tracks are not spread out; this is the opposite of Dispersal
Continuous descent	A climb or descent that is constant, without long periods of level flight
Controlled airspace (CAS)	Generic term for the airspace in which an air traffic control service is provided as standard; note that there are different sub classifications of airspace that define the particular air traffic services available in defined classes of controlled airspace. Abbreviated to CAS
Conventional navigation	The historic navigation standard where aircraft fly with reference to ground based radio navigation aids
Conventional routes	Routes defined to the conventional navigation standard
Delay Absorption Area	See Holds
Dispersal	Refers to the density of aircraft flight paths over a given location; generally refers to lower density – tracks that are spread out; this is the opposite of Concentration
Easterly operation	When a runway is operating such that aircraft are taking off and landing in an easterly direction
Final approach path	The final part of a flight path that is directly lined up with the runway;
Flexible Use Airspace FUA	Airspace which can be designated as neither "civilian" nor "military" but which can operate in either guise, allocated according to need, or switched entirely on/off according to a schedule.

Flight-path	The track flown by aircraft when following a route, or when being directed by air traffic control (see also Vector)
ft, feet	The standard measure for vertical distances used in air traffic control
GA	See General Aviation
General Aviation (GA)	All civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire. The most common type of GA activity is recreational flying by private light aircraft and gliders, but it can range from paragliders and parachutists to microlights and private corporate jet flights.
Holds/Holding Stacks	An airspace structure where aircraft circle in a racetrack-shaped pattern above one another at 1,000ft intervals when queuing to land.
Lower airspace	Airspace in the general vicinity of the airport containing arrival and departure routes below 7-8,000ft. Airports have the primary accountability for the design of this airspace, as its design and operation is largely dictated by local noise requirements, airport capacity and efficiency
NATS including NERL	The UK's licenced air traffic service provider for the en route airspace that connects our airports with each other, and with the airspace of neighbouring states (NERL). NATS is also the air navigation service provider at LCY, under commercial contract for the aerodrome control provision and via the London Licence for the approach control function.
Nautical Mile	Aviation measures distances in nautical miles. One nautical mile (nm) is 1,852 metres. One road mile ('statute mile') is 1,609 metres, making a nautical mile about 15% longer than a statute mile.
Network airspace	En route airspace above 7,000ft in which NATS NERL has accountability for safe and efficient air traffic services for aircraft travelling between the UK airports and the airspace of neighbouring states
nm	See Nautical Mile
PBN	See Performance Based Navigation
Performance Based Navigation (PBN)	Referred to as PBN; a generic term for modern standards for aircraft navigation capabilities including satellite navigation (as opposed to 'conventional' navigation standards).
Radar, radar blip, radar target, radar return	Generic terms covering how ATC 'sees' the air traffic in the vicinity. One type of radar (Primary) sends out radio pulses that are reflected back to the receiver (the 'return'), defining the target's position accurately and displaying a marker on the controller's screen ('blip' or 'target'). The other type (Secondary, often attached to the Primary and rotating at the same speed) sends out a request for information and receives coded numbers by return (see Transponder). These numbers are decoded and displayed on top of the Primary return, showing an accurate target with callsign identity and altitude.

RNAV	Short for aRea NAVigation. This is a generic term for a particular specification of Performance Based Navigation
RNAV1	See RNAV. The suffix '1' denotes a requirement that aircraft can navigate to with 1nm of the centreline of the route 95% or more of the time. In practice the accuracy is much greater than this.
RNP1+RF	Required Navigation Performance 1. An advanced navigation specification under the PBN umbrella. The suffix '1' denotes a requirement that aircraft can navigate to with 1nm of the centreline 95% or more of the time, with additional self-monitoring criteria. In practice the accuracy is much greater than this. The RF means Radius to Fix, where airspace designers can set extremely specific curved paths to a greater accuracy than RNAV1.
Route	Published routes that aircraft plan to follow. These have a nominal centreline that give an indication of where aircraft on the route would be expected to fly; however, aircraft will fly routes and route segments with varying degrees of accuracy based on a range of operational factors such as the weather, ATC intervention, and technical factors such as the PBN specification. RNAV1 routes and RNP1 routes are flown accurately.
Route system or route structure	The network of routes linking airports to one another and to the airspace of neighbouring states.
Separation	Aircraft under Air Traffic Control are kept apart by standard separation distances, as agreed by international safety standards. Participating aircraft are kept apart by at least 3nm or 5nm lateral separation (depending on the air traffic control operation), or 1,000ft vertical separation.
Sequence	The order of arrivals in a queue of airborne aircraft waiting to land
SID	See Standard Instrument Departure
Standard Arrival Route (STAR)	The published routes for arriving traffic. In today's system these bring aircraft from the route network to the holds (some distance from the airport at high levels), from where they follow ATC instructions (see Vector) rather than a published route. Under PBN it is possible to connect the STAR to the runway via a Transition.
Standard Instrument Departure	Usually abbreviated to SID; this is a route for departures to follow straight after take-off
STAR	See Standard Arrival Route
Statute mile	A standard mile as used in normal day to day situations (e.g. road signs) but not for air traffic where nautical miles are used
Stepped descent	A descent that is interrupted by periods of level flight required to keep the aircraft separated from another route in the airspace below

Systemisation	The process of reducing the need for human intervention in the air traffic control system, primarily by utilising improved navigation capabilities to develop a network of routes that are safely separated from one another so that aircraft are guaranteed to be kept apart without the need for air traffic control to intervene so often
Tactical methods	Air traffic control methods that involve controllers directing aircraft for specific reasons at that particular moment (see Vector)
Terminal airspace	An aviation term to describe a designated area of controlled airspace surrounding a major airport or cluster of airports where there is a high volume of traffic; a large part of the airspace above London and the South East is defined as terminal airspace (or Terminal Manoeuvring Area – TMA). This is the airspace that contains all the arrival and departure routes for Heathrow, Gatwick, Stansted, Luton and London City from around 2,000ft-3,000ft up to approximately 20,000ft.
Tonne, t	Metric Tonne (1,000kg)
Transition	The part of a PBN arrival route, defined to either RNAV1 or RNP1 standard, between the last part of the hold and the final approach path to the runway. Typically followed accurately in three dimensions by an aircraft's flight management system.
Transponder	An electronic device on board aircraft which sends out coded information which is picked up by radar and other systems. Most importantly the aircraft altitude, and identity code, by which the aircraft can be identified on the radar screen.
Uncontrolled Airspace	Generic term for the airspace in which no air traffic control service is provided as standard.
Unknown traffic	Aircraft not participating in ATC services. They may show on radar with altitude information (if they are operating with a Transponder) or in the worst case they will only show as a blip on the radar screen (a radar primary return) with no other information. If ATC sees a primary return on radar, they have to assume that it could be at the same altitude as any flight they are controlling, and hence the flight has to be tactically vectored to safely avoid it.
Vector, Vectoring, Vectored	An air traffic control method that involves directing aircraft off the established route structure or off their own navigation – ATC instruct the pilot to fly on a compass heading and at a specific altitude. In a busy tactical environment, these can change quickly. This is done for safety and for efficiency.
Westerly operation	When a runway is operating such that aircraft are taking off and landing in a westerly direction

13 Annexe: Additional Resources

The CAA Airspace Change Portal (**link**) for Stage 2 of this proposal contains the following material:

13.1.1 **Step 2A(i)** Design Options document

13.1.2 **Step 2A(ii)** Design Principle Evaluation document

13.1.3 **Step 2B** Options Appraisal (Phase 1 Initial) Including Safety Considerations

13.1.4 An **example presentation**, as given to stakeholders either by virtual online meeting, or via email for self-briefing

13.1.5 A document containing **stakeholder feedback** (redacted to de-personalise)

13.1.6 A **technical reference map**, with layers. This map allows for the switching on and off of 'data layers', allowing the user to see illustrations of the current airspace system, the systems LCY designed to engage with stakeholders, and the airspace designs modified following receipt of stakeholder feedback. These can be compared, to illustrate potential areas of change in overflight.

The map is technical in nature but on initial opening it provides an explanation of what the layers mean and how to understand them.

- This layered map is designed to be downloaded to a computer/laptop.
- It will not function correctly if viewed using most tablet/smartphone devices.
- It must be opened using the freely available and commonly-used Adobe Reader software, or other genuine Adobe product.
- It will not function correctly if viewed within a browser such as Chrome or Edge or Internet Explorer, or any non-Adobe PDF viewing application.
- It is relevant to the airspace design development thus far (May 2022). Future development and design evolution will occur.

End of document