Future Airspace Strategy Implementation (FASI)

London Terminal Manoeuvring Area (LTMA)

Airspace Change Proposal (ACP)
ACP-2020-043
ACP-2020-044
ACP-2020-045

Stage 2 Develop and Assess
London City Airport Arrivals Connectivity Module

To be read in conjunction with Master Document

NATS

1. Introduction

1.1 About this document

1.1.1 This document describes the arrival connectivity options for London City Airport, which have been developed using the methodology described in Section 2 of the Master document.

1.1.2 London City is the 5th busiest airport in the LTMA, located 6 miles east of the City of London, near the City's financial district Canary Wharf. It is a single-runway operation.

2. Baseline

2.1.1 This description of the current airspace around London City should be considered the 'Do Nothing' option if no airspace change was to take place.

2.1.2 Table 1 shows actual[1] airport traffic counts from the 2019 baseline traffic year to 2022. The NERL forecast for network traffic levels is shown in the Master document Section 3.9. Airport forecasts are independent of the network and will be included within airport ACPs.

Year	Arrivals	Departures	Total Movements
2019	42,363	42,077	**84,440**
2020	9,873	9,764	**19,637**
2021	7,286	7,240	**14,526**
2022	23,601	23,436	**47,037**

Table 1 Actual air traffic movements: London City Airport 2019-2022

2.1.3 London City has a number of arrival and departure procedures (STARs & SIDs) which connect with the network, as shown in Figure 1 and described in Table 2 & Table 3. London City's arrival procedures are also shared with Biggin Hill. All traffic is routed to a Point Merge structure to the east for arrival sequencing. Two holds, JACKO and GODLU, provide for delay absorption if required.

Airport	Hold	STARs	Associated ATS Routes
London City	JACKO	XAMAN 1C, SUMUM 1C, SILVA 1C, LISTO 1C, HON 1C	L608, Q63, L980, (U)Q4/Z197, UL612/L10
	GODLU	KATHY 1C, SAM 1C, SIRIC 1C, AVANT 1C, NEVIL 1C, SOVAT 1C, KONAN 1C	L980, L620, L89, P2, M189, L9, L613

Table 2 Current arrival connectivity for London City

2.1.4 London City has several SIDs which join with the ATS route network at designated waypoints[2] (Table 3).

Airport	SIDs	Associated ATS Routes
London City	BPK (1A/1H)	N57, N601
	SOQQA (1A/1H)	M87
	ODUKU (1A/1H)	M84
	SAXBI (1A/1H)	N27

Table 3 Current departure connectivity for London City

[1] This is based on CFMU actual data for 2019; this may vary from airport data.

[2] SIDs are all below 7,000ft and will be subject to Airport ACP. NERL will ensure network connectivity.

Figure 1 Current arrival and departure procedures for London City

2.1.5 Figure 2 shows a radar density plot of London City arrival traffic for a typical busy summer week and indicates traffic distribution. About 65% of traffic arrives from the east and southeast.

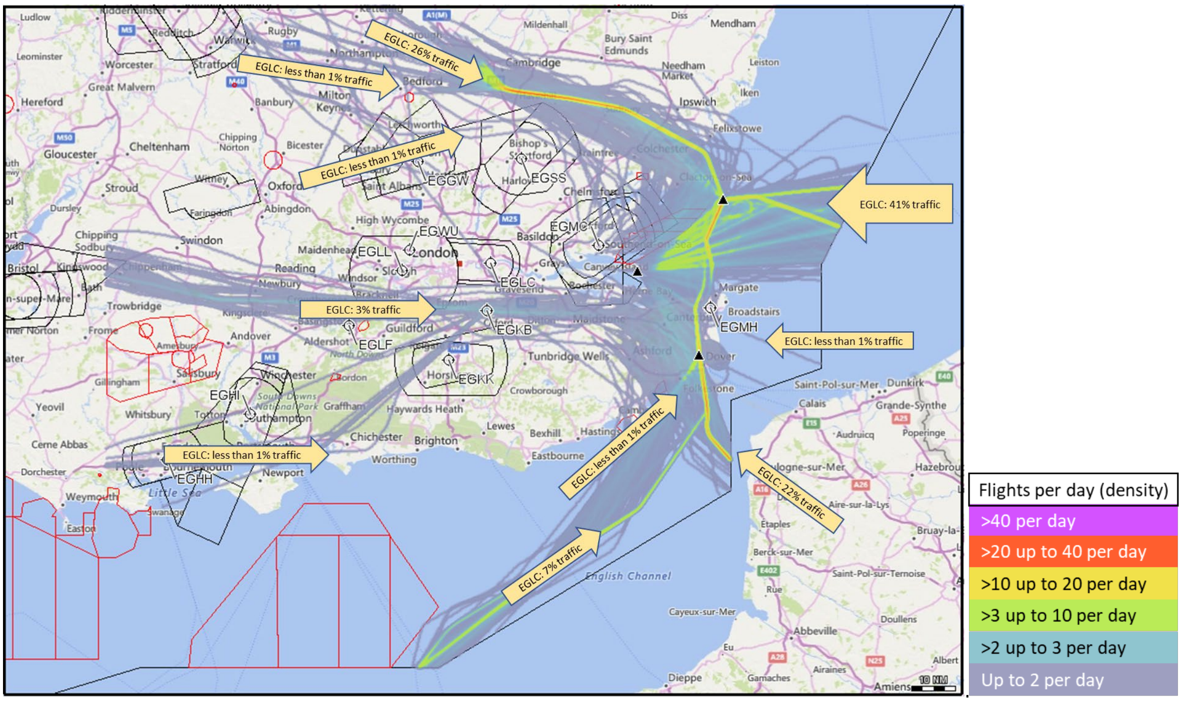


Figure 2 EGLC traffic density arrivals FL245-FL70 5-11 August 2019

2.1.6 Medium jets are the most prevalent aircraft type at London City, as shown in Table 4. British Airways (including their regional CityFlyer service) was the most prevalent operator in 2019, with approximately 49% of traffic.

London City – Aircraft Type		
Aircraft Group	Movements	% traffic
Small Jet	4,814	5%
Medium Jet	63,817	76%
Heavy Jet	-	-
Turboprop/Piston/Prop	15,809	19%

London City – Top 4 Aircraft Operator Usage		
Operator	Movements	% traffic
BA & CityFlyer	41,454	49%
Flybe[3]	8,647	10%
KLM	5,012	6%
Swiss	4,841	6%

Table 4 Aircraft type and top carriers - London City

3. Design Development

3.1.1 Working with the airport, NERL developed 13 high-level concept options for London City[4]. NERL has assessed that based on required traffic loading, London City would require at least one hold, either attached to an RMA or attached to a systemised arrival structure. Initial viability assessments were produced for location and structure type (Figure 3) and presented to stakeholders in formal engagement (Ref 7). Feedback was requested through the engagement response questionnaire.

Arrival Structure Viability Assessment									
Arrival Structure Type	Location								
	N	NE	E	SE	S	SW	W	NW	OH
Do nothing	✗	✗	✗	✗	✗	✗	✗	✗	✗
Optimised (inner) hold(s)	✗	✓	✓	✓	✗	✗	✗	✗	✗
Hold(s) further out	✗	✓	✓	✓	✗	✗	✗	✗	✗
Point merge	✗	✓	✓	✓	✗	✗	✗	✗	✗
Switch merge	✗	✗	✓	✗	✗	✗	✗	✗	✗
Trombone	✗	✓	✓	✓	✗	✗	✗	✗	✗

✓ Viable Option: taken forward to DPE

✗ Not considered a viable option: eliminated at this point

Figure 3 Engagement Initial Viability Matrix

3.2 Stakeholder engagement

3.2.1 We received 7 responses from 7 different stakeholders related to the London City design concepts. Table 5 presents a summary of the feedback and how this has influenced the design.

3.2.2 Feedback relating to capacity and efficiency of various design options has been used to inform the Design Principle Evaluation.

3.2.3 No new options were developed as a result of the stakeholder engagement, but engaged-upon options were removed due to SME development (see paragraph 3.3.3).

[3] Flybe went into administration in March 2020, and again in January 2023.

[4] See Master document Section 2.2 for a detailed description of this work.

Stakeholder	Feedback ('You said')	Response ('We did')
Airspace4All	Major airports requiring flow management would benefit from PBN approaches and systemised approach structures.	Feedback was used to inform the evaluation of DP1, DP2, DP3 & DP8. The traffic demand is considered when making these assessments so the impact on individual airports is considered.
Biggin Hill	Full engagement is required.	NERL has worked collaboratively with all FASI sponsors throughout the process, including Biggin Hill, and will continue to do so going forward.
British Airways	Considering the number of movements at London City, this must be deprioritized to facilitate Heathrow and Gatwick efficiencies.	At this stage, no airport will be prioritised over another, as we strive for a balanced network-wide design. Stage 3 development will identify prioritisation needs.
BGA	Solutions appear to sensibly suggest the use of airspace over the sea would suit this airport.	We used this feedback to inform our evaluation of DP5 and DP6.
London City Airport	A shared facility could limit capacity, in which case London City would not be supportive of this approach. Require shorter arrivals route from the north for environmental benefits.	NERL will consider this feedback along with operational constraints and forecast traffic to determine the proportionate arrival structure from a specific airport, or groups of airports. NERL is aware of London City's aspiration for a short route from the north to minimise carbon. Arrival structures from the northeast are included in the long list of options and will be considered at our DPE stage. This feedback will be used for the evaluation of DP3.
Luton Airport	Supports the design area to the east of the UK and London. Concerns the envelope is close to Luton's lower-level design options near BPK. A hold in this area could restrict Luton's departure climbs.	It is reasonable in Stage 2 to continue development where design envelopes overlap (see Master document, paragraph 2.2.11). The appropriate deconfliction or colocation of routes will be considered at Stage 3.
Southend Airport	Currently a lot of interaction between London City and Southend. If London City arrival structure is via Southend overhead this could conflict with Southend traffic.	It is reasonable in Stage 2 to continue development where design envelopes overlap (see Master document, paragraph 2.2.11). The appropriate deconfliction or colocation of routes will be considered at Stage 3.

Table 5 Engagement feedback and NERL response

3.3 London City Design Concepts

3.3.1 Table 6 summarises the high-level qualitative considerations for potential locations for London City arrival structures, and Table 7 summarises the viability assessment for the arrival structures suitable for London City. These have been developed from SME input and stakeholder engagement.

3.3.2 Not every arrival structure concept may be viable in every location; the Viability Matrix (Figure 5) illustrates the possible combinations.

3.3.3 As described in the Master document paras 2.4.2 & 2.4.3, the concepts Holds Further Out and Trombones were removed as viable concepts at this stage. A detailed description of each structure can be found in Section 5 Appendix 1.

Location		Viability Considerations
North	✗	An arrival structure, and associated connectivity, to the north of the airfield would likely conflict with Heathrow, Luton, Northolt and Stansted traffic.
Northeast	✓	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the northeast of the airfield, subject to deconfliction with Heathrow, Luton, Southend and Stansted traffic and the Shoeburyness DA Complex.
East	✓	An arrival structure to the east of the airfield is already in place within the current design, albeit shared with another sponsor. A structure in this area remains possible, subject to deconfliction with Heathrow, Biggin Hill and Southend traffic and the Shoeburyness DA Complex.
Southeast	✓	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the southeast of the airfield, subject to deconfliction with Biggin Hill, Gatwick, Heathrow and Southend traffic.
South	✗	An arrival structure, and associated connectivity, to the south of the airfield would likely conflict with LTMA traffic.
Southwest	✗	An arrival structure, and associated connectivity, to the southwest of the airfield would likely conflict with Gatwick traffic.
West	✗	An arrival structure, and associated connectivity, to the west of the airfield would likely conflict with Heathrow traffic.
Northwest	✗	An arrival structure, and associated connectivity, to the northwest of the airfield would likely conflict with Heathrow traffic.
Overhead	✗	An arrival structure, and associated connectivity, overhead the airfield would likely conflict with Heathrow traffic.

Table 6 London City Arrivals: Location viability considerations – post engagement

Structure		Viability Considerations
Optimised (inner) holds	✓	There is sufficient airspace for optimised hold(s), and this would likely meet the runway throughput demands.
Point Merge	✓	Optimisation of current day structure. There is sufficient airspace to suitably place a Point Merge. Based on traffic throughput, this may need to be a shared facility.
Switch Merge	✗	There is insufficient airspace to suitably place a Switch Merge.

Table 7 London City Arrival structures: Viability considerations – post engagement

3.3.4 Figure 4 shows the London City design envelope, developed by SMEs through collaborative workshops and formal engagement with London City and other stakeholders. This design envelope is based on the viability considerations presented above in paragraph 3.3.1, Table 6 & Table 7, developed through two-way engagement as shown in Table 5.

3.3.5 Airspace design constraints, as described in the Master document Section 3.5, are highlighted in orange. A consideration for London City is the Shoeburyness Danger Area as shown.

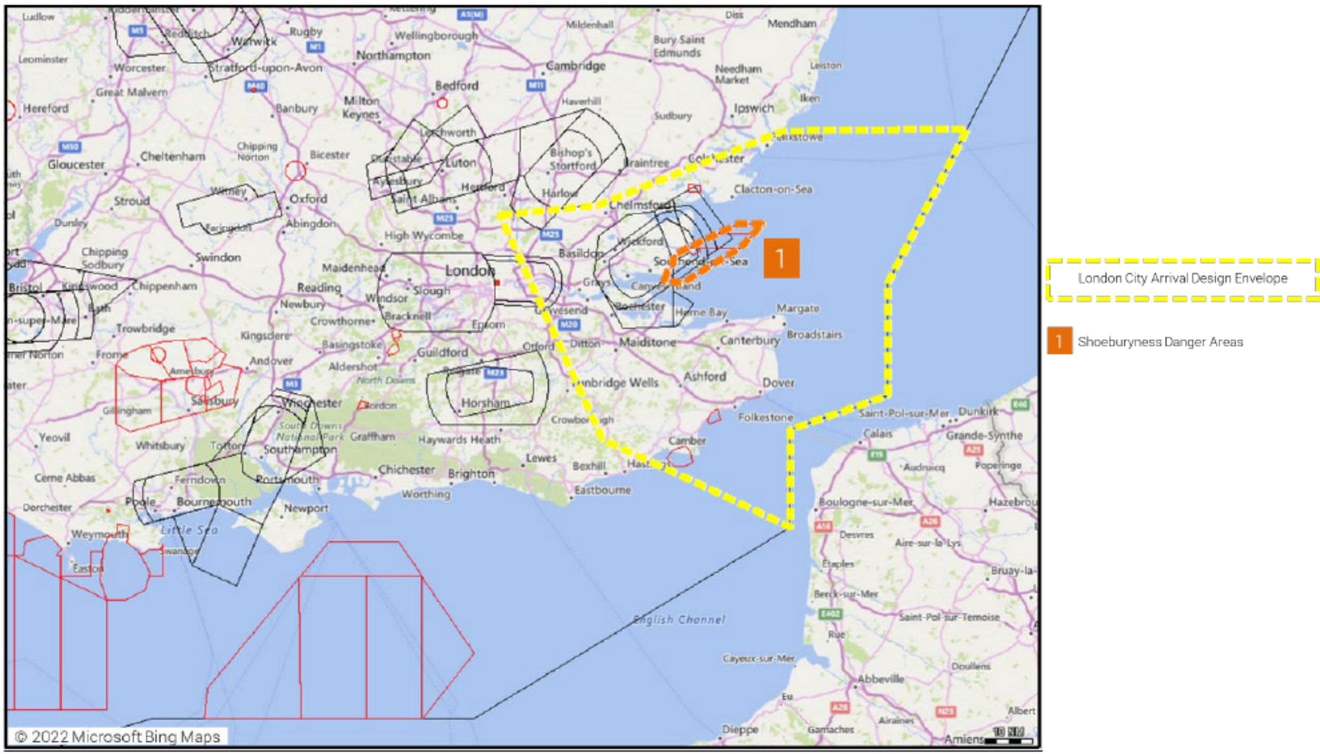


Figure 4 London City Design Envelope and design constraints – post engagement

3.3.6 The London City Design Concepts which were considered viable at this stage, within the Design Envelope presented, are shown in the Viability Assessment below (Figure 5).

Arrival Structure Viability Assessment									
Arrival Structure Type	Location								
	N	NE	E	SE	S	SW	W	NW	OH
Do nothing	✗	✗	✗	✗	✗	✗	✗	✗	✗
Optimised (inner) hold(s)	✗	✓	✓	✓	✗	✗	✗	✗	✗
Point merge	✗	✓	✓	✓	✗	✗	✗	✗	✗
Switch merge	✗	✗	✗	✗	✗	✗	✗	✗	✗

✓ Viable Option: taken forward to DPE

✗ Not considered a viable option: eliminated at this point

Figure 5 London City Design Options Comprehensive Viability Matrix

3.3.7 These 6 viable options were taken forward as the comprehensive list to Design Principle Evaluation, along with 'Do Nothing'.

3.4 Design Principle Evaluation

3.4.1 Table 8 shows the DPE assessment criteria. SMEs, in this case air traffic control experts and airspace change experts, list topics associated with each DP and qualitatively test how each option would react to those topics, describing how a red/amber/green outcome is reached.

DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
0	A AMS	**Safety** Safety is always the highest priority (Note: Red could not be solved by mitigation, amber may be able to be solved by mitigation).	Human performance (ATCO control-ability) Human performance (pilot fly-ability) IFP (fly-ability) Surrounding airspace users (inside/outside of CAS) Impact if ATM tools fail	Unacceptable level of safety risk	Diminished - Issue(s) identified could result in an elevated level of safety risk when compared to today's operation	Enhanced - improvement over today's level of safety. Maintained - safety risk could be maintained within acceptable levels of today's operation
1	B AMS	**Operational** The airspace will enable increased operational resilience	<u>Network</u> Weather avoidance Disruption in neighbouring ANSPs	Reduced resilience and capacity during disruption	Similar resilience and capacity during disruption	Increased resilience and capacity during disruption
			<u>Airport</u> Holding levels Delay absorption between hold and 7,000ft	Reduction in delay absorption	Delay absorption similar to today	Improve delay absorption
			<u>Airport</u> Time to restart after runway closure Number of aircraft off the hold	Reduction in disruption recovery	Disruption recovery similar to today	Improve disruption recovery
2	B	**Economic** Optimise network fuel performance	Track mileage Economic performance Aircraft height Method of delay absorption	Fuel performance worsened	Fuel performance similar to today	Fuel performance improved
3	B AMS	**Environmental** Optimise CO_2 emissions per flight	Track mileage GHG performance Aircraft height Method of delay absorption	CO_2 emissions worsened	CO_2 emissions similar to today	CO_2 emissions improved

DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
4	C	**Environmental** Minimising of noise impacts due to LAMP influence will take place in accordance with local needs	Overall environmental impact Environmental impact below 7,000ft Impact on tranquillity (or visual intrusion)	LAMP influence not aligned with local ACP sponsors' needs	Extent of alignment not yet known	LAMP influence fully aligned with local ACP sponsors' needs
5	C	**Technical** The volume of controlled airspace required for LAMP should be the minimum necessary to deliver an efficient airspace design, taking into account the needs of the UK airspace users	Lateral footprint of CAS Vertical footprint of CAS Proportional to airport traffic levels	Airspace required not the minimum necessary to deliver an efficient design	Extent of airspace required not yet known	Airspace required the minimum necessary to deliver an efficient design
6	C AMS	**Technical** The impacts on GA and other civilian airspace users due to LAMP will be minimised	Change to boundaries of CAS Changes to CAS classification Safety based impacts	Excessive negative impacts	Negative impacts minimised but requires changes to other airspace users' activities	Negative impacts minimised, no impact, or positive impacts to other airspace users' current activities
7	C AMS	**Technical** The impacts on MoD users due to LAMP will be minimised	Overall amount of danger area available Amount of time for danger area available Flexible use airspace provision Change to access between danger areas Safety based impacts Radar corridor access	Negative impacts not minimised or would require excessive changes to current MoD operations	Negative impacts minimised but requires changes to current MoD operations Or Extent of impact not yet known	Negative impacts minimised or no negative impact on current MoD operations
8	B AMS	**Operational** Systemisation will deliver the optimal capacity and efficiency benefits (Note: This is about airspace capacity, not ground infrastructure capacity which could be the limiting factor to overall airport capacity).	Traffic throughput Sectorisation Effect on overall network capacity Effect on airports' arrival flow	Design option unable to support the forecast traffic loading for the airport and the network	Design option supports the forecast traffic loading for the airport or the network	Design option supports the forecast traffic loading beyond the reference period for both the airport and the network
			Overall ATCO workload Levels of tactical intervention (radio transmissions per flight) No increase to operations requirements Balancing out of hot spots	Design option increases ATCO workload	ATCO workload similar to today	Design option decreases ATCO workload

DP	Priority	Description	SME subjective assessment topics, include but not limited to	Red	Amber	Green
9	B	**Technical** The main route network linking airport procedures with the En Route phase of flight will be spaced to yield maximum safety and efficiency benefits by using an appropriate standard of PBN (Note: The main route network is considered as FL70 - FL245. Approach structures are not considered as 'the main route network').	Airspace requirement vs. RNAV rating Required aircraft equipage standards	PBN standard applied to route spacing would maintain or decrease efficiency and maintain safety	PBN standard applied to route spacing would limit efficiency and safety benefits	PBN standard applied to route spacing is likely to maximise efficiency and safety benefits
10	A	**Policy** Must accord with the CAA's published Airspace Modernisation Strategy (CAP1711) and any current or future plans associated with it.	AMS "Ends" Strategic Objectives Safety (DP0) Integration of diverse users (DP6 and DP7) Simplification (DP1 and DP8) Environmental sustainability (DP3)	No or limited alignment with the AMS	Partial alignment with the AMS	Aligned with the AMS

Table 8 Design Principle Evaluation Assessment Criteria

3.4.2 Table 9 shows the AMS assessment criteria which are used to determine the overall RAG status for DP10.

DP10 outcome	Criteria for DP0, DP1, DP3, DP6, DP7, and DP8
Red	DP0 (Safety) is red OR 2 other DPs are red
Amber	All other colour combinations not covered by Red or Green
Green	2 DPs are green and 0 are red OR 3 DPs are green and 1 is red

Table 9 - AMS Assessment Criteria

3.4.3 The criteria in Table 10 describe how each option's overall combination of reds/ambers/greens lead to the option progressing to the next step or to rejection and discounting from further development.

DP Priority	Criteria for Rejection Status
A	1 red OR 1 amber
B	2 reds
C	2 reds

Table 10 - Accept / Reject Criteria

3.4.4 Each design option has been assessed against the Design Principles. The following code is used for each design option. Airport (e.g. LC) - Structure Type (e.g. Inner Hold: IH/Point Merge: PM) - Location (e.g. Northeast: NE). DN = Do Nothing. DM = Do Minimum.

DP	Priority	LC - DN (Shared)	LC - IH - NE	LC - IH - E
RESULT		REJECT	ACCEPT	ACCEPT
DP0 Safety	A AMS	Maintained: Similar operation to today	Maintained: Holds are used elsewhere in current day operations and are known to be safe	Maintained: Holds are used elsewhere in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Today's operation, no change from baseline	Would maintain a similar number of holding levels, therefore similar level of delay absorption	Would maintain a similar number of holding levels, therefore similar level of delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Today's operation, no change from baseline	Holds closer to the runway allow a quicker recovery following disruption	Holds closer to the runway allow a quicker recovery following disruption
DP2 Economic (Fuel)	B	Today's operation, no change from baseline	Improved fuel performance due to aircraft having reduced track miles by not operating today's PM structure	Improved fuel performance due to aircraft having reduced track miles by not operating today's PM structure
DP3 Environmental (CO_2)	B AMS	Today's operation, no change from baseline	CO_2 emissions per flight improved due to aircraft having reduced track miles by not operating today's PM structure	CO_2 emissions per flight improved due to aircraft having reduced track miles by not operating today's PM structure
DP4 Environmental (Noise)	C	Today's operation, no change from baseline	Impact on routes (and noise distribution) below 7,000ft not known at this point	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Today's operation, no change from baseline	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Today's operation, no change from baseline	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	Operation is known not to impact MoD currently, therefore no change in impact	No military-use areas in the vicinity, therefore, would not require a change to MoD operations	Assumes design would not impact Shoeburyness DA Complex. Therefore, no impact on current MoD operations
DP8 Operational (Capacity)	B AMS	Aligns with network traffic flows. As a shared facility would support airport arrival loading for Biggin Hill or London City. not both	Supports the required airport arrival loading, however, negatively impacts capacity of eastbound network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity of eastbound network traffic flows
DP8 Operational (Efficiency)	B AMS	Today's operation, no change in ATCO workload anticipated	An independent facility could reduce Approach ATCO workload. A hold structure may be less systemised than baseline and increase TMA ATCO workload. Net neutral	An independent facility could reduce Approach ATCO workload. A hold structure may be less systemised than baseline and increase TMA ATCO workload. Net neutral
DP9 Technical (Route Spacing)	B AMS	Does not fully utilise the performance capabilities of modern aircraft	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes
DP10 Policy (AMS)	A	Green: DP0, DP7 Amber: DP1, DP1, DP3, DP6, DP8, DP8 Red: DP9	Green: DP0, DP1, DP3, DP7, DP9 Amber: DP1, DP6, DP8, DP8 Red: None	Green: DP0, DP1, DP3, DP7, DP9 Amber: DP1, DP6, DP8, DP8 Red: None

DP	Priority	LC - IH - SE	LC - PM - NE (Maybe shared)	LC - PM - E (DM) (Maybe shared)
RESULT		ACCEPT	ACCEPT	ACCEPT
DP0 Safety	A AMS	Maintained: Holds are used elsewhere in current day operations and are known to be safe	Maintained: PM are used in current day operations and are known to be safe	Maintained: PM are used in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Would maintain a similar number of holding levels, therefore similar level of delay absorption	Optimised PM and associated holds would provide increased levels of delay absorption	Optimised PM and associated holds would provide increased levels of delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Holds closer to the runway allow a quicker recovery following disruption	Assumed contingency hold within the transition, net disruption recovery similar to today	Assumed contingency hold within the transition, net disruption recovery similar to today
DP2 Economic (Fuel)	B	Improved fuel performance due to aircraft having reduced track miles by not operating today's PM structure	Improved fuel performance as it is assumed the PM levels will be optimised and aligns with airport traffic flows	Optimised concept aligned with airport traffic flows, therefore improved fuel performance
DP3 Environmental (CO_2)	B AMS	CO_2 emissions per flight improved due to aircraft having reduced track miles by not operating today's PM structure	CO_2 emissions per flight improved as it is assumed the PM levels will be optimised and aligns with airport traffic flows	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved
DP4 Environmental (Noise)	C	Impact on routes (and noise distribution) below 7,000ft not known at this point	Impact on routes (and noise distribution) below 7,000ft not known at this point	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	No military-use areas in the vicinity, therefore, would not require a change to MoD operations	No military-use areas in the vicinity, therefore, would not require a change to MoD operations	Assumes design would not impact Shoeburyness DA Complex. Therefore, no negative impact on current MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of eastbound network traffic flows	Aligns with network traffic flows and concept can support the airport required arrival loading	Aligns with network traffic flows and concept can support the airport required arrival loading
DP8 Operational (Efficiency)	B AMS	Current day is systemised, a hold structure could be less systemised. May increase complexity southeast of London City	Similar concept to today's operation, therefore no change in ATCO workload anticipated	Similar concept to today's operation, therefore no change in ATCO workload anticipated
DP9 Technical (Route Spacing)	B AMS	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes
DP10 Policy (AMS)	A	Green: DP0, DP1, DP3, DP7, DP9 Amber: DP1, DP6, DP8 Red: DP8	Green: DP0, DP1, DP3, DP7, DP8, DP9 Amber: DP1, DP6, DP8 Red: None	Green: DP0, DP1, DP3, DP7, DP8, DP9 Amber: DP1, DP6, DP8 Red: None

DP	Priority	LC - PM - SE (Maybe shared)
RESULT		REJECT
DP0 Safety	A AMS	Maintained: PM are used in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Optimised PM and associated holds would provide increased levels of delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Assumed contingency hold within the transition, net disruption recovery similar to today
DP2 Economic (Fuel)	B	Optimised concept, not aligned with airport traffic flows, therefore fuel performance worsened
DP3 Environmental (CO_2)	B AMS	Optimised concept, not aligned with airport traffic flows, therefore CO_2 emissions worsened
DP4 Environmental (Noise)	C	Impact on routes (and noise distribution) below 7,000ft not known at this point
DP5 Technical (CAS)	C	Design likely to be within current day CAS; ability to return CAS will be assessed in Stage 3
DP6 Technical (Other Users)	C AMS	Likely to be in current day CAS, no anticipated change in impacts
DP7 Technical (MoD)	C AMS	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Supports the required airport arrival loading, however, negatively impacts capacity of eastbound network traffic flows
DP8 Operational (Efficiency)	B AMS	Similar concept to today's operation but could increase complexity SE of EGLC. Overall, may increase ATCO workload
DP9 Technical (Route Spacing)	B AMS	Structure will be designed, in collaboration with the airport, to the highest appropriate PBN standard enabling efficient spacing between routes
DP10 Policy (AMS)	A	Green: DP0, DP1, DP7, DP9 Amber: DP1, DP6, DP8 Red: DP3, DP8

Table 11 Design Principle Evaluation

3.4.5 'Do Nothing' and 1 design option were assessed as not meeting the DPs and were rejected at this stage. The remaining 5 viable design options progress to Step 2B Options Appraisal.

3.5 Initial Options Appraisal

3.5.1 The following viable options have been progressed to IOA:

London City Option Concepts progressed to IOA
Inner Holds – Northeast
Inner Holds – East
Inner Holds – Southeast
Point Merge – Northeast (Maybe shared)
Point Merge – East (DM) (Maybe shared)

Table 12 Summary of design options progressed from DPE to IOA

Table 13 shows the assessment criteria used to complete the initial appraisal of each shortlisted option.

Group	Impact
Communities	Noise impact on health and quality of life
A qualitative assessment of changes to noise impacts compared with the 'Do Nothing' baseline. A qualitative assessment of changes to tranquillity impacts compared with the 'Do Nothing' baseline.	
Communities	Air Quality
A qualitative assessment of changes to local air quality compared with the 'Do Nothing' baseline.	
Wider Society	Greenhouse Gas Impacts
A qualitative assessment of changes to greenhouse gas impacts compared with the 'Do Nothing' baseline.	
Wider Society	Capacity / Resilience
A qualitative assessment of changes to airspace capacity and resilience compared with the 'Do Nothing' baseline.	
General Aviation (GA)	Access
A qualitative assessment of changes to GA access compared with the 'Do Nothing' baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
A qualitative assessment of changes to GA and commercial operator economic impacts from increased effective capacity compared with the 'Do Nothing' baseline.	
GA/Commercial Airlines	Fuel Burn
A qualitative assessment of changes to GA and commercial operator fuel burn impacts compared with the 'Do Nothing' baseline.	
Commercial Airlines	Training Costs
A qualitative assessment of changes to commercial operator training costs compared with the 'Do Nothing' baseline.	
Commercial Airlines	Other Costs
A qualitative assessment of changes to other relevant commercial operator costs compared with the 'Do Nothing' baseline.	
Airport / ANSP	Infrastructure Costs
A qualitative assessment of changes to airport and ANSP infrastructure costs compared with the 'Do Nothing' baseline.	
Airport / ANSP	Operational Costs
A qualitative assessment of changes to airport and ANSP operational costs compared with the 'Do Nothing' baseline.	
Airport / ANSP	Deployment Costs
A qualitative assessment of changes to airport and ANSP deployment costs compared with the 'Do Nothing' baseline.	
All	Performance against the vision and parameters/strategic objectives of the AMS
A qualitative assessment of how the design option performs, considering the AMS objectives of improved capacity, reduced CO_2, minimal impact on other users, maintaining or enhancing safety, and facilitation of defence and security objectives, compared with the 'Do Nothing' baseline.	

Table 13 Table 13 Initial Options Appraisal Assessment Criteria.

3.5.2 The baseline 'Do Nothing' is described in Section 2. It did not progress through the DPE however, in line with CAP1616, it must be included in the IOA for comparison purposes. Each option is described in Section 3.3 and Section 5 Appendix 1.

LC – DN (Shared) Qualitative Initial Impacts Assessment	REJECTED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. No change in airspace design – no changes to impacts.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". No change in airspace design – no changes to impacts.	
Wider Society	Greenhouse Gas Impacts
In the short term, there would be no change. In the long term, failure to modernise the airspace would have a negative impact on GHG emissions due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase.	
Wider Society	Capacity / Resilience
In the short term, there would be no change. In the long term, failure to modernise the airspace would have a negative impact on capacity and resilience due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase.	
General Aviation (GA)	Access
In the short term, there would be no change in impact. In the long term, failure to modernise the airspace would lead to increased likelihood of commercial aircraft delays and holding in an unchanged design as traffic is forecast to increase. This may lead to negative impacts on GA access due to the busier airspace, however as GA access is currently relatively infrequent at network levels, this may not be a major impact.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
In the short term, there would be no change in impact. In the long term, failure to modernise the airspace would have a negative impact on capacity due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase. This would lead to a negative economic impact.	
GA/Commercial Airlines	Fuel Burn
In the short term, there would be no change in impact. In the long term, failure to modernise the airspace would have a negative impact on fuel burn due to increased likelihood of delays/holding in an unchanged design as traffic is forecast to increase.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. If this baseline system was retained, the same flight procedures would be used, and training cost impacts would not change.	
Commercial Airlines	Other Costs
No change in airspace design – no changes to other commercial operator costs.	
Airport / ANSP	Infrastructure Costs
No change in airspace design – no changes to infrastructure costs. If this baseline system was retained, the same infrastructure would continue to be used in the same way, with no additional costs.	
Airport / ANSP	Operational Costs
No change in airspace design – no changes to infrastructure costs. If this baseline system was retained, the same infrastructure would continue to be used in the same way, with no additional operational costs.	
Airport / ANSP	Deployment Costs
If this baseline system was retained, there would be no deployment, hence no associated costs.	
AMS	Performance against the vision and parameters/strategic objectives of the AMS
• Safety: maintained • Simplification: worsens delay absorption, disruption recovery, airport capacity, network capacity and ATCO workload. Does not utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA • Environmental sustainability: worsens CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that if the baseline system was retained, the existing level of safety performance undertaken within the current operation would be at least maintained. However, if there was no change to the current operation the potential increase in traffic as forecast would increase controller workload and traffic complexity within the LTMA leading to potential safety issues in the future. In order to mitigate any reduction in safety margins it is likely that increased flow management measures would be required, resulting in additional delay.	
Conclusion from IOA	
This option was rejected during the DPE stage. It has been included for comparison purposes only.	

Table 14 LC-DN Initial Options Appraisal

<table>
<tr><th>LC - IH - NE Qualitative Initial Impacts Assessment</th><th>PROGRESSED</th></tr>
<tr><th>Group</th><th>Impact</th></tr>
<tr><td>Communities</td><td>Noise impact on health and quality of life</td></tr>
<tr><td colspan="2">ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.</td></tr>
<tr><td>Communities</td><td>Air Quality</td></tr>
<tr><td colspan="2">ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.</td></tr>
<tr><td>Wider Society</td><td>Greenhouse Gas Impacts</td></tr>
<tr><td colspan="2">This design option could provide shorter arrival routes compared with today's PM structure. An independent arrival structure could reduce the likelihood of delays due to no longer sharing a facility with Biggin Hill's arrival traffic. This could reduce GHG emissions for each flight compared with the baseline.</td></tr>
<tr><td>Wider Society</td><td>Capacity / Resilience</td></tr>
<tr><td colspan="2">Capacity: An independent arrival structure could enable increased airport capacity due to no longer sharing a facility with Biggin Hill's arrival traffic. Also, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. However, this location does not align with network traffic flows. Therefore, this option could improve airport capacity but worsen network capacity compared with the baseline.
Resilience: An independent arrival structure could remove the negative impact of an unplanned runway closure at Biggin Hill on London City. A hold closer to the runway could also allow a quicker recovery following disruption than the baseline. Furthermore, this option could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.</td></tr>
<tr><td>General Aviation (GA)</td><td>Access</td></tr>
<tr><td colspan="2">A holding facility to the northeast would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.</td></tr>
<tr><td>GA/Commercial Airlines</td><td>Economic Impact from Increased Effective Capacity</td></tr>
<tr><td colspan="2">This option could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at London City.
An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.</td></tr>
<tr><td>GA/Commercial Airlines</td><td>Fuel Burn</td></tr>
<tr><td colspan="2">This design option could provide shorter arrival routes compared with today's PM structure. An independent arrival structure could reduce the likelihood of delays due to no longer sharing a facility with Biggin Hill's arrival traffic. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic.
An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.</td></tr>
<tr><td>Commercial Airlines</td><td>Training Costs</td></tr>
<tr><td colspan="2">Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.</td></tr>
<tr><td>Commercial Airlines</td><td>Other Costs</td></tr>
<tr><td colspan="2">No other operator costs are foreseen.</td></tr>
<tr><td>Airport / ANSP</td><td>Infrastructure Costs</td></tr>
<tr><td colspan="2">This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.</td></tr>
<tr><td>Airport / ANSP</td><td>Operational Costs</td></tr>
<tr><td colspan="2">This design option is not expected to change airport or ANSP operational cost impacts.</td></tr>
<tr><td>Airport / ANSP</td><td>Deployment Costs</td></tr>
<tr><td colspan="2">At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.</td></tr>
</table>

AMS	Performance against the vision and parameters/strategic objectives of the AMS
	- Safety: maintained - Simplification: could improve disruption recovery and enables airport capacity, maintain delay absorption and maintain ATCO workload. Will utilise aircraft performance capabilities. Worsens network capacity. - Integration of diverse users: continues to integrate defence and security and GA, subject to constraints on the design - Environmental sustainability: could reduce CO_2 emissions. Could result in network inefficiencies
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that Inner Hold to the northeast would at least maintain current safety performance. There are multiple holds within current UK airspace which have a proven safety performance. An arrival structure in this location would need to deconflict with Heathrow arrivals, Luton departures and all Southend and Stansted traffic.	
Conclusion from IOA	
Compared to the baseline, this option could improve disruption recovery, fuel burn, CO_2 emissions, and enable airport capacity. It would maintain safety and maintain any current MoD access. However, the negative impact on transiting GA traffic and network capacity may be worse than the baseline. **Therefore, LC – IH – NE is progressed to Stage 3 for further development.**	

Table 15 LC-IH-NE Initial Options Appraisal

LC - IH - E Qualitative Initial Impacts Assessment	PROGRESSED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.	
Wider Society	Greenhouse Gas Impacts
This design option could provide shorter arrival routes compared with today's PM structure. An independent arrival structure could reduce the likelihood of delays due to no longer sharing a facility with Biggin Hill's arrival traffic. These could reduce GHG emissions for each flight compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: An independent arrival structure could enable increased airport capacity due to no longer sharing a facility with Biggin Hill's arrival traffic. Also, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. However, this location does not align with network traffic flows. Therefore, this option could improve airport capacity but worsen network capacity compared with the baseline. Resilience: An independent arrival structure could remove the negative impact of an unplanned runway closure at Biggin Hill on London City. A hold closer to the runway could also allow a quicker recovery following disruption than the baseline. Furthermore, this option could maintain a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
An independent arrival facility to the east would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
This option could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at London City. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
This design option could provide shorter arrival routes compared with today's PM structure. An independent arrival structure could reduce the likelihood of delays due to no longer sharing a facility with Biggin Hill's arrival traffic. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen.	
Airport / ANSP	Infrastructure Costs
This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
Airport / ANSP	Operational Costs
This design option is not expected to change airport or ANSP operational cost impacts.	
Airport / ANSP	Deployment Costs
At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	

AMS	Performance against the vision and parameters/strategic objectives of the AMS
- Safety: maintained - Simplification: could improve disruption recovery and enables airport capacity, maintain delay absorption and maintain ATCO workload. Will utilise aircraft performance capabilities. Could worsen network capacity. - Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design - Environmental sustainability: could reduce CO_2 emissions. Could result in network inefficiencies	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that Inner Hold to the east would at least maintain current safety performance. There are multiple holds within current UK airspace which have a proven safety performance. An arrival structure in this location would need to deconflict with Heathrow arrivals and all Biggin Hill and Southend traffic.	
Conclusion from IOA	
Compared to the baseline, this option could improve disruption recovery, fuel burn, CO_2 emissions, and enable airport capacity. It would maintain safety and any current MoD access. However, the negative impact on transiting GA traffic and network capacity may be worse than the baseline. **Therefore, LC – IH – E is progressed to Stage 3 for further development.**	

Table 16 LC-IH-E Initial Options Appraisal

LC - IH - SE Qualitative Initial Impacts Assessment	PROGRESSED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.	
Wider Society	Greenhouse Gas Impacts
This design option would provide shorter arrival routes compared with today's PM structure. An independent arrival structure would reduce the likelihood of delays due to no longer sharing a facility with Biggin Hill's arrival traffic. These could reduce GHG emissions for each flight compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: An independent arrival structure could enable increased airport capacity due to no longer sharing a facility with Biggin Hill's arrival traffic. Also, as traffic levels increase, this capacity improvement could reduce the frequency of delays/holding compared with the baseline. However, this location does not align with network traffic flows. Overall, this option could improve airport capacity but worsen network capacity, compared with the baseline. Resilience: An independent arrival structure could remove the negative impact of an unplanned runway closure at Biggin Hill on London City. A hold closer to the runway could also allow a quicker recovery following disruption than the baseline. Furthermore, this option could maintain a similar number of holding levels, therefore could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
An independent arrival facility to the southeast would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
This option could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at London City. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
This design option could provide shorter arrival routes compared with today's PM structure. An independent arrival structure could reduce the likelihood of delays due to no longer sharing a facility with Biggin Hill's arrival traffic. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen.	
Airport / ANSP	Infrastructure Costs
This design option is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
Airport / ANSP	Operational Costs
This design option is not expected to change airport or ANSP operational cost impacts.	
Airport / ANSP	Deployment Costs
At this stage it is disproportionate to attempt to quantify deployment costs per design option. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	

AMS	Performance against the vision and parameters/strategic objectives of the AMS
	• Safety: maintained • Simplification: could improve disruption recovery and enables airport capacity, maintain delay absorption. Could worsen ATCO workload and network capacity. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints to the design • Environmental sustainability: could reduce CO_2 emissions. Could result in network inefficiencies
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that Inner Holds to the southeast would at least maintain current safety performance. There are multiple holds within current UK airspace which have a proven safety performance. Controller workload could increase over the baseline option, which is a systemised structure. An arrival structure in this location would need to deconflict with Biggin Hill, Gatwick, Heathrow, and Southend traffic.	
Conclusion from IOA	
Compared to the baseline, this option could improve disruption recovery, fuel burn, CO_2 emissions, and enable airport capacity. It would maintain safety and any current MoD access. However, the negative impact on transiting GA traffic, network capacity, and ATCO workload, may be worse than the baseline. **Therefore, LC – IH – SE is progressed to Stage 3 for further development.**	

Table 17 LC-IH-SE Initial Options Appraisal

LC - PM – NE (Maybe shared) Qualitative Initial Impacts Assessment	PROGRESSED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.	
Wider Society	Greenhouse Gas Impacts
As either an independent or shared facility, an optimised PM structure could reduce GHG emissions compared to the baseline. However, this location is partially aligned with airport traffic flows. Overall, it could maintain GHG emissions for each flight compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: If the PM is a shared facility, there could be no change to airport capacity. However, if this is an independent facility, there could be an increase compared with the baseline. This location aligns with network traffic flows so could maintain network capacity. Resilience: An independent arrival structure could remove the negative impact of an unplanned runway closure at Biggin Hill on London City. As either an independent or shared facility, disruption recovery could be similar to the baseline, with a contingency hold[5] utilised in the event of unplanned runway closure. This option could provide a greater number of holding levels, therefore could improve delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, an arrival facility to the northeast would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
A shared facility could have no short-term change in impact. In the long term, a shared facility may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. No impact on GA is expected. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at London City. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
An optimised shared PM structure could reduce fuel burn compared to the baseline. However, this location is partially aligned with airport traffic flows. It could maintain fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
Airport / ANSP	Operational Costs
This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	

[5] The positioning and altitude of this contingency hold would be the subject of collaborative work with the airport in Stage 3.

Airport / ANSP	Deployment Costs
At this stage it is disproportionate to attempt to quantify deployment costs per design option, either an independent or shared. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	
AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • Safety: maintained • Simplification: could improve delay absorption and enables airport capacity, maintain disruption recovery, maintain network capacity, and maintain ATCO workload. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design • Environmental sustainability: could reduce CO_2 emissions. Could result in network inefficiencies AMS Assessment – Shared Option • Safety: maintained • Simplification: could improve delay absorption. Could maintain disruption recovery, airport capacity, network capacity, and ATCO workload. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design • Environmental sustainability: could reduce CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that a Point Merge to the northeast would at least maintain current safety performance. There is a Point Merge in current UK airspace which has a proven safety performance. An arrival structure in this location would need to deconflict with Heathrow arrivals, Stansted departures and all Southend traffic.	
Conclusion from IOA	
Compared to the baseline, an independent facility could improve delay absorption and enable airport capacity. A shared facility in this location could limit airport capacity gains. As either an independent or shared facility, it could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, access to other users, network capacity, and ATCO workload. **Therefore, LC – PM – NE (Maybe shared) is progressed to Stage 3 for further development.**	

Table 18 LC-PM-NE Initial Options Appraisal

LC - PM – E (DM) (Maybe shared) Qualitative Initial Impacts Assessment	PROGRESSED
Group	**Impact**
Communities	Noise impact on health and quality of life
ANG (2017) states "at or above 7,000ft…minimising of noise is no longer a priority". CAP1616 instructs sponsors to consider noise and tranquillity impacts where the proposal has the potential to change overflight of inhabited areas, AONBs and NPs below 7,000ft. In this network-level proposal, changes would not occur below 7,000ft therefore these impacts are not considered.	
Communities	Air Quality
ANG (2017) states "emissions from aircraft above 1,000ft are unlikely to have a significant impact on local air quality". Changes would occur at or above 7,000ft, thus in accordance with ANG (2017) there would be no change in local air quality impacts.	
Wider Society	Greenhouse Gas Impacts
As either an independent or shared facility, an optimised PM structure could reduce GHG compared to the baseline. This location is aligned with airport traffic flows, so it could reduce GHG emissions for each flight compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: If the PM is a shared facility, there could be no change to airport capacity. If this is an independent facility, there could be an increase in airport capacity compared with the baseline. This location aligns with network traffic flows so could maintain network capacity. Resilience: An independent arrival structure could remove the negative impact of an unplanned runway closure at Biggin Hill on London City. Disruption recovery could be maintained compared with the baseline, with a contingency hold[6] utilised in the event of unplanned runway closure. This option could provide a greater number of holding levels, therefore could improve delay absorption compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, an arrival facility to the east would likely be within current day CAS. As a result, the access impact on GA traffic is unlikely to change compared with the baseline.	
GA/Commercial Airlines	Economic Impact from Increased Effective Capacity
A shared facility could have no short-term change in impact. In the long term, a shared facility may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. No impact on GA is expected. An independent facility could enable airport capacity which could result in an economic benefit over the baseline for commercial traffic. However, other non-airspace constraints may hinder capacity and economic gains at London City. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative economic impact on other LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
An optimised shared PM structure could reduce fuel burn compared to the baseline. This location is aligned with airport traffic flows. These could reduce fuel burn for each airport arrival flight compared with the baseline for commercial traffic. An independent facility could create network inefficiencies over the current baseline (shared facility). This is due to the extended track distance or inefficient profiles required by the network traffic, to deconflict from the additional arrival structure, resulting in increased fuel burn. This could have a negative impact on all LTMA traffic – commercial and GA.	
Commercial Airlines	Training Costs
Flight procedures change worldwide with each AIRAC cycle and operators would update their procedures accordingly, training staff if required. This option, either shared or independent, is not anticipated to impose additional training cost impacts for operators.	
Commercial Airlines	Other Costs
No other operator costs are foreseen, as either an independent or shared facility.	
Airport / ANSP	Infrastructure Costs
This design option, either shared or independent, is not expected to change airport or ANSP infrastructure impacts, beyond the initial deployment phase which will require some systems engineering adaptations.	
Airport / ANSP	Operational Costs
This design option, either shared or independent, is not expected to change airport or ANSP operational cost impacts.	
Airport / ANSP	Deployment Costs
At this stage it is disproportionate to attempt to quantify deployment costs per design option, either an independent or shared. However, a large LTMA system change would involve training a large number of controllers and assistants via the use of various air traffic simulators (including sim prep, management, and staffing), with additional system engineering costs.	

[6] The positioning and altitude of this contingency hold would be the subject of collaborative work with the airport in Stage 3.

AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • Safety: maintained • Simplification: could improve delay absorption, maintain disruption recovery, maintain airport capacity, maintain network capacity, and maintain ATCO workload. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design • Environmental sustainability: could reduce CO_2 emissions. Could result in network inefficiencies AMS Assessment – Shared Option • Safety: maintained • Simplification: could improve delay absorption, maintain disruption recovery, maintain network capacity and maintain ATCO workload. Could worsen airport capacity. Will utilise aircraft performance capabilities • Integration of diverse users: continues to integrate defence and security and GA, subject to constraints of the design • Environmental sustainability: could reduce CO_2 emissions	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that a shared Point Merge to the east would at least maintain current safety performance. There is a Point Merge in current UK airspace which has a proven safety performance. An arrival structure in this location would need to deconflict with Biggin Hill and Stansted departures and all Southend traffic.	
Conclusion from IOA	
Compared to the baseline, an independent facility could improve delay absorption and enable airport capacity. A shared facility in this location could limit airport capacity gains. As either an independent or shared facility, it could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access. It could maintain disruption recovery, access to other users, network capacity, and ATCO workload. **Therefore, LC – PM – E (Maybe shared) is progressed to Stage 3 for further development.**	

Table 19 LC-PM-E (DM) (Maybe shared) Initial Options Appraisal

4. Step 2B Conclusion and Next Steps

4.1.1 There is not yet enough detailed quantified data to make a statement on preferred option(s). Compromises and trade-offs may be necessary between airports taking part in the FASI regional airspace change. Appropriate quantitative assessments and trade-offs will be carried out as part of Stage 3 to allow a preferred option to be selected prior to consultation.

4.1.2 This table provides a summary of design option concepts for London City, showing how the number of design options has changed through the design development stages as described above.

Module	Initial Long List	Comprehensive List	Progress to IOA	Progress to Stage 3
London City	13	6	5	5

Table 20 Count of Design Option Concepts for each module through option development stages

4.1.3 These shortlisted viable options have been carried forward to Stage 3:

London City Option Concepts progressed to Stage 3
Inner Holds – Northeast
Inner Holds – East
Inner Holds – Southeast
Point Merge – Northeast (Maybe shared)
Point Merge – East (DM) (Maybe shared)

Table 21 Summary of design options progressed to Stage 3

5. APPENDIX 1: Arrival Structure Concepts

5.1.1 Arrival structure types identified as being viable options for potential airspace designs across the LTMA airports:

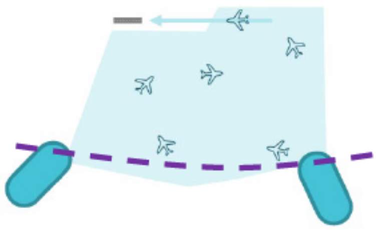
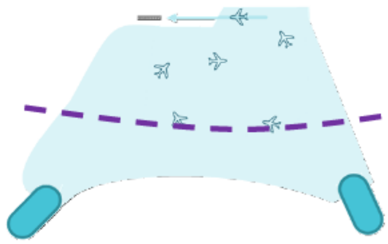
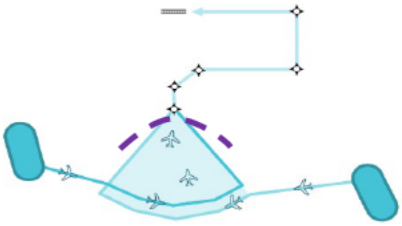
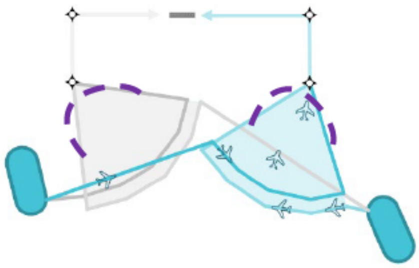
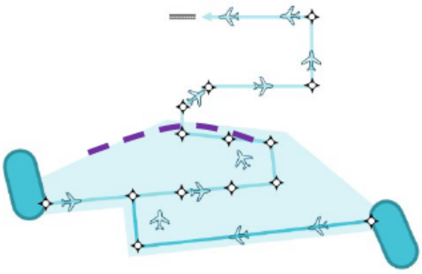
Structure	Diagram	Description
Optimised[7] Holds llustration of network/airport boundary (indicative c.7,000ft)		A holding pattern is used to delay aircraft from landing, in a vertically separated stack. ATC control entry to, and exit from, the stack; and aircraft are vectored to the runway or may use a transition. Linked with either a traditional Radar Manoeuvring Area (RMA) or Transitions. This design is for holds within c.30nm of the airport.
Holds Further Out llustration of network/airport boundary (indicative c.7,000ft)		As above but would typically be higher. This design is for holds c.30nm-60nm from the airport.
Point Merge llustration of network/airport boundary (indicative c.7,000ft)		Point Merge (PM) is a systemised method for sequencing arrival flows, allowing controllers to sequence and merge arrivals without vectoring, whilst enabling continuous descent operations and maintaining runway throughput. This design has a fixed location regarding the merge legs and merge point.
Switch Merge llustration of network/airport boundary (indicative c.7,000ft)		SM is a concept not currently in UK operation, whereby two separate PM structures exist within a given airspace volume to serve different runway directions for the same airport. The merge legs and merge point (the tip of each triangle) is angled to favour the runway in use, but only one of the merge structures is in operation at any time; they are 'switched' when the runway direction changes. The holds do not change.
Trombone llustration of network/airport boundary (indicative c.7,000ft)		A 'snake-like' PBN transition which can be closed (fixed) which aircraft must fly; or open, whereby tactical flexibility is retained with defined short cuts.

Figure 6 Arrival structure concepts (at and above 7,000ft)

[7] See paragraph 2.2.10 of Master document for explanation of 'Optimised'

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