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
Gatwick Airport Arrivals Connectivity Module

To be read in conjunction with Master Document

1. Introduction

1.1 About this document

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

1.1.2 Gatwick is a major international airport. It operates as a single runway airport and is sited 30 miles south of central London. The airport is a base for scheduled airlines including British Airways, easyJet, WizzAir and charter operators such as TUI Airways.

2. Baseline

2.1.1 This description of the current airspace around Gatwick 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	142,457	142,451	**284,908**
2020	40,167	40,143	**80,310**
2021	27,845	27,925	**55,770**
2022	108,850	108,836	**217,686**

Table 1 Actual air traffic movements: Gatwick Airport 2019-2022

2.1.3 Gatwick has a number of arrival and departure procedures (STARs & SIDs), as shown in Figure 1 and described in Table 2 & Table 3. Two holds, WILLO and TIMBA, provide for delay absorption.

Airport	Hold	STARs	Associated ATS Routes
Gatwick	TIMBA	BARMI 1G, TEBRA 2G, KONAN 2G, NEVIL 1G, KUNAV 1G	P7, Y4, Q63, L610, L607, M189, G27, Z273, (U)T421
	WILLO	OTMET 1G, VASUX 1G, DISIT 1G, KIDLI 1G, ABSAV 1G, BEDEK 1G, GWC 1G	N17, (U)P88, L982, L151, N859, L980, P2, Y8

Table 2 Current arrival connectivity for Gatwick

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

Airport	SIDs	Associated ATS Routes
Gatwick	LAM (5P/5W/6M/6V/1Z)	N57, L10, N601
	TIGER (3M/3V/1X)	N57, L10, N601
	DAGGA (1M/1V/1X)	L620
	FRANE (1M/1V/1P/1W/1Z)	M604
	WIZAD (4M/4V/1X)	L9, L10
	MIMFO (1M/1V)	Y312
	DVR (2P/2W)	L9, L10, L18
	ODVIK 2Z	Y311
	HARDY (5M/5V/1X)	M605
	BOGNA (1M/1V/1X)	L612, Y47
	SAM (3P/3W)	Q41, L620, N621, N866
	IMVUR 1Z	N63
	SFD (5M/5V/9W/9P/4Z/1X)	M605, Y47
	KENET (3P/3W)	L9, N14
	NOVMA (1M/1V/1Z)	L620

Table 3 Current departure connectivity for Gatwick

[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.

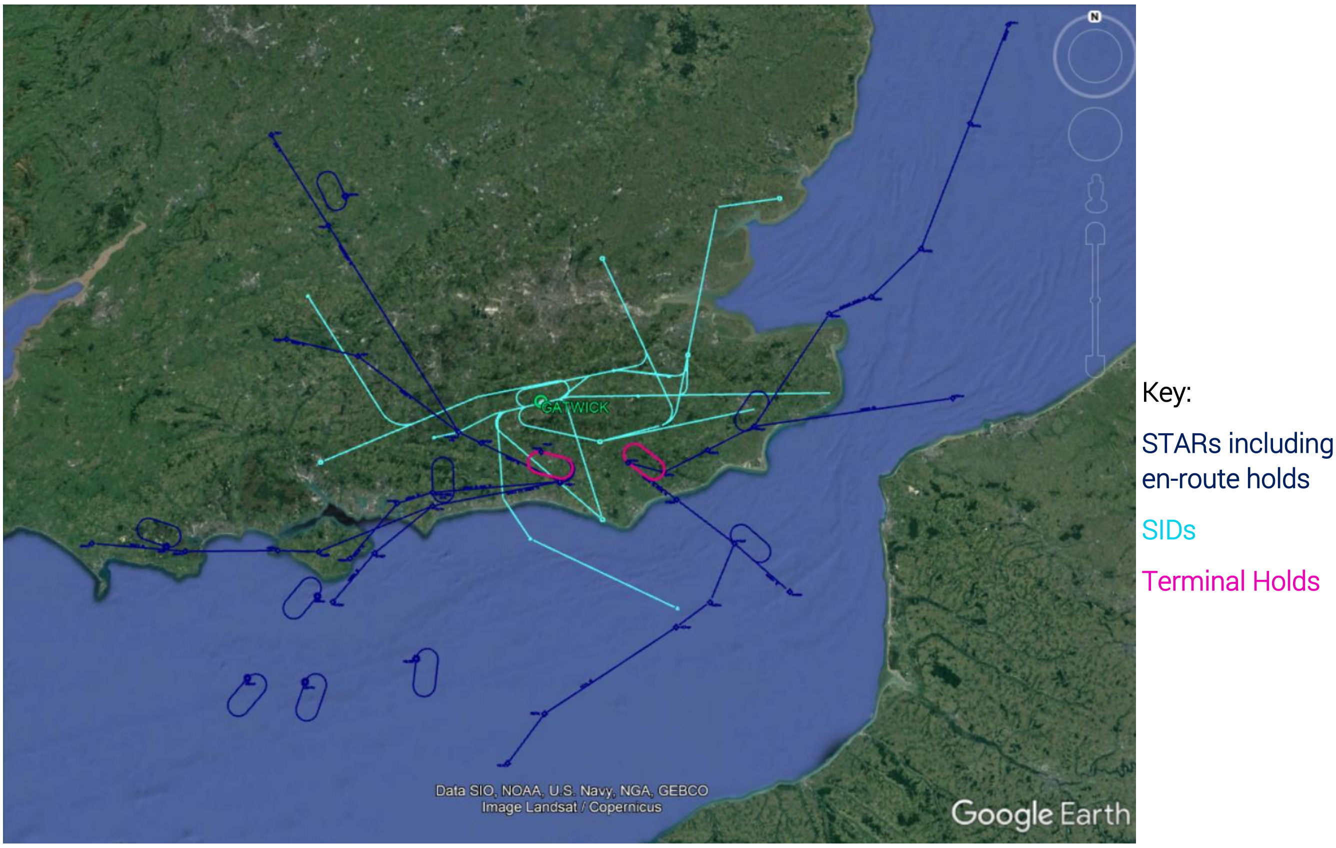


Figure 1 Current arrival and departure procedures for Gatwick

2.1.5 Figure 2 shows a radar density plot of Gatwick arrival traffic for a typical busy summer week and indicates traffic distribution. Most of the traffic (61%) arrives from the south and southeast.

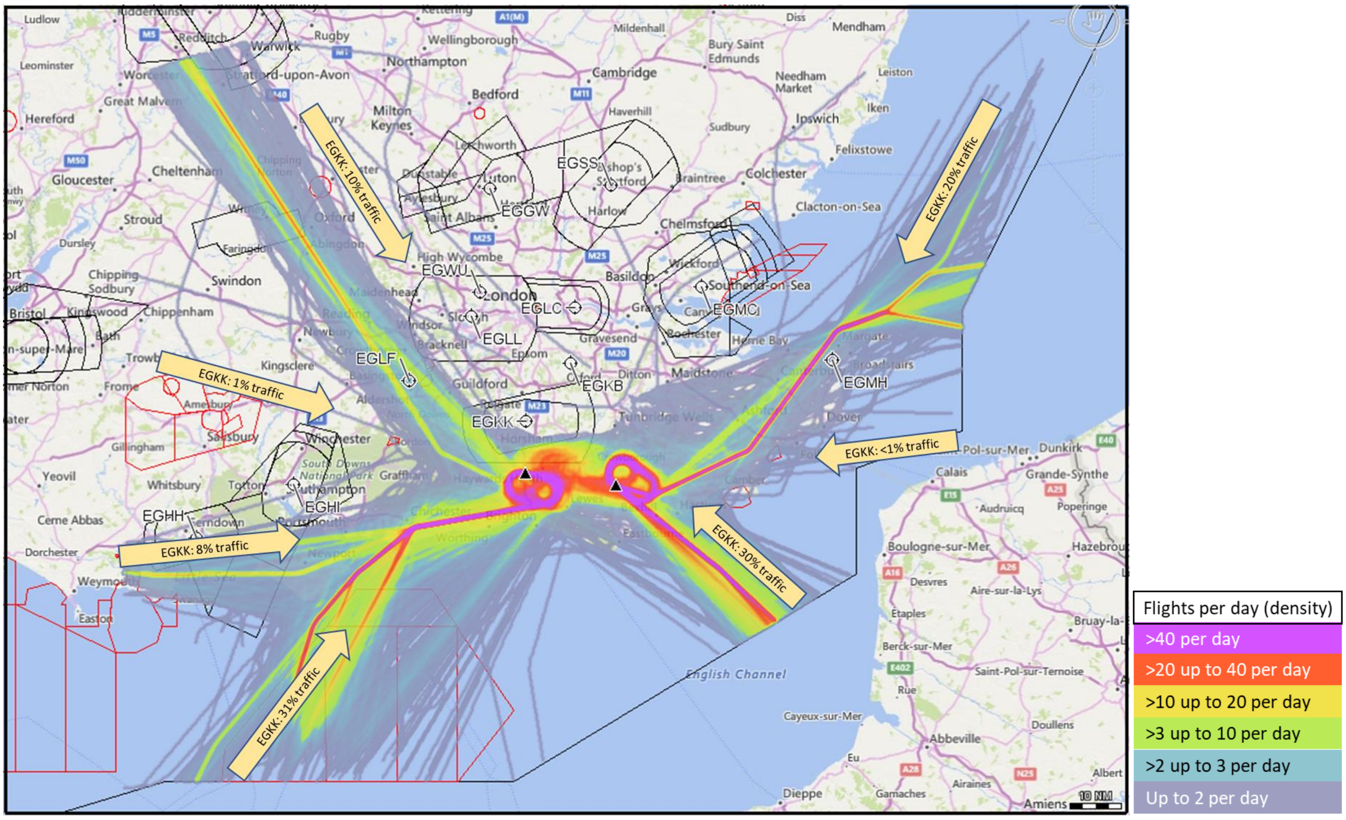


Figure 2 Gatwick traffic density arrivals FL245-FL70 5-11 August 2019

2.1.6 Medium jets are the most prevalent aircraft type at Gatwick, as shown in Table 4. easyJet was the most prevalent operator in 2019, with approximately 43% of the traffic.

Gatwick – Aircraft Type		
Aircraft Group	Movements	% traffic
Small Jet	421	>1%
Medium Jet	246,544	87%
Heavy Jet	36,456	13%
Turboprop/Piston/Prop	1,486	>1%

Gatwick – Top 4 Aircraft Operator Usage		
Operator	Movements	% traffic
easyJet	123,464	43%
British Airways	50,140	18%
Norwegian Air	25,207	9%
TUI	14,437	5%

Table 4 Aircraft type and top carriers - Gatwick

3. Design Development

3.1.1 Working with the airport, NERL developed 15 high-level concept options for Gatwick[3]. NERL has assessed that based on required traffic loading, Gatwick would require at least two holds, either attached to an RMA or attached to a systemised arrival structure. Initial viability assessments were produced for location and structure type and presented to stakeholders in formal engagement (Ref 7). Feedback was requested through the engagement response questionnaire.

3.2 Stakeholder engagement

3.2.1 We received 6 responses from 6 different stakeholders related to the Gatwick design concepts. Table 5 presents a summary of the feedback and how this has influenced the design.

3.2.2 Feedback recognises that Gatwick is a major airport with high traffic demand compared to others in the LTMA and suggests this should be a consideration in the design development. This feedback has been used to inform the Design Principle Evaluation.

3.2.3 Some new options were developed as a result of the stakeholder engagement and the design envelope was revised to include an area to the west and northwest.

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. Biggin Hill attended the formal Stage 2 engagement briefing and received a copy of the briefing presentation and recording.
British Airways	The only viable option is to enhance and modernize the Arrival structures to the south to ensure there is no conflict with the LTMA traffic.	Arrival structures to the south are included in the long list of options.
BGA	Conclusions suggest that any new network solutions would not require additional CAS. An opportunity should also be taken to remove legacy CAS segments where possible.	No conclusions have been made at this point. We used this feedback to inform our evaluation of DP5 and DP6.
Gatwick Airport	We highlight again the potential for arrival options to the west and north of Gatwick, providing other aerodrome and TMA designs allow this.	The design envelope and viability matrix has been refined to encompass an area to the west and northwest of Gatwick. An arrival structure to the north of Gatwick is considered unviable as it will significantly restrict all LTMA departures, including Gatwick, and conflict with the Heathrow arrivals.
Ryanair	Capacity is the most important consideration.	The design envelope and viability matrix has been refined to encompass an area to the west and northwest of Gatwick.

Table 5 Engagement feedback and NERL response

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

3.3 Gatwick Design Concepts

3.3.1 Table 6 summarises the high-level qualitative considerations for potential locations for Gatwick arrival structures, and Table 7 summarises the viability assessment for the arrival structures suitable for Gatwick. These have been developed from SME input and stakeholder engagement. 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 Biggin Hill, Heathrow, London City, Luton, Northolt and Stansted traffic.
Northeast	An arrival structure, and associated connectivity, to the northeast of the airfield would likely conflict with Biggin Hill, Heathrow, London City, Northolt, Southend and Stansted traffic.
East	An arrival structure, and associated connectivity, to the east of the airfield would likely conflict with Biggin Hill, Heathrow, London City, Northolt and Southend traffic.
Southeast	An arrival structure to the southeast of the airfield is already in place within the current design. A structure in this area remains possible, subject to deconfliction with Bournemouth, Farnborough, Heathrow and Southampton traffic.
South	An arrival structure to the south of the airfield is already in place within the current design. A structure in this area remains possible, subject to deconfliction with Bournemouth, Farnborough, Heathrow and Southampton traffic and Portsmouth DA Complex.
Southwest	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the southwest of the airfield, subject to deconfliction with Bournemouth, Farnborough, Gatwick, Heathrow and Southampton traffic and the Portsmouth DA Complex.
West	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the west of the airfield, subject to deconfliction with Bournemouth, Farnborough, Heathrow, Northolt and Southampton traffic.
Northwest	There is sufficient airspace to enable an arrival structure, and associated connectivity, to the northwest of the airfield, subject to deconfliction with Bournemouth, Farnborough, Heathrow, Luton, Northolt and Southampton traffic.
Overhead	An arrival structure, and associated connectivity, overhead the airfield would likely conflict with Heathrow traffic.

Table 6 Gatwick Arrivals: Location viability considerations – post engagement

Structure	Viability Considerations
Optimised (inner) holds	Optimisation of current day structures. There is sufficient airspace for optimised hold(s), and this would likely meet the runway throughput demands.
Point merge	There is sufficient airspace for Point Merge, and this would likely meet the runway throughput demands.
Switch merge	There is sufficient airspace for Switch Merge, and this would likely meet the runway throughput demands.

Table 7 Gatwick Arrival structures: Viability considerations – post engagement

3.3.2 Figure 3 shows the Gatwick design envelope, developed by SMEs through collaborative workshops and formal engagement with Gatwick and other stakeholders. This design envelope is based on the viability considerations presented above in Table 6 & Table 7, developed through two-way engagement as shown in Table 5.

3.3.3 Airspace design constraints, as described in the Master document Section 3.5, are highlighted in orange. A consideration for Gatwick is the Portsmouth Danger Area as shown.

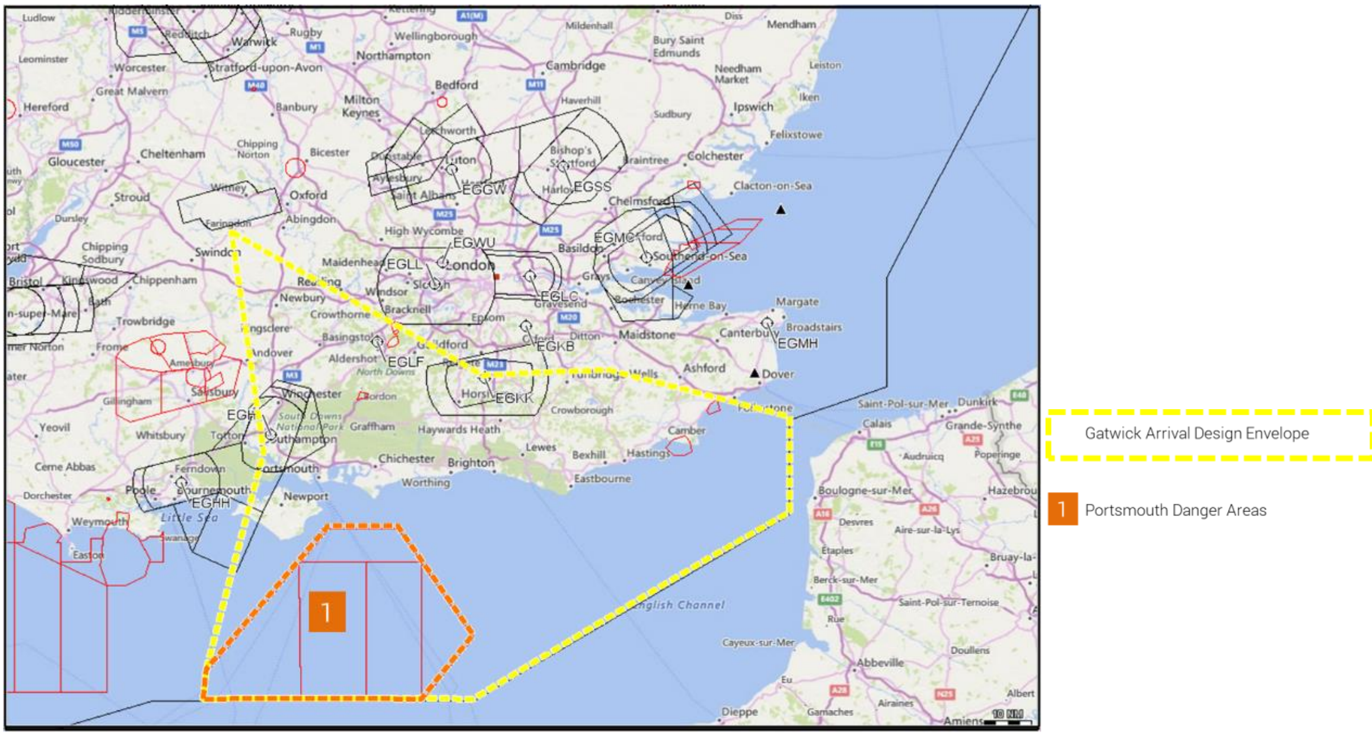


Figure 3 Gatwick Design Envelope and design constraints – post engagement and SME development

3.3.4 The Gatwick Design Concepts which were considered viable at this stage, within the Design Envelope presented, are shown in the Gatwick Arrival Structure Viability Assessment (Figure 4).

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 4 Gatwick Design Options Viability Matrix

3.3.5 These 11 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 AMS	**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 decrease efficiency and 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, DP8 and DP9) 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, DP8 and DP9
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. KK) - Structure Type (e.g. Inner Hold: IH/ Point Merge: PM/ Switch Merge: SM) - Location (e.g. Northeast: NE). DN = Do Nothing. DM = Do Minimum.

DP	Priority	KK - DN	KK - IH - SE (DM)	KK - IH - S (DM) (Maybe shared)
RESULT		REJECT	ACCEPT	ACCEPT
DP0 Safety	A AMS	Maintained: Similar operation to today	Maintained: Holds are used in current day operations and are known to be safe	Maintained: Holds are used in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation, which provides similar delay absorption	Optimised concept of current day operation, which provides similar delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation, which provides similar disruption recovery	Optimised concept of current day operation, which provides similar disruption recovery
DP2 Economic (Fuel)	B	Today's operation, no change from baseline	Optimised concept aligned with airport traffic flows, therefore improved fuel performance	Optimised concept aligned with airport traffic flows, therefore improved fuel performance
DP3 Environmental (CO_2)	B AMS	Today's operation, no change from baseline	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved	Optimised concept of current day operation aligned with airport traffic flows, therefore CO_2 emissions per flight improved
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	No military-use areas in the vicinity, therefore, would not require a change to MoD operations
DP8 Operational (Capacity)	B AMS	Aligns with network traffic flows. Concept may not support the airport required arrival loading	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	Today's operation, no change in ATCO workload anticipated	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	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, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None	Green: DP0, DP3, DP7, DP8, DP9 Amber: DP1, DP1, DP6, DP8 Red: None

DP	Priority	KK - IH - SW	KK - IH - W	KK - IH - NW
RESULT		ACCEPT	REJECT	REJECT
DP0 Safety	A AMS	Maintained: Holds are used in current day operations and are known to be safe	Maintained: Holds are used in current day operations and are known to be safe	Maintained: Holds are used in current day operations and are known to be safe
DP1 Operational (Delay Absorption)	B AMS	Optimised concept of current day operation, which provides similar delay absorption	Optimised concept of current day operation, which provides similar delay absorption	Optimised concept of current day operation, which provides similar delay absorption
DP1 Operational (Disruption Recovery)	B AMS	Optimised concept of current day operation, which provides similar disruption recovery	Optimised concept of current day operation, which provides similar disruption recovery	Optimised concept of current day operation, which provides similar disruption recovery
DP2 Economic (Fuel)	B	Optimised concept, partially aligns with airport traffic flows, therefore fuel performance neutral	Does not align with airport traffic flows. Fuel performance worsened	Does not align with airport traffic flows. Fuel performance worsened
DP3 Environmental (CO_2)	B AMS	Optimised concept, partially aligns with airport traffic flows, therefore CO_2 emissions neutral	Does not align with airport traffic flows. CO_2 emissions per flight worsened	Does not align with airport traffic flows. CO_2 emissions per flight worsened
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	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 on multiple network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity on multiple network traffic flows	Supports the required airport arrival loading, however, negatively impacts capacity on multiple network traffic flows
DP8 Operational (Efficiency)	B AMS	Similar concept to today's operation, therefore no change in ATCO workload anticipated	Increased workload due to complexity of airspace and multiple network flows	Increased workload due to complexity of airspace and multiple network flows
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, DP7, DP9 Amber: DP1, DP1, DP3, DP6, DP8, DP8 Red: None	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8 Red: DP3, DP8	Green: DP0, DP7, DP9 Amber: DP1, DP1, DP6, DP8 Red: DP3, DP8

DP	Priority	KK - PM - SE	KK - PM - S	KK - PM - SW
RESULT		ACCEPT	ACCEPT	REJECT
DP0 Safety	A AMS	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error
DP1 Operational (Delay Absorption)	B AMS	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today	Similar holding capacity as today, plus delay absorption by flying the PM. Overall delay absorption similar to today
DP1 Operational (Disruption Recovery)	B AMS	Assumed contingency hold within the transition, net disruption recovery similar to today	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	Extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened
DP3 Environmental (CO_2)	B AMS	Extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Extended track miles to complete the PM structure. Aligns with airport traffic flows. Net neutral	Worsened due to extended track miles to complete the PM structure. Not aligned with airport traffic flows. Net worsened
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	Potential negative impact to Portsmouth DA Complex
DP8 Operational (Capacity)	B AMS	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	Supports the required airport arrival loading, however, negatively impacts capacity on multiple network traffic flows
DP8 Operational (Efficiency)	B AMS	Reduced controller tactical intervention required, leading to reduced ATCO workload	Reduced controller tactical intervention required, leading to reduced ATCO workload	PM structure require less tactical intervention. Negatively impacts on network traffic flows; increases ATCO workload. Net neutral
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, DP7, DP8, DP8, DP9 Amber: DP1, DP1, DP3, DP6 Red: None	Green: DP0, DP7, DP8, DP8, DP9 Amber: DP1, DP1, DP3, DP6 Red: None	Green: DP0, DP9 Amber: DP1, DP1, DP6, DP7, DP8, DP8 Red: DP3

DP	Priority	KK - SM - SE	KK - SM - S	KK - SM - SW
RESULT		ACCEPT	ACCEPT	REJECT
DP0 Safety	A AMS	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error	Enhanced: Reduced controller tactical intervention required, reducing potential for human error
DP1 Operational (Delay Absorption)	B AMS	Similar holding capacity and further delay absorption by flying the SM arc; overall similar to today	Similar holding capacity and further delay absorption by flying the SM arc; overall similar to today	Similar holding capacity and further delay absorption by flying the SM arc; overall similar to today
DP1 Operational (Disruption Recovery)	B AMS	Assumed contingency hold within the transition, net disruption recovery similar to today	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	Track miles to complete the SM structure, aligns with airport traffic flows, SM can be orientated to runway. Net neutral	Track miles to complete the SM structure, aligns with airport traffic flows, SM can be orientated to runway. Net neutral	Extended track miles to complete the SM, not aligned with airport traffic flows. Orientated to runway. Net worsened
DP3 Environmental (CO_2)	B AMS	Track miles to complete the SM structure, aligns with airport traffic flows, SM can be orientated to runway. Net neutral	Track miles to complete the SM structure, aligns with airport traffic flows, SM can be orientated to runway. Net neutral	Extended track miles to complete the SM, not aligned with airport traffic flows. Orientated to runway. Net worsened
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	Potential negative impact to Portsmouth DA Complex
DP8 Operational (Capacity)	B AMS	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	Supports the required airport arrival loading, however, negatively impacts capacity on multiple network traffic flows
DP8 Operational (Efficiency)	B AMS	Reduced controller tactical intervention. Method of operations configured to support switching runway ends.	Reduced controller tactical intervention. Method of operations configured to support switching runway ends.	Reduced controller tactical intervention required. Method of operations configured to support switching runway ends. Increased workload due to airspace complexity and network flows. Net neutral
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, DP7, DP8, DP8, DP9 Amber: DP1, DP1, DP3, DP6 Red: None	Green: DP0, DP7, DP8, DP8, DP9 Amber: DP1, DP1, DP3, DP6 Red: None	Green: DP0, DP9 Amber: DP1, DP1, DP6, DP7, DP8, DP8 Red: DP3

Table 11 Design Principle Evaluation

3.4.5 'Do Nothing' and 4 design options were assessed as not meeting the DPs and were rejected at this stage. The remaining 7 design options progress to Step 2B Options Appraisal.

3.5 Initial Options Appraisal

Table 12 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 12 Initial Options Appraisal Assessment Criteria

KK – DN 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 13 KK-DN Initial Options Appraisal

KK - IH – SE (DM)	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 is an optimised version of today which could improve the approach phase from the hold to 7,000ft. Additionally, this option has the potential to raise the holding height. This location aligns with airport traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As this option would be implemented alongside another Inner Hold, an independent facility could maintain airport capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Resilience: This option could maintain disruption recovery and a similar number of holding levels, therefore it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A holding facility to the southeast would likely be within current day CAS. There is already an arrival structure in this location. 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
Could enable economic impacts through airport capacity gains, however, other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. Aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. This could positively impact all LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
This design option is an optimised version of today which could improve the approach phase from the hold to 7,000ft. Additionally, this option has the potential to raise the holding levels. This location aligns with airport traffic flows. Overall, could reduce aircraft fuel burn for commercial operators. There are currently structures in this location so no change in impact is expected for GA traffic.	
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 maintain delay absorption, 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 an Inner Hold to the southeast 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 Bournemouth, Farnborough, Heathrow and Southampton arrivals.	
Conclusion from IOA	
Compared to the baseline, this option could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access; it could maintain delay absorption, disruption recovery, access to other users, airport capacity, network capacity, and ATCO workload. Therefore, KK – IH – SE (DM) is progressed to Stage 3 for further development.	

Table 14 KK-IH-SE (DM) Initial Options Appraisal

KK - IH – S (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 1,000 ft 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, this design option is an optimised version of today which could improve the approach phase from the hold to 7,000ft. Additionally, this option has the potential to raise the holding height. This location aligns with airport traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As this option would be implemented alongside another Inner Hold, an independent facility could maintain airport capacity compared with the baseline. If the facility is shared, airport capacity could be worse than the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Resilience: As either an independent or shared facility, this option could maintain disruption recovery. If an independent facility, this option could maintain a similar number of holding levels, therefore maintaining delay absorption compared with the baseline. If the Inner Hold is a shared facility, there could be a reduction in holding levels available to Gatwick compared with the baseline.	
General Aviation (GA)	Access
As either an independent or shared facility, a holding facility to the south would likely be within current day CAS. There is already an arrival structure in this location. 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
As either an independent or shared facility, this option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. A shared facility may limit capacity resulting in increased likelihood of delays/holding. This could lead to a negative economic impact for commercial operators. As an independent facility it could enable positive economic impacts through capacity gains, however, other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
As either an independent or shared facility, this design option is an optimised version of today which could improve the approach phase from the hold to 7,000ft. Additionally, this option has the potential to raise the holding height. This location aligns with airport traffic flows. Overall, could reduce GHG emissions through improved aircraft trajectories. There are currently structures in this location so no change in impact is expected for GA traffic.	
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.	

AMS	Performance against the vision and parameters/strategic objectives of the AMS
AMS Assessment – Independent Option • Safety: maintained • Simplification: could maintain delay absorption, 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 AMS Assessment – Shared Option • Safety: maintained • Simplification: could maintain disruption recovery, network capacity, and ATCO workload. Could worsen delay absorption and 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 an Inner Hold to the south 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 Bournemouth arrivals, Heathrow departures, and all Farnborough and Southampton traffic.	
Conclusion from IOA	
Compared to the baseline, an independent facility could maintain delay absorption and airport capacity. A shared facility would worsen delay absorption and airport capacity compared to the baseline. As either a shared or independent facility, the option could improve fuel burn and CO_2 emissions. It would maintain safety and any current MoD access; and could maintain disruption recovery, network capacity, and ATCO workload. Therefore, KK – IH – S (DM) (Maybe shared) is progressed to Stage 3 for further development.	

Table 15 KK-IH-S (DM) (Maybe shared) Initial Options Appraisal

KK - IH – SW 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 1,000 ft 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 is an optimised version of today which could improve the approach phase from the hold to 7,000ft. Additionally, this option has the potential to raise the holding height. However, this location only partially aligns with airport traffic flows causing additional track miles for LTMA aircraft. Overall, could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: As this option would be implemented alongside another Inner Hold, an independent facility could maintain airport capacity compared with the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location does not align with network traffic flows and could hinder network capacity compared with the baseline. Resilience: This option could maintain disruption recovery and a similar number of holding levels. Therefore, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A holding facility to the southwest 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 location does not align with network traffic flows, which could hinder potential capacity gains across the LTMA from an improved network design. Could enable positive economic impacts through airport capacity gains, however other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. This could positively impact all LTMA traffic – commercial and GA.	
GA/Commercial Airlines	Fuel Burn
This design option is an optimised version of today which could improve the approach phase from the hold to 7,000ft. Additionally, this option has the potential to raise the holding height. However, this location partially aligns with airport traffic flows causing additional track miles for LTMA aircraft. Overall, could maintain fuel burn compared with the baseline. A structure in this location could lead to extended track distance and increased network fuel burn to deconflict the arrival structures. This could negatively impact 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 maintain delay absorption, disruption recovery, airport capacity, and ATCO workload. Could worsen network 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 maintain CO_2 emission	
Qualitative Safety Assessment	
A high-level safety appraisal for this proposed option indicates that an Inner Hold to the southwest 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 Gatwick and Heathrow departures, and all Bournemouth, Farnborough and Southampton traffic.	
Conclusion from IOA	
Compared to the baseline, this option would maintain safety and any current MoD access. It could maintain delay absorption, disruption recovery, access to other users, airport capacity and ATCO workload. This location could worsen network capacity. Therefore, KK – IH – SW is progressed to Stage 3 for further development.	

Table 16 KK-IH-SW Initial Options Appraisal

KK – PM - 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 could result in extended track miles to complete the Point Merge structure, compared with baseline. However, this location aligns with airport traffic flows. Overall, could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: This option could maintain airport capacity, providing the same number of holds as the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Resilience: Disruption recovery could be similar to the baseline, with a contingency hold[4] utilised in the event of unplanned runway closure. This option could provide similar holding capacity as today plus additional delay absorption by flying the Point Merge structure. Therefore, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A Point Merge 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
A Point Merge could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. This option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
This design option could result in extended track miles to complete the Point Merge structure, compared with baseline. However, this location aligns with airport traffic flows. Overall, it could maintain fuel burn compared with the baseline for commercial operators. No change in impact is expected for 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: could enhance • Simplification: could maintain delay absorption, disruption recovery, airport capacity, and network capacity. Could improves 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 maintain CO_2 emissions	

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

Qualitative Safety Assessment
A high-level safety appraisal for this proposed option indicates that a Point Merge to the southeast could enhance current safety performance. There is already a Point Merge within current UK airspace which has a proven safety performance. A Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. An arrival structure in this location would need to deconflict with Bournemouth, Farnborough, Heathrow and Southampton traffic.
Conclusion from IOA
Compared to the baseline, this option could improve safety, and ATCO workload. It would maintain any current MoD access and could maintain delay absorption, resilience, fuel burn, CO_2 emissions, airport capacity, network capacity, and access to other users. Therefore, KK – PM – SE is progressed to Stage 3 for further development.

Table 17 KK-PM-SE Initial Options Appraisal

KK – PM - S 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 result in extended track miles to complete the Point Merge structure, compared with baseline. However, this location aligns with airport traffic flows. Overall, it could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: This option could maintain airport capacity, providing the same number of holds as the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Resilience: Disruption recovery could be maintained compared with the baseline, with a contingency hold[5] utilised in the event of unplanned runway closure. This option could provide similar holding capacity as today plus additional delay absorption by flying the Point Merge structure. Therefore, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A Point Merge facility to the south 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 Point Merge could enable positive economic impacts through capacity gains; however other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. This option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
This design option could result in extended track miles to complete the Point Merge structure, compared with baseline. However, this location aligns with airport traffic flows. Overall, it could maintain fuel burn compared with the baseline for commercial operators. No change in impact is expected for 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: could enhance • Simplification: could improve ATCO workload, maintain delay absorption, maintain disruption recovery, maintain airport capacity, and maintain network 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 maintain CO_2 emissions	

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

Qualitative Safety Assessment
A high-level safety appraisal for this proposed option indicates that a Point Merge to the south could enhance current safety performance. There is already a Point Merge within current UK airspace which has a proven safety performance. A Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. An arrival structure in this location would need to deconflict with all Bournemouth, Farnborough, Heathrow and Southampton traffic.
Conclusion from IOA
Compared to the baseline, this option could improve safety, and ATCO workload. It would maintain any current MoD access and could maintain delay absorption, resilience, fuel burn, CO_2 emissions, airport capacity, network capacity, and access to other users. Therefore, KK – PM – S is progressed to Stage 3 for further development.

Table 18 KK-PM-S Initial Options Appraisal

KK – SM - 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 could result in extended track miles to complete the Switch Merge structure, compared with baseline. However, this location aligns with airport traffic flows and the structure can be orientated to the runway in use. Overall, it could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: This option could maintain airport capacity, providing the same number of holds as the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Resilience: Disruption recovery could be similar to the baseline, with a contingency hold[6] utilised in the event of unplanned runway closure. This option could provide similar holding capacity as today plus additional delay absorption by flying the Switch Merge structure. Therefore, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A Switch Merge 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
A Switch Merge could enable positive economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. This option aligns with network traffic flows, which could enable capacity gains across the LTMA from an improved network design. No impact on GA is expected.	
GA/Commercial Airlines	Fuel Burn
This design option could result in extended track miles to complete the Switch Merge structure, compared with baseline. However, this location aligns with airport traffic flows and the structure can be orientated to the runway in use. Overall, it could maintain fuel burn compared with the baseline for commercial operators. No change in impact is expected for 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: could enhance • Simplification: could improve ATCO workload, maintain delay absorption, maintain disruption recovery, maintain airport capacity, and maintain network 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 maintain CO_2 emissions	

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

Qualitative Safety Assessment
A high-level safety appraisal for this proposed option indicates that a Switch Merge to the southeast could enhance current safety performance. Although there are not currently any Switch Merges used within UK airspace, there is already a Point Merge which has a proven safety performance. A Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. Method of operation will be configured to support switching runway ends. An arrival structure in this location would need to deconflict with all Bournemouth, Farnborough, Heathrow and Southampton traffic.
Conclusion from IOA
Compared to the baseline, this option could improve safety, and ATCO workload. It would maintain any current MoD access and could maintain delay absorption, resilience, fuel burn, CO_2 emissions, airport capacity, network capacity, and access to other users. Therefore, KK – SM – SE is progressed to Stage 3 for further development.

Table 19 KK-SM-SE Initial Options Appraisal

KK – SM - S 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 1,000 ft 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 result in extended track miles to complete the Switch Merge structure, compared with baseline. However, this location aligns with airport traffic flows and the structure can be orientated to the runway in use. Overall, it could maintain GHG emissions compared with the baseline.	
Wider Society	Capacity / Resilience
Capacity: This option could maintain airport capacity, providing the same number of holds as the baseline. Other non-airspace constraints may hinder overall capacity gains at Gatwick. This location aligns with network traffic flows so could maintain network capacity compared with the baseline. Resilience: Disruption recovery could be similar to the baseline, with a contingency hold[7] utilised in the event of unplanned runway closure. This option could provide similar holding capacity as today plus additional delay absorption by flying the Switch Merge structure. Therefore, it could maintain delay absorption compared with the baseline.	
General Aviation (GA)	Access
A Switch Merge facility to the south 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 Switch Merge could enable economic impacts through capacity gains; however, other non-airspace constraints may hinder overall capacity and economic gains at Gatwick. This option aligns with network traffic flows, which enables capacity gains across the LTMA from an improved network design. No change in impact is expected for GA.	
GA/Commercial Airlines	Fuel Burn
This design option could result in extended track miles to complete the Switch Merge structure, compared with baseline. However, this location aligns with airport traffic flows and the structure can be orientated to the runway in use. Overall, it could maintain fuel burn compared with the baseline for commercial operators. No impact on GA is expected.	
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: could enhance • Simplification: could improve ATCO workload, maintain delay absorption, maintain disruption recovery, maintain airport capacity, and maintain network 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 maintain CO_2 emissions	

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

Qualitative Safety Assessment
A high-level safety appraisal for this proposed option indicates that a Switch Merge to the south could enhance current safety performance. Although there are not currently any Switch Merges used within UK airspace, there is already a Point Merge which has a proven safety performance. A Point Merge may decrease controller workload by reducing the requirement for tactical intervention due to aircraft following a systemised structure. Method of operation will be configured to support switching runway ends. An arrival structure in this location would need to deconflict with Gatwick and Heathrow departures and all traffic from Bournemouth, Farnborough and Southampton.
Conclusion from IOA
Compared to the baseline, this option could improve safety, and ATCO workload. It would maintain any current MoD access and could maintain delay absorption, resilience, fuel burn, CO_2 emissions, airport capacity, network capacity, and access to other users. Therefore, KK – SM – S is progressed to Stage 3 for further development.

Table 20 KK-SM-S 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 Gatwick, 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
Gatwick	15	11	7	7

Table 21 Count of Design Option Concepts for each module through option development stages

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

Gatwick Option Concepts progressed to Stage 3
Inner Holds – Southeast (DM)
Inner Holds – South (DM) (Maybe shared)
Inner Holds – Southwest
Point merge – Southeast
Point merge – South
Switch merge – Southeast
Switch merge – South

Table 22 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:

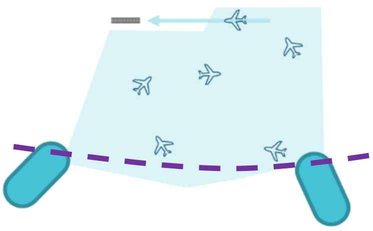
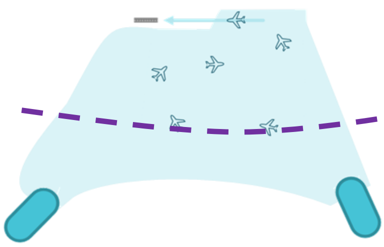
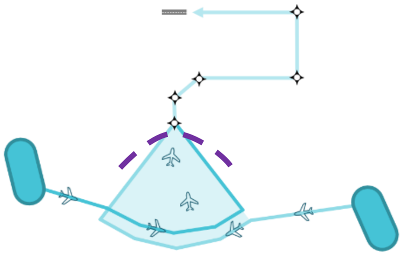
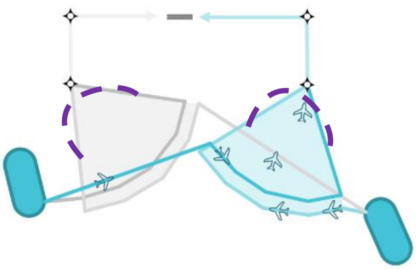
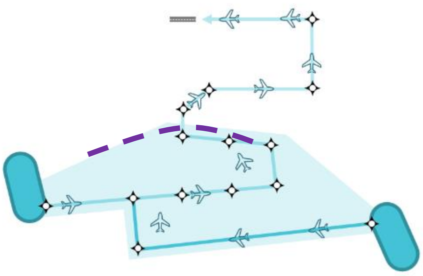
Structure	Diagram	Description
Optimised[8] Holds Illustration of network/airport boundary (indicative c.7,000ft)		A holding pattern is used to delay aircraft from landing, in a vertically separated stack. ATC control entry to, and exit from, the stack; and aircraft are vectored to the runway, or may 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 Illustration 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 Illustration 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 Illustration 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 Illustration 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 5 Arrival structure concepts (at and above 7,000ft)

End of document

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