

APPENDIX B - DESIGN PRINCIPLE EVALUATION TEMPLATE RNAV VPA OPTIONS

Design principle evaluation	Option No: B1
Option Name: RNAV(GNSS) 3.0° Do nothing	REJECT
Description of option: <ul style="list-style-type: none"> This option is the status quo: Both the ILS and RNAV approaches remain at 3.0° Does not reduce the noise footprint. 	

Design principle: Must be safe	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's 3.0° RNAV approaches were operational for many years and demonstrated as safe. 			

Design principle: Must achieve the objective of reducing noise compared to a 3.0° approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> This would not reduce noise. 			

Design principle: Must not increase the numbers of go-arounds	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's 3.0° RNAV approaches were operational for many years and demonstrated as not increasing the numbers of go-arounds. 			

Design principle: Must not reduce Heathrow's capacity	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's 3.0° RNAV approaches were operational for many years and demonstrated as not reducing Heathrow's capacity. 			

Design principle: Must not change the lateral tracks of aircraft over the ground	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's 3.0° RNAV approaches were operational for many years and have set the baseline for assessing changes to the tracks over the ground for slightly steeper RNAV approaches. 			

Design principle: Should not reduce the ability for arrivals to fly Continuous Descent Approach.	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's 3.0° RNAV approaches were operational for many years and demonstrated as not reducing CDA performance. 			

Design principle: Should maximise the number of aircraft able to fly the slightly steeper approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Would not allow any aircraft to fly slightly steeper approaches. 			

Design principle: Should not adversely increase pilot or ATC workload	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> 3.0° RNAV approaches are safe although ATC workload is a limiting factor on the number of RNAV approaches that can be flown at Heathrow which means that numbers in excess of 2% is unlikely. 			

Design principle evaluation	Option No: B2
Option Name: RNAV(GNSS) 3.2°	ACCEPT
Description of option: <ul style="list-style-type: none"> This option would see the Vertical Path Angle (VPA) all of Heathrow's RNAV approaches increased from 3.0° to 3.2°. The ILS will remain at 3.0°. Less than 2% of Heathrow's arrivals fly RNAV approaches. Carried forward. 	

Design principle: Must be safe	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated that the RNAV Vertical Path angle can be safely increased (to 3.2°). 			

Design principle: Must achieve the objective of reducing noise compared to a 3.0° approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated average noise reductions of 0.5dBA (SEL) for 3.2° RNAV approaches compared to 3.0° ILS approaches. 			

Design principle: Must not increase the numbers of go-arounds	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated that there were no increases in the number of go-arounds as a result of 3.2° RNAV approaches. 			

Design principle: Must not reduce Heathrow's capacity	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated that there was no reduction in capacity as a result of 3.2° RNAV approaches. However, ATC workload is a limiting factor on the number of RNAV approaches that can be flown at Heathrow. 			

Design principle: Must not change the lateral tracks of aircraft over the ground	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated that there was no change to the lateral tracks of aircraft over the ground as a result of 3.2° RNAV approaches. 			

Design principle: Should not reduce the ability for arrivals to fly Continuous Descent Approach.	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated that there was no reduction in CDA performance as a result of 3.2° RNAV approaches. 			

Design principle: Should maximise the number of aircraft able to fly the slightly steeper approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Nearly all Heathrow's aircraft are capable of performing RNAV approaches although ATC workload is a limiting factor on the number of RNAV approaches that can be flown at Heathrow which means that numbers in excess of 2% is unlikely. (This workload increase is not expected to be a factor for Slightly Steeper ILS approaches). 			

Design principle: Should not adversely increase pilot or ATC workload	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Heathrow's trials demonstrated that 3.2° RNAV approaches are safe although ATC workload is a limiting factor on the number of RNAV approaches that can be flown at Heathrow which means that numbers in excess of 2% is unlikely. 			

Design principle evaluation	Option No: B3
Option Name: RNAV(GNSS) 3.5°	REJECT
Description of option: <ul style="list-style-type: none"> • This option would see the Vertical Path Angle (VPA) all of Heathrow’s RNAV approaches increased from 3.0° to 3.5°. The ILS will remain at 3.0°. • When air temperature is above 15°C, these procedures would be unavailable. This option would result in significantly less than 2% of Heathrow’s arrivals flying the approach. • Rejected 	

Design principle: Must be safe	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> • No evidence available to support that 3.5° RNAV approaches at Heathrow are safe. However, a maximum VPA of 3.27° would only be permitted owing to the effect of temperature – this angle would cater for the hottest day on record at Heathrow. 			

Design principle: Must achieve the objective of reducing noise compared to a 3.0° approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> • It is likely that 3.5° approaches would reduce noise at ground level during some portions of final approach but there is no evidence to support this. It is also likely that landing gear and flap deployment would change in order to manage the energy of the aircraft. This could result in more noise under some parts of final approach. 			

Design principle: Must not increase the numbers of go-arounds	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> • No evidence available to support that 3.5° RNAV approaches would result in no increase in go-arounds. Anecdotally, airlines advised that an increase in go-arounds is likely for angles greater than 3.2° in a high intensity operation. This is articulated in the slightly steeper approach trial reports. 			

Design principle: Must not reduce Heathrow’s capacity	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> • If an increase in go-arounds materialised, this would result in a reduction in Heathrow capacity. However, no evidence to support this at this time. 			

Design principle: Must not change the lateral tracks of aircraft over the ground	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No evidence available to support that 3.5° RNAV approaches would not result in a change to the tracks over the ground. 			

Design principle: Should not reduce the ability for arrivals to fly Continuous Descent Approach.	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No evidence available to support that 3.5° RNAV approaches would not result in a reduction in CDA performance. 			

Design principle: Should maximise the number of aircraft able to fly the slightly steeper approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> Concerns from operators as to the increased energy management would likely result in significantly less than 2% of Heathrow's arrivals flying the approach. 			

Design principle: Should not adversely increase pilot or ATC workload	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No evidence to suggest an increase in pilot or ATC workload although an increase in pilot workload can be expected due to the increased energy and speed of the aircraft that would need to be managed by the pilot. Pilots will not be used to flying a 3.5° approach and as well as energy management on final approach they could have a longer flare and a greater discrepancy to the PAPIs to take account of. 			

Design principle evaluation	Option No: B4
Option Name: RNAV(GNSS) Segmented 4.5° to 3.2°	REJECT
Description of option: <ul style="list-style-type: none"> This option is based on the live operational trials performed by British Airways at Heathrow in 2015 although that saw a 4.5° approach reducing to 3.0°. Would result in significantly less than 2% of Heathrow’s arrivals flying the approach as they would require specific operator and crew certification to fly them. 	

Design principle: Must be safe	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> The trials performed by British Airways in 2015 demonstrated that the concept was safe however they were limited in number and were performed during low traffic levels. There is no evidence available to support that segmented RNAV approaches at Heathrow are safe during a high intensity operation. Further evidence required. 			

Design principle: Must achieve the objective of reducing noise compared to a 3.0° approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> There is no evidence that would enable Heathrow to claim an overall noise benefit with such approaches. The trials in 2015 did not measure noise impacts. It is likely that these approaches would reduce noise at ground level during some portions of final approach but there is no evidence to support this. It is also possible that landing gear and flap deployment would change in order to manage the energy of the aircraft. This could result in more noise under some parts of final approach. Further evidence required. 			

Design principle: Must not increase the numbers of go-arounds	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No evidence available to support whether segmented approaches would result in an increase in the number of go-arounds or not. Further evidence required. 			

Design principle: Must not reduce Heathrow’s capacity	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No firm evidence available to support that segmented approaches would result in a reduction in Heathrow capacity. Segmented approach trials did take place at Heathrow in limited conditions for a small number of flights with increased spacing between arrivals due to the potential for increased Vortex Wake encounters. Further evidence is required to understand the effect of such approaches on Heathrow’s landing rates. 			

Design principle: Must not change the lateral tracks of aircraft over the ground	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No evidence available to understand if segmented approaches would result in a change to the tracks over the ground. 			

Design principle: Should not reduce the ability for arrivals to fly Continuous Descent Approach.	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> No evidence available to understand if segmented approaches would result in a reduction in CDA performance. 			

Design principle: Should maximise the number of aircraft able to fly the slightly steeper approach	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> In 2015, British Airways flew a limited number of segmented approaches into Heathrow under trial conditions on B777 aircraft. Whilst the procedures were flown safely, the spacing on final approach between subsequent aircraft was greatly increased to cater for a potential increase in Vortex Wake encounters. In addition, the pilots selected to fly the procedures were briefed and trained to fly the approaches for the trial period. Such approaches would require individual crew training and approval and therefore the numbers of approaches flown would be very low indeed as there would be a limited need for operators to train their crews to fly these approaches. This would result in significantly less than 2% of Heathrow's arrivals flying the approach. 			

Design principle: Should not adversely increase pilot or ATC workload	Not met	Partial	Met
Summary of qualitative assessment: <ul style="list-style-type: none"> The complex nature of these approaches increases pilot workload on final approach and hence require individual crew training and approval because they are considered non-standard. 			