

CAA CAP 1616 Options Appraisal Assessment (Phase III Final)

Title of Airspace Change Proposal:	Heathrow Slightly Steeper Approaches
Change Sponsor:	Heathrow Airport
ACP Project Ref Number:	ACP-2017-49

Account Manager: [REDACTED]		Airspace Regulator (Engagement & Consultation): [REDACTED]		IFP: [REDACTED]		OGC: [REDACTED]	
Airspace Regulator (Principal): [REDACTED]		Airspace Regulator (Environmental): [REDACTED]		Airspace Regulator (Economist): [REDACTED]		ATM (Inspector ATS Ops): [REDACTED]	

Instructions

To aid the SARG project leader's efficient project management, please highlight the "status" cell for each question using one of the four colours to illustrate if it is:

Resolved - GREEN

Not Resolved – AMBER

Not Compliant – RED

Not Applicable - GREY

Guidance

The broad principle of economic impact analysis is **proportionality**; is the level of analysis involved proportionate to the likely impact from that ACP? There are three broad levels of economic analysis; qualitative discussion, quantified through metrics, and monetised in £ terms. The more significant the impact, the greater should be the effort by sponsors to quantify and monetise the impact.

1. Background – Identifying the Do Nothing (DN) /Do Minimum (DM) scenarios			Status
1.1	Are the outcomes of DN/DM scenarios clearly outlined in the proposal?		<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
1.1.1	Has the change sponsor produced an Options Appraisal (Phase III - Final) which consists of the Full appraisal with any refinements or changes made as a result of the Stage 3 formal consultation with stakeholders? [E24]	<p>Yes, the change sponsor has produced the Final Options Appraisal which summarises the outcome of the consultation feedback received from stakeholders. The sponsor states that there are no changes to the final proposal because of the stakeholders' consultation but has addressed the feedback received by the CAA during the Gateway at Stage 3.</p> <p>Addressing CAA's feedback includes updating the WebTAG Noise table which has led to a slight change in the final Net Present Value compared to Stage 3, attributable to the underlying updated TAG data.</p>	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

2. Direct impact on air traffic control					Status
2.1	Are there direct cost impacts on air traffic control / management systems? If so, please provide below details of the factors considered and the level in which this has been analysed.				<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2.1.1	<i>Examples of costs considered (please add costs that have been discussed, and any reasonable costs that the Airspace Regulator (Technical) feels have NOT been addressed)</i>				
		Not applicable	Qualitative	Quantified	Monetised
2.1.2	Infrastructure changes		x	N/A	N/A
2.1.3	Deployment		x	N/A	N/A
2.1.4	Training		x	N/A	N/A
2.1.5	Day-to-day operational costs / workload / risks		x	N/A	N/A
2.1.6	Other (provide details)	x			

2.1.7	Comments: The sponsor states that there are no changes in the assessment compared to the one provided at Stage 3, hence provides a qualitative assessment of the infrastructure change, deployment and training costs which will not be affected by the proposed airspace change. There will not be deployment and training costs because IFP design, validation, AIP promulgation and ATC operational instructions were completed during the flight trials completed in 2015 and 2017.				
2.2	Are there direct beneficial impacts on air traffic control / management systems? If so, please provide details and how they have been addressed:				<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
2.2.1	Examples of benefits considered	Not applicable	Qualitative	Quantified	Monetised
2.2.2	Reduced work-load	x			
2.2.3	Reduced complexity / risk	x			
2.2.4	Other (provide details)	x			
2.2.5	Comments: N/A				
2.3	Where monetised, what is the net monetised impact on air traffic control (in net present value) over the project period? N/A				
2.4	Are the direct impacts on air traffic management analysed accurately and proportionately? Yes. The sponsor provides an accurate and proportionate analysis of the direct impacts of the final option suggesting that its impact would be marginal, due to the nature of the proposed airspace change that will only affect vertical flight paths leaving lateral ones unchanged.				<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

3. Changes in air traffic movements / projections				Status	
3.1	What is the impact of the ACP on the following and has it been addressed in the ACP proposal?			<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
		Not applicable	Qualitative	Quantified	Monetised
3.1.1	Number of aircraft movements	x			
3.1.2	Type of aircraft movement		x	N/A	N/A





3.1.3	Distance travelled	x			
3.1.4	Area flown over / affected		x	N/A	N/A
3.1.5	Other impacts	x			
3.1.6	Comments: The sponsor states that the proposed final option does not aim to change traffic movements and that the traffic cap of 480,000 movements per annum will be the same by 2031. The sponsor clarifies that the provided forecast has not considered a change in the number of movements in 2031 but evaluates aircraft fleet turnover and retirements, and future aircraft types predicted to be in operation in that year, along with how routes may be used to reflect departure destinations.				
3.2	Has the forecasting of traffic done reasonably using best available guidance (e.g. DfT WebTAG, the Green Book, Academic sources...etc?) Yes. The sponsor used 2019 traffic data to inform the baseline assessment for the Final Options Appraisal. This was selected as the sponsor states that Heathrow Airport was operating close to its capped traffic movements of 480,000 per annum. The sponsor expects demand to recover close to the traffic cap of 480,000 movements per annum before 2031. HAL provided a robust justification for the capped traffic movements that are based on: i. aircraft fleet turnover and retirements, ii. future aircraft types predicted to be in operation, and iii. how routes may be used to reflect departure destinations.				   

Table 2 Fleet mix % 2019/2031

Aircraft (IATA Code)	Aircraft (ICAO Code)	2019 Movements %	2031 Movements %
77W	7773ER	4.5	5.3
321	A321-232	13.4	4.2
333	A330-343	1.3	1.5
772	777200	4	0
788	7878R	3.6	6.6
789	7879	4.4	10.7
763	767300	0.2	0
7M8	737MAX8	0.5	1
319	A319-131	21.8	2.2
320	A320-211	17.1	9.4
32A	A320-232	12.6	0
738	737800	1.1	0.3
E90	E190	0.5	0
32B	A321	0.5	0.4
359	A350-941	0.7	2
388	A380-841	2	0

	Aircraft (IATA Code)	Aircraft (ICAO Code)	2019 Movements %	2031 Movements %
	744	747400	2.7	0
	DH4	Dash -8	1.2	0
	332	A330-200	1.2	0.4
	773	7773ER	0.4	1.9
	74N	7478	0.1	0
	74Y	747400	0.2	0
	346	A340-600	0.6	0
	76W	767300	1	0
	32Q	A321neo	0.8	0
	76W	757200	0.2	0
	752	757200	0.2	0
	77X	777200	0.1	0
	73H	737800	0.8	0
	73J	737900	0.1	0
	73W	737700	0.5	0
	CS1	737700	0.2	0
	CS3	CS300	0.5	0
	339	A330neo-900	0.2	0.5
	32S	A320-211	0.3	0

Aircraft (IATA Code)	Aircraft (ICAO Code)	2019 Movements %	2031 Movements %
351	A350-1000	0.1	7.8
ABY	A300-600	0.3	0
318	A318-100	0.1	0
320N	A320neo	0	31.2
321N	A321neo	0	7.6
781	78710	0	0.6
32H	A320 (s)	0	3.2
319N	A319neo	0	0.4
E95	EMB195	0	1
7M9	737MAX8	0	0.3
74H	7478	0	0.1
7M7	737MAX8	0	1
779	777X-900	0	0.4
	Total	100	100

3.3



What is the impact of the above changes (3.1) on the following factors?

The sponsor has updated the WebTAG tables, monetised the net benefits of implementing the final options - NPV £27,630,267, and provided a justification for the marginal changes in the NPV at this stage for the stakeholders. The noise WebTAG assessment of adopting 3.2° RNAV SSA is summarised in the table below:

Noise Workbook - Worksheet 1

Proposal Name: Environmental Appraisals for LHR SSA ACP

Present Value Base Year:

Current Year:

Proposal Opening year:

Project (Road, Rail or Aviation):

	WebTAG assessment	Sensitivity test excluding impacts below 51 dB (for aviation proposals only)
Net present value of change in noise (£, 2010 prices):	£27,630,267	£10,543,304
	<small>Positive values indicate a net benefit (i.e. a reduction in noise)</small>	
Net present value of impact on sleep disturbance (£, 2010 prices):	£10,121,350	£1,625,423
Net present value of impact on amenity (£, 2010 prices):	£14,916,333	£5,125,297
Net present value of impact on AMI (£, 2010 prices):	£51,094	£51,094
Net present value of impact on stroke (£, 2010 prices):	£1,012,953	£1,012,953
Net present value of impact on dementia (£, 2010 prices):	£1,528,538	£1,528,538

Quantitative results

households experiencing increased daytime noise in forecast year:	12408
households experiencing reduced daytime noise in forecast year:	41825
households experiencing increased night time noise in forecast year:	1008
households experiencing reduced night time noise in forecast year:	12170

Figure 1 WebTAG output for option B2 .32° RNAV SSA using July 2020 WebTAG workbook

In addition to WebTAG, the sponsor utilised data gathered from the SSA trials which demonstrated an average Sound Exposure Level (SEL) reduction of 0.51 dBA¹ per aircraft when compared to the existing 3.0° ILS approach. The sponsor does caveat that this reduction would be imperceptible from the ground however the permanent adoption of 3.2° RNAV SSAs is regarded as an “*incremental step to reducing the impact of Heathrow Airport’s noise footprint on health and quality of life*”.

Regarding fuel burn and CO₂ emissions, the sponsor provided a quantified assessment calculated using the EUROCONTROL BADA Aircraft

¹ Calculated by HAL using the differences in average measured aircraft SEL between approaches using the 3.2° RNAV SSA compared to the existing 3.0° ILS approach. This was measured at the following Noise Monitoring Terminals (NMT): NMT129, NMT130 and NMT131.

<p>Performance Model² as implemented within the Aviation Environmental Design Tool (AEDT) version 3b for the Airbus A320, the most common aircraft variant in operation at Heathrow Airport. The model suggested a 1.3% reduction in average engine thrust between 10,000 ft and touchdown, resulting in a 3% reduction in fuel burn and subsequent carbon emissions. Further analysis by the sponsor showed that the majority of reduced thrust and fuel burn occurred in the final approach between 4,500 ft and touchdown, resulting in a 9.8% reduction in thrust and subsequent 7.4% reduction in fuel burn and CO₂ emissions for this segment of flight. The sponsor states that this effect on thrust and fuel burn is “likely” to be similar for other aircraft variants. The sponsor’s conclusion of an overall negligible reduction in CO₂ emissions is considered reasonable given 0.6% of arrivals that operated SSAs into Heathrow Airport in 2019.</p> <p>Similarly, for Local Air Quality, the sponsor provided a quantified assessment using the EUROCONTROL BADA Aircraft Performance Model³ as implemented within the Aviation Environmental Design Tool (AEDT) version 3b for the Airbus A320. The model predicted a 1.3% reduction in average engine thrust between 10,000 ft and touchdown when compared to a 3.0° approach, which is anticipated to result in “lower” overall emissions of NO_x, Particulate Matter (PM) and hydrocarbons. The sponsor continues to state that the steeper Vertical Path Angle (VPA) maintains the aircraft at a slightly higher altitude above ground for longer, thus “reducing” the contribution of emissions to ground level air quality. The sponsor’s conclusion of an overall marginal positive impact to air quality due to the 0.6% of aircraft that operated SSA in 2019 is reasonable.</p> <p>The sponsor provides a qualitative assessment of the impacts upon tranquillity, stating as there will be no change to existing lateral flight paths and no increase in the number of air traffic movements, the nationally protected landscapes of National Parks and Areas of Outstanding Natural Beauty (AONBs) will not be impacted by this airspace change. The sponsor also refers to the noise assessment with respect to Tranquillity, stating that any noise decrease as a result of SSAs will be “imperceptible on the ground”, therefore concluding that any effects on sensitive biodiversity or tranquillity receptors as a result of permanently adopting SSAs will be “negligible”. These conclusions are considered reasonable.</p> <p>A qualitative assessment of the impacts upon biodiversity were provided by the sponsor, concluding a negligible impact. This conclusion was based on the fact that any noise or emissions decrease as a result of SSAs will be “imperceptible” on the ground.</p>		Not applicable	Qualitative	Quantified	Monetised
3.3.1	Noise			x	x
3.3.2	Fuel Burn			x	N/A
3.3.3	CO2 Emissions			x	
3.3.4	Operational complexities for users of airspace	x			

² EUROCONTROL, (2011) Base of Aircraft Data Aircraft Performance Model version 3.9.

³ EUROCONTROL, (2011) Base of Aircraft Data Aircraft Performance Model version 3.9.

3.3.5	Number of air passengers / cargo	X																																																																																														
3.3.6	Flight time savings / Delays	X																																																																																														
3.3.7	Air Quality			X	N/A																																																																																											
3.3.8	Tranquillity		X		N/A																																																																																											
3.4	Are the traffic forecast and the associate impact analysed proportionately and accurately according to available guidelines (e.g. WebTAG or the Green Book?) Yes, see 3.2				<div><div><input checked="" type="checkbox"/></div><div><input type="checkbox"/></div><div><input type="checkbox"/></div><div><input type="checkbox"/></div></div>																																																																																											
3.5	What is the total monetised impact of 3.3? (Provide comments) The sponsor estimates a net present value of £5.3 million																																																																																															
<table><tr><th>Year</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th><th>2027</th><th>2028</th><th>2029</th><th>2030</th><th>2031</th><th>Net Present Value (NPV)</th></tr><tr><th>CBA Year</th><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td></td></tr><tr><th>Discount factor</th><td>1</td><td>0.9662</td><td>0.9335</td><td>0.9019</td><td>0.8714</td><td>0.842</td><td>0.8135</td><td>0.786</td><td>0.7594</td><td>0.7337</td><td>0.7089</td><td></td></tr><tr><td>Net community benefit (Noise) M£</td><td>0.33</td><td>0.37</td><td>0.40</td><td>0.43</td><td>0.46</td><td>0.49</td><td>0.52</td><td>0.54</td><td>0.57</td><td>0.60</td><td>0.62</td><td>5.33</td></tr><tr><td>Net airspace users benefit</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>Net sponsors benefit</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>Present value</td><td>0.33</td><td>0.37</td><td>0.40</td><td>0.43</td><td>0.46</td><td>0.49</td><td>0.52</td><td>0.54</td><td>0.57</td><td>0.60</td><td>0.62</td><td>5.33</td></tr></table>						Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Net Present Value (NPV)	CBA Year	0	1	2	3	4	5	6	7	8	9	10		Discount factor	1	0.9662	0.9335	0.9019	0.8714	0.842	0.8135	0.786	0.7594	0.7337	0.7089		Net community benefit (Noise) M£	0.33	0.37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.62	5.33	Net airspace users benefit	0	0	0	0	0	0	0	0	0	0	0	0	Net sponsors benefit	0	0	0	0	0	0	0	0	0	0	0	0	Present value	0.33	0.37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.62	5.33
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4. Benefits of ACP					Status
4.1	Does the ACP impact refer to the following groups and how they are impacted by the ACP?				
		Not applicable	Qualitative	Quantified	Monetised
4.1.1	Air Passengers	x			
4.1.2	Air Cargo Users	x			
4.1.3	General aviation users		x	N/A	N/A

4.1.4	Airlines	x			
4.1.5	Airports	x			
4.1.6	Local communities			x	x
4.1.7	Wider Public / Economy		x	N/A	N/A
4.1.8	Comments: The FOA states that the proposed airspace change is not going to have an impact on the existing controlled airspace boundaries, or airspace classifications or on traffic numbers with the introduction of 3.2° RNAV SSA. The proposed final option, Option B2, will not change the current impact on general aviation (GA) access. The proposed airspace change will not increase traffic movements and the current traffic cap of 480,000 movements per annum will remain, as reinforced by the results of the flight trials in 2017 and 2019. The WebTAG assessment provided by the sponsor indicates an overall net benefit in terms of the number of people impacted by noise. The overall reduction of 0.51 dBA for aircraft operating the 3.2° RNAV SSA would be imperceptible from the ground, however, the permanent adoption of 3.2° RNAV SSAs is regarded as an “ <i>incremental step to reducing the impact of Heathrow Airport’s noise footprint on health and quality of life</i> ”.				
4.2	How are the above groups impacted by the ACP, especially (but not exclusively) looking at the following factors: below:				
4.2.1	Improved journey time for customers of air travel	N/A			
4.2.2	Increase choice of frequency and destinations from airport	N/A			
4.2.3	Reduced price due to additional competition because of new capacity	N/A			
4.2.4	Wider economic benefits	N/A			
4.2.5	Other impacts	N/A			
4.2.6	Comments: The sponsor predicts a positive impact on society such as the reduction in the noise level, better air quality and tranquillity.				
4.3	What is the overall monetised impacts associated with 4.1 and 4.2 the above? See Q3.5				
4.4	What are the non-monetised but quantified impacts of the above? (Insert details of description) Based on 2019 data, there is a potential fuel burn reduction (approx. 3%) when aircrafts use the 3.2°VPA rather than a 3.0° VPA.				
4.5	What are the qualitative / strategic impacts described above? The sponsor promotes the implementation of a 3.2° VPA approaches that will lead to a reduction in the noise impact and potentially to a reduction in the fuel burn and CO ₂ emissions, hence an overall better air quality.				

4.6	What is the overall monetised benefits-costs ratio (BCR) of the policy? Is it more than 1? N/A			
4.7	Have the sponsors provided reasonable justification for the proportionality of analysis above? Yes, the sponsor undertakes a quantitative assessment of the noise impact and provides sufficient justification of the qualitative assessment carried out for the fuel burn, i.e. small percentage of 3.2° VPA approaches (0.6% in 2019).			<div><div><input checked="" type="checkbox"/></div><div><input type="checkbox"/></div><div><input type="checkbox"/></div><div><input type="checkbox"/></div></div>
4.8	If the BCR is less than 1, are the quantitative and qualitative strategic impacts proportional to the costs of the ACP? Nil			

5. Other aspects	
5.1	Nil

6. Summary of Assessment of Economic Impacts & Conclusions		
6.1	<p>The Final Options Appraisal fulfils the minimum requirement for the options appraisal for a (scalable) Level 1 ACP. The sponsor provides both a qualitative and a quantitative assessment of the environmental impacts this ACP will have. The final option - Option B2: 3.2° RNAV SSA - aims to introduce only vertical flight path changes, leaving the lateral flight paths unchanged, therefore marginal benefits, i.e. noise reduction, fuel burn and CO2 emissions reductions, are expected. The sponsor clarifies that the proposed change will not increase the airspace capacity and its usage and, predicts that the maximum traffic movements of today (i.e. 480,000 movements per annum in 2019) are expected to be the same in 2031. These conclusions are based on: <i>i.</i> aircraft fleet turnover and retirements assumptions; <i>ii.</i> the future aircraft types in operation; and <i>iii.</i> Use of routes to reflect departure destinations. The estimated benefits of the proposed airspace change is equal to (Net Present Value, NPV) £27,632,143.</p> <p>The CAA concludes that the FOA summaries the main impacts of the proposed airspace change, and it is in line with the CAP1616 requirements.</p>	
Outstanding issues?		
Serial	Issue	Action required
Nil		

CAA Initial Options Appraisal Completed by	Name	Signature	Date
Airspace Regulator (Economist)	[REDACTED]	[REDACTED]	18/06/2021
Airspace Regulator (Environmental)	[REDACTED]	[REDACTED]	16/07/2021

Please see accompanying CAA Operational Assessment for Final Regulatory Decision made by Head of Airspace, ATM and Aerodromes