CAA CAP 1616 Options Appraisal Assessment (Phase II Full)

Title of Airspace Change Proposal:	Shetland Space Centre Satellite Vertical Launch Safety Area		
Change Sponsor:	Shetland Space Centre Limited (trading as SaxaVord Spaceport)		
ACP Project Ref Number:	ACP-2017-79		
Case study commencement date:	23/01/2023	**Case study report as at:**	18/04/2023

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

Instructions

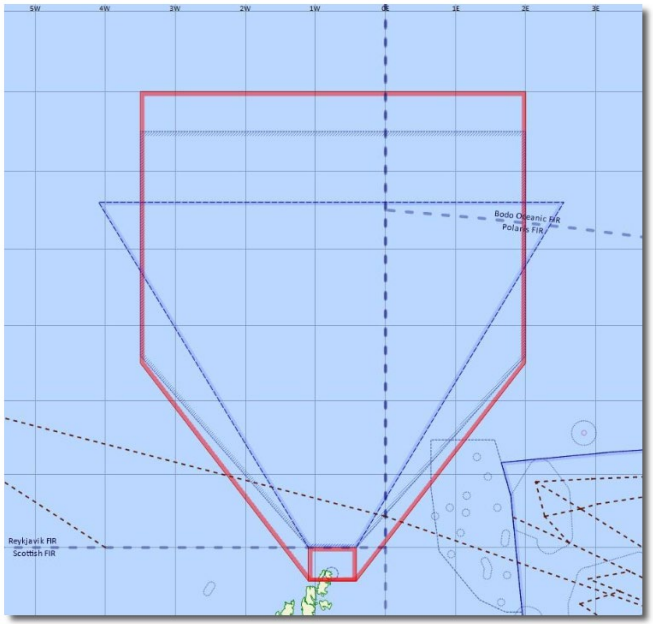
To aid the SARG project leader's efficient project management, please highlight the "status" cell for each question using one of the four colours to illustrate if it is:

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 impact of the shortlist of options (including Do Nothing (DN) / Do Minimum (DM))			Status
1.1	**Are the outcomes of DN/DM and DS scenarios clearly outlined in the proposal?**		☒ ☐ ☐ ☐
1.1.1	Has the change sponsor produced an Options Appraisal (Phase II - Full) which sets out how Initial appraisal is developed into a more detailed quantitative assessment, moving from qualitatively defined shortlist options to the selected preferred option? [E23]	Yes, the change sponsor has produced the second phase of the options appraisal which refined the shortlist of options considered by the Sponsor. The Full Options Appraisal (FOA) was built on the Initial Options Appraisal but introduces a different option – Option 3 which further refines the Sponsor's preferred option at Stage 2 and introduces a revised segmentation mechanism within the wedge shape and remains the only design option to be consulted upon Stage 3. The Full Options Appraisal also includes more detailed monetised analysis as suggested to the Sponsor; the greenhouse gas and fuel burn impact for the proposed Option 3 was monetised for the incremental change against the Baseline (i.e. no change).	☒ ☐ ☐ ☐
1.1.2	Does each shortlist option include the impacts in comparison to the 'do nothing / do minimum' option, in particular: -all reasonable costs and benefits quantified -all other costs and benefits described qualitatively -reasons why costs and benefits have not been quantified	The Sponsor did only take forward Design Option 2 to Stage 3 as a result of Stage 2 and also reported that the airspace design could evolve as the ACP process continued and options were matured and refined. So, at Stage 3 the Sponsor stated performance data for potential LV (launch vehicles) seeking to utilise the spaceport evolved has in turn precipitated a refinement of the airspace design being proposed. The Sponsor's now considering a refined shape for the airspace design that introduces revised segmentation mechanism within the wedge shape and remains the only design option to be consulted upon Stage 3.	☒ ☐ ☐ ☐

		 *Figure 1 - Design Option 3 (Outline) Compared With Stage 2 "Box and Wedge"* So, the Sponsor has only considered Design Option 3 and assessed its impacts against the baseline scenario. The impacts they reported for the Design Option 2 at Stage 2 is exactly the same for the Design Option 3 but this time the sponsor also managed to detail the analysis with further monetisation and considering not only the indirect impacts of greenhouse gas (GHG) from the airspace change considered but also the direct impacts of the launch vehicle itself too. Therefore, their approach for this unique airspace change and slight diversion from the process by discounting Design Option 2 without assessing it in this stage is found to be reasonable and accepted to be resolved by the CAA.	

1.1.3	Where options have been discounted, does the change sponsor clearly set out why?	SaxaVord decided to discount and refine the structure they considered for their preferred option at Stage 2. The reason of the Sponsor to decide to refine the original design structure is that the proposed segments with the original design concept could be very complicated as there would be many complex co-ordinates and some individual segments could traverse FIR boundaries. Therefore, SaxaVord only considered Design Option 3 which uses segments based on simplified lines of latitude and longitude.	☒ ☐ ☐ ☐

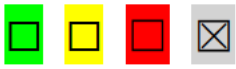
2. Impacts of the proposed airspace change					**Status**
2.1	**Are there direct impacts on the following:**				☒ ☐ ☐ ☐
2.1.1	*Examples of costs considered (please add costs that have been discussed, and any reasonable costs that the Airspace Regulator (Technical) feels have NOT been addressed)*				
2.1.2	Airport/ANSPs	Not applicable	Qualitative	Quantified	Monetised
	- Infrastructure	X			
	- Operation	X			
	- Deployment	X			
	- Other(s)	X			
2.1.3	Commercial Airlines/General Aviation	Not applicable	Qualitative	Quantified	Monetised
	- Training	X			
	- Economic impact from increased effective capacity	X			
	- Fuel burn		X	X	X

	- Other(s)	X			
2.1.4	General Aviation	Not applicable	Qualitative	Quantified	Monetised
	- Access	X			
2.1.5	Military	Not applicable	Qualitative	Quantified	Monetised
		X			
2.1.6	Wider Society, i.e., wider economic benefits, capacity resilience	Not applicable	Qualitative	Quantified	Monetised
		X			
2.1.7	Other (provide details)	Not applicable	Qualitative	Quantified	Monetised
	Greenhouse gas impact on wider society has been also assessed against the baseline scenario for indirect and direct impacts of the launch vehicles that may launch from SaxaVord.		X	X	X

2.2 

Are there direct beneficial impacts on air traffic control / management systems? Provide details.

The Full Options Appraisal states that airspace reservations and their management are a routine occurrence for ANSPs. Design Option 3 would not impose neither a change in ANSP operational nor infrastructure costs.



2.3

Where impacts have been monetised, what is the overall value (expressed in net present value (NPV)) of the project?

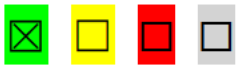
The Cost Benefit Analysis has not been provided by the Sponsor, but the monetisation has been completed for GHG and fuel burn impacts. So, the total NPVs are presented by the CAA in the table below.

Group	Impact	SaxaVord Assessment
Wider Society	**GHG**	-$103,792.65
	Direct	-$71,762.52
	Indirect	-$32,030.13
GA/Commercial Airlines	**Fuel Burn**	-$92,313.18
Total NPV		-$196,105.83

2.4

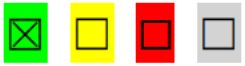
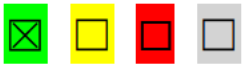
Has the sponsor provided an accurate and proportionate assessment of the proposed airspace change impacts?

BM – The sponsor has provided the monetised indirect and direct impacts of GHG (CO_2e) and fuel burn impact on



	commercial airlines which anticipates the incremental change for the most limiting case – activation of Design Option 3 against the baseline scenario. The FOA states it'd disproportionate to monetise and quantify the individual scenarios due to the numerous possible combinations of the activation of the airspace design and its impact on the wider ATM/airspace network and its users. SaxaVord analysed a year's ADS-B surveillance data to establish a pre-COVID-19 baseline traffic assessment to be able to identify potential impacts of Design Option 3 on the ATM/airspace network and its users. A peak day and hour were identified, and 12 flights observed that may be affected by the activation of Design Option 3. The sponsor also identified that 12 flights could increase to 14 flights in 11 years using EUROCONTROL traffic forecast data.	

3. Changes in air traffic movements / projections				**Status**
3.1	**If the proposed airspace change has an impact on the following factors, have they been addressed in the proposal?**			☒ ☐ ☐ ☐
		Not applicable	Qualitative	Quantified / Monetised
3.1.1	Number of aircraft movements	X		
3.1.2	Number of air passengers / cargo	X		
3.1.3	Type of aircraft movements (i.e., fleet mix)	X		
3.1.4	Distance travelled		X	X
3.1.5	Operational complexities for users of airspace	X		
3.1.6	Flight time savings / Delays	X		
3.1.7	Other impacts		X	X
	Comments: The FOA stated for the considered Design Option 3 that it will not drive changes that increase air transport numbers and estimated passenger numbers or cargo tonnage carried. However, in terms of the distance travelled the sponsor demonstrated in the IOA and FOA that the negligible re-route impacts associated with the activation of the proposed airspace design has an equally negligible impact on CO2e emissions; in some cases, the potential re-route could produce either a shorter, equivalent or longer flight distance. The FOA states flight distances were observed to be impacted by between -19 and +31km and SaxaVord takes into account the absolute worst-case scenario of an additional 31km for each flight even though an observed cumulative variation adds up to +12km across the whole flight sample. It is also explained in the FOA that the annual impact of flight distance across 12 flights and 30 instances (i.e. SaxaVord launches), fuel burn and CO2e could be shown to increase by 11.160km, 107 tonnes of fuel burn and 341 tonnes of CO2e respectively, representing a 0.39% increase in all metrics above the baseline			

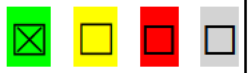
	calculations.	
3.2	• Has the sponsor used the most up-to-date, credible and clearly referenced source of data to develop the 10 years traffic forecast and considered the available guidelines (i.e., the Green Book and TAG models) in a proportionate and accurate manner? [B11 and E11] The sponsor has extracted traffic forecast data from EUROCONTROL's Traffic Forecast Update for Europe 2022-2029, dated Spring 2023. By using this data, the base scenario forecast is considered the measure for extrapolating data to 2029. The sponsor explains their methodology to drive the forecast from 2019 to 2034 in detail in the FOA; the assumed base and application of percentage variance by year is set out to see the differentiation for the 10-year period and the sponsor estimated the potential number of flights impacted by the airspace activation following the variances determined for low, base and high scenarios. The FOA also states the analysis assumed the most limited airspace design, Design Option 3. The sponsor has not developed any further detail at Stage 3 and used their same assumptions that they used in Stage 2. • Has the sponsor explained the methodology adopted to reach its input and analysis results? [B11 and E11] The sponsor's assessment of GHG impacts assumes a reroute of 12 flights and 31 km per flight due to each activation of the design option (based on AVISU's Airspace Analysis Report that used ADS-B data to perform a traffic survey assessment). For 30 launches in a year, this equates to an impact of 107 tonnes of additional fuel burn resulting in 341 tCO2e. ICAO's Carbon Emissions Calculator has been used to estimate fuel flow rates for a representative aircraft and trajectory. The sponsor's environmental assessment of direct space launch impacts is sourced from its Environmental Impact Assessment Report submitted as part of the planning applications made to the Shetland Islands Council. The planning applications have been approved and therefore results and conclusions from these assessments that are included to support this ACP are considered as acceptable. The sponsor also refers to the Assessment of Environmental Effects Report (AEE) submitted to the CAA as part of the SIA 2018 licence application. This application is still pending approval from the CAA's space team and therefore results and conclusions that are included in this ACP are considered as uncertain and unvalidated. The population data used for the probability of awakening assessment has been estimated using local knowledge and it is considered that the Stage 3 consultation may be used to confirm these assumptions.	 
3.3	**Has the sponsor developed an assessment of the following environmental aspects?** <u>Direct impacts (spaceflight activities):</u> The sponsor's assessment is based on the EIA and AEE mentioned above, including additional elements as required by government policy:	

	80 dB LAmax contours for Launch Pad 1, operational diagrams, encouragement for use of sustainable fuel and probability of awakenings. Indirect consequential impacts (other airspace users): The sponsor has scoped out impacts upon noise, air quality, tranquillity and biodiversity based on the limited number of aircraft operating in the airspace over land below 7,000 ft. (maximum of 2 aircraft per hour). This is evidenced through the 2019's ADS-B traffic survey described in AVISU's Airspace Analysis Report. The nature of surrounding airspace (Class G), the frequency of launches (30/year or approximately 1/week) and the launch duration (1 hour) also mitigate any further impacts. The sponsor has quantified GHG emissions due to consequential rerouting of aircraft around the design option based on the data and methodology described above.

		Not applicable	Qualitative	Quantified	Monetised
3.3.1	Noise			X	
3.3.2	Operational diagrams		X		
3.3.3	Overflight	X			
3.3.4	CO2 emissions			X	
3.3.5	Local air quality			X	
3.3.6	Tranquillity		X		
3.3.7	Biodiversity		X		

3.4	**What is the monetised impact (i.e., Net Present Value (NPV)) of 3.3? (Provide comments)** The sponsor has calculated the annual direct and indirect greenhouse gas impact for the launch campaigns that is reported to result in up to 764 tCO2e and 341 tonnes of CO2e respectively. Please refer to the NPVs given in the answer to Question 2.3.

4. Economic Indicators of the ACP	**Status**
4.1	**What are the qualitative / strategic impacts described in the ACP?** SaxaVord Spaceport seeks to conduct vertical launch operations for orbital and sub-orbital activities on Lamba Ness, Unst. A suitable airspace reservation of defined dimensions is required to ensure the safety of other airspace users from SaxaVord launch activities and to ensure the safety of SaxaVord launch activities from other airspace users. The proposed airspace reservation would be activated for the minimum specified periods necessary to support nominated launch operations and would extend from surface (SFC) to unlimited (UNLTD). The wider society and airlines may benefit from the negligible impacts associated with the activation of the proposed airspace design that has an equally negligible impact on fuel burn and CO2e emissions which in some cases lead to a shorter or equivalent flight distance.

4.2	**What is the overall monetised and non-monetised (quantified) impact of the proposed airspace change?** The overall monetised impact of the proposed airspace change for a year has been calculated as -$196,105.83.	
4.3	**What is the Net Present Value of the proposed options? Has the sponsor used this information to progress/discount options? Has the sponsor provided the benefits-costs ratio (BCR) of the proposed options and used it to support the choice of the preferred options? [E44]** The NPV of the proposed Design Option for the year of implementation is calculated as -$196,105.83. The sponsor has not used this information to progress or discount the options but only to complete the requirements of the process. The reason they haven't used this piece of information in their options appraisal is because they do not consider any other option at Stage 3. Even if the sponsor considered other options from Stage 2, they'd argue all quantifiable impacts were exactly the same for the proposed options as they based their assumptions for the potential impact of a worst-case scenario. The reported re-routing and flight distances caused as a result and its impact on CO2e and fuel burn assessments used for Design Option 2 now provided for Design Option 3 which is stated to be more efficient and enabling greater granularity in selecting the most appropriate airspace volume for a given space launch operation. Therefore, the sponsor has not calculated any other impact assessment for other options.	
4.3.1	**If the preferred option does not have the highest NPV or BCR, then has the sponsor justified the reasons to progress this option? [B50 and E23]** N/A – The preferred option already has a negative NPV but due to the nature of this ACP and the rationale of the sponsor to consider only one option, which provides the most efficient airspace structure comparing against the other complicated structures at Stage 2, the CAA concludes that the sponsor has justified with the set-out reasons of preference that the proposed Design Option 3 would better meet with their objective.	
4.4	**Have the sponsors provided reasonable justification for the proportionality of analysis above?** The sponsor provided proportionate environmental and economic impact assessment and more detailed quantified and monetised analysis for the indirect, direct impacts of GHG and fuel burn.	

5. Other aspects	
5.1	N/A

6. Summary of the Full Options Appraisal & Conclusions	
6.1	The sponsor has provided proportionate environmental and economic impact analysis for the Full Options Appraisal; they've improved the level of detail from Stage 2 and quantified and monetised indirect and direct impacts of CO2e plus fuel burn impact as advised to the sponsor after Stage 2. The sponsor also provided a better explanation as to how they consider the proposed options and they clearly identified the reasons why their preferred option at Stage 2 is now being discounted. SaxaVord provided the same explanation to detail their methodology to drive the estimation on CO2e emissions analysis and the traffic forecast driven from 2019 to 2034. In conclusion, the sponsor completed the necessary requirements for their Full Options Appraisal to indicate the impacts for their proposed option against the baseline scenario.

Outstanding issues		
Serial	Issue	Action required
1		
2		

CAA Full Options Appraisal Completed by	Name	Signature	Date
Airspace Regulator (Economist)	[redacted]	[redacted]	18/04/2023
Airspace Regulator (Environmental)	[redacted]		18/04/2023