Edinburgh Airport
Where Scotland meets the world

R24 Offset arrivals

Date: August 2018
Prepared by: Gordon Robertson

Contents

Background

Significant progress has been made in reducing the impact of aircraft noise on communities near airports. However as volumes of air traffic continue to increase efforts to reduce the effects, in terms of the process and procedures used, are continuing to be made.

Through the Cramond Noise Action Group meetings, Edinburgh Airport received a request to investigate the possibility of a curved or steeper approach for aircraft arriving onto Runway 24 (R24) in order to reduce the noise exposure to the Cramond community.

Cramond lies close to the final approach for R24 and the majority of arriving aircraft make a straight-in approach to the runway using the Instrument Landing System (ILS), overflying the community on its final approach.

Edinburgh Airport commissioned Osprey Consulting Services Ltd (Osprey) to undertake analysis on the potential benefits in terms of noise exposure that might be realised from introducing a curved or steeper approach to R24.

Initial studies

Offset and curved approach operations

This study was intended to aid Edinburgh Airport in assessing the potential implications of introducing offset or curved final (non-straight-in) approaches to reduce noise under the approach path. It examined the aircraft certification issues, pilot and aircraft operator requirements and airport infrastructure requirements together with airport operational and regulatory implications. It explored how the location of a noise sensitive area determines the likely effects of an offset approach and reviewed three other airports that have unusual (non-aligned) final approaches.

Modern turbo-jet and turbo-prop aircraft are designed to have highly efficient low drag aerodynamic characteristics. This helps reduce fuel consumption but does result in such aircraft needing longer distances for descent and deceleration. Landing beyond the ideal touchdown point or landing at excessive speeds can result in an aircraft over-running the end of the runway and excessive sink rates or failure to capture the correct vertical profile can contribute to hard landings or Controlled Flight into Terrain (CFIT).

In a de-stabilised approach, the rapidly changing and abnormal condition of the aircraft may lead to loss of control. Airliners must meet certain criteria on approach (such as height and speed) to be able to land safely, managing an aircraft during the descent and approach phases essentially becomes a task of aircraft energy management. Typically airline operators require the aircraft to be established on the glide path in the landing configuration at the correct speed at a specified height between 1,500 feet (ft) and 500 ft above runway level.

For the purposes of this report, the term ‘non-straight-in’ has been used generically to describe the following:

- an ‘offset approach’ – a procedure that has an approach path that is straight but not aligned to the runway centreline
- an ‘RNP AR approach’ – a procedure that has a turning element and aligns to the runway later than would normally be the case for an instrument approach procedure.

Below is a diagram that shows likely positions for a 5° offset, a 15° offset (not compliant with regulations but included for illustration), and an RNP AR from the north for runway 24 at Edinburgh Airport.

Figure 1 Example of Runway 24 Approach Routes (5° offset, a 15° offset and an RNP AR from the north)

The study concluded that a non-straight-in approach should not be pursued for reducing noise within 2 nautical miles (NM) of the runway threshold. This conclusion was based on the following considerations:

• Although limited noise reduction may be possible at specific locations in small areas, there would be a disproportionate increase in disturbance for other locations at greater ranges.
• There would be a significant risk that an application would be rejected by the Civil Aviation Authority (CAA) as it would be very unlikely that the operation could be shown to be as safe as a conventional approach, thereby increasing the risk of unstable approaches compared with the current conventional final approach operations.
• The operational complexity introduced due to mixed types of approaches to the runway, non-straight-in and conventional (as not all operators / airlines will be able to use a non-straight-in approach) would be significant for both the airport Air Traffic Control (ATC) and airlines as they would be required to:

- accept additional safety risk due to the inherent unconventional attributes of the non-straight-in approach
- introduce greater pilot workload, and potentially more unstable approaches, requiring additional training and risk management in the certification (approval) process
- integrate with other procedures at a greater distance from the airport; this would be a challenge and mean that overall, more people would be affected by noise. This could not be justified compared to the small potential benefit to a few in the communities around the airport
- accept additional operational risk in training and managing the approval of the procedure mix
- retain the capacity for straight in approaches by all operators when the use of non-standard approaches are prohibited due to inclement weather or operational circumstances.

Offset and curved approach noise study

Methodology

Osprey utilised the FAA Aviation Environment Design Tool (AEDT) (version 2c SP2) to calculate noise contours in order to meet the requirements of CAP 725, 54-72 dBA Leq contours (plotted at 3 dBA intervals) for aircraft movements in summer 2016. AEDT provides an aircraft performance model which handles, engine thrust, flap angles and speed and assumes aircraft complete a continuous decelerating approach, reaching final approach speed and full landing flap configuration (undercarriage down) at approximately 1,200 feet, ~ 4 Nautical Miles (NM) from threshold.

The study required a comparison between a modified northerly approach to R24, known as the R24 RNP AR Approach (Curved approach) to that of the current conventional approach to R24 following the extended centreline towards the runway (in this case, R24) from approximately 18 NM, referred to as the Straight-In Approach.

The study which was completed in AEDT, included full details of the aircraft flight profiles; the two separate noise studies utilised the same aircraft data for the R24 RNP AR Approach and Straight-In Approach profiles, and it assumed that 100% of all approaches were made using the analysed profiles.

For those specific aircraft models not contained within the AEDT database, a comparative aircraft model was selected. Furthermore, assumptions were made regarding the engine fit to aircraft types, in that individual aircraft matching from registration marking to specific aircraft engine fit have not been included. However, the study has applied the same assumptions to both approach profiles to establish a comparable result.

The analysis does not include data for night flights (between 2300 and 0700); therefore, no SEL footprints were modelled. Furthermore, noise contour modelling would ordinarily utilise arrival and departure data for both runways. This study has only considered arrival data for R24, assessing the effects of the two different approach paths only, and therefore the contours produced may differ from those previously published by Edinburgh Airport encompassing departures as well as arrivals.

Assumptions

In order to model a true comparison, a number of assumptions were made about the nature of Edinburgh Airport's traffic. All of the arrival data from the summer period 2016 that made an approach to R24 was utilised in the two separate analyses. The assumption was made that all aircraft positioning for arrival for R24 would either fly the Straight-In profile or all of the aircraft would fly the RNP AR (Curved approach).

If a new curved approach from the north were to be introduced, it is highly unlikely that all aircraft could be made to follow this approach as an alternative to the Straight-In. There are many reasons that aircraft may not be able to fly the Curved approach, which include the aircraft's equipment fit and a pilot's qualification to fly the Curved approach.

Furthermore, the example RW 24 RNP AR profile has not been simulated, safety assessed or achieved regulatory approval. The arrival direction (from the north or the south) will influence how aircraft enter the profile; aircraft from the south would be required to make extended paths to the north of Edinburgh Airport to initiate the Curved approach inducing noise displacement and disturbance to the north of the Airport as well as potentially leading to a greater environmental impact through greater fuel burn.

There are many factors including weather, aircraft performance and weight of aircraft that could also influence the ability to fly the Curved approach.

Results

Noise contours were produced for both of the approach profiles to provide a valid comparison. Analysis of the population database was made to understand how many households and people are exposed to the various noise levels for each approach.

The noise contour models were produced based on existing traffic levels and types of aircraft utilising the airport during the defined summer 2016 period for both of the R24 Approach profiles assessed. The data has been assessed to depict an average summers day based on annualised summer 2016 traffic levels between 16 June and 15 September.

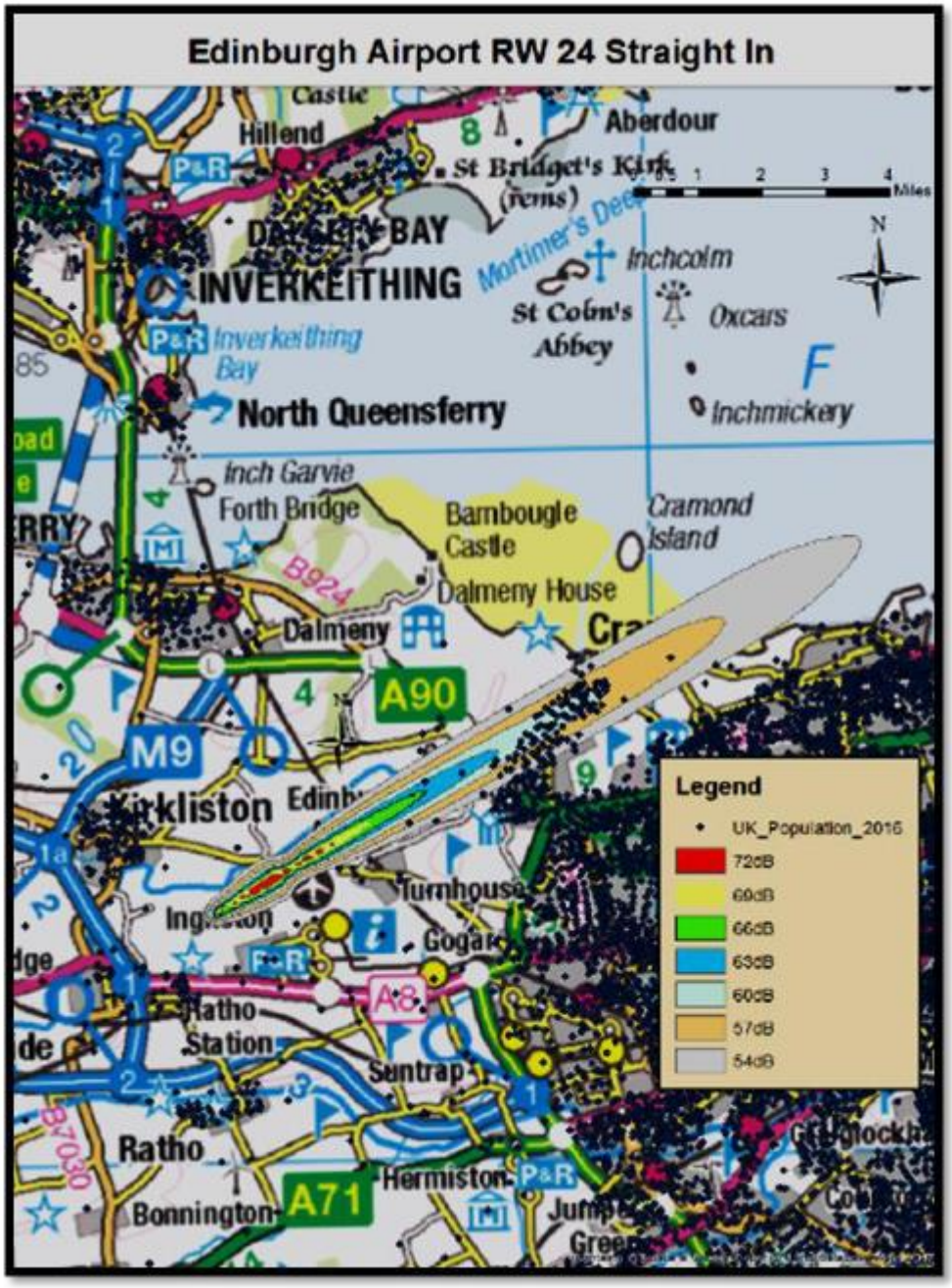

Figure 2 Noise Contours for Edinburgh Airport R24 Arrivals using the current operational Straight-In Approach

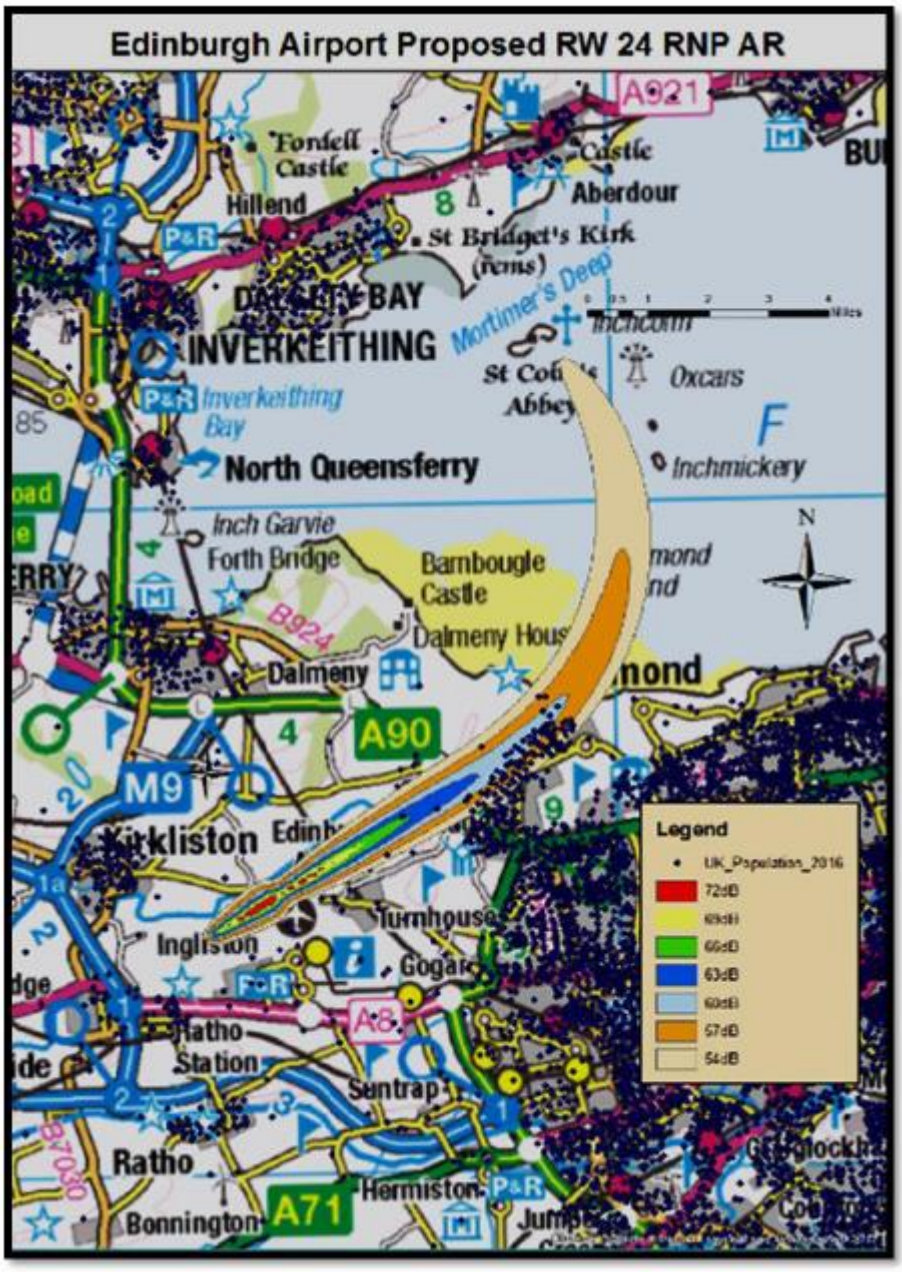

Figure 3 Noise Contours for Edinburgh Airport R24 Arrivals utilising a R24 RNP Approach

Analysis of both contour models shows that there is a slight shift northwards, near the Firth of Forth coast, in the 54, 57, and 60 dB contours for the Curved approach in comparison to the current Straight-In approach.

These indicate a potential minor reduction in noise exposure to the north edge of Cramond when aircraft fly the R24 RNP AR Approach as an alternative to the Straight-In Approach. However, there is a potential consequential increase in noise exposure towards Cramond Beach.

The estimated populations and households within the contours are summarised in Table 1 and Table 2 below. The population database used was a 2016 update of the 2011 Census supplied by CACI Ltd1. The figures are rounded to the nearest whole 50.

Leq (dBA)	Population	Households
>54	3500	1400
>57	2900	1200
>60	1800	750
>63	100	50
>66	<50	<50
>69	<50	<50
>72	<50	<50

Table 1 2016 Leq contours R24 straight in approach arrivals

Leq (dBA)	Population	Households
>54	2900	1200
>57	2100	950
>60	1200	550
>63	100	50
>66	<50	<50
>69	<50	<50
>72	<50	<50

Table 2 2016 Leq contours R24 RNP AR approach arrivals

The results provided within the tables above indicate that there is no change to the number of households or people exposed to noise levels of 63 dB, or above. These contours continue to be produced in an area within 1 NM of the runway. The modelling does indicate a slight reduction to the number of households and people exposed to noise levels between 54 dB and 60 dB from aircraft completing the R24 RNP AR Approach when compared to that of the R24 Straight-In Approach profile.

Households that potentially would benefit, if 100% of approaches could be made using the Curved Approach, are those between Cargilfield School and Whitehouse Rd, north of Barnton Ave (W) and south of Gamekeeper's Rd.

Context

The objective of the R24 RNP AR Approach analysis is to assess any theoretical potential reduction the noise exposure to those members of the public living within the Cramond area. Whilst a net reduction in noise exposure appears to have been indicated, in the Cramond area, this has to be balanced with adverse operational effects (detailed in the initial study) as well as environmental effects introduced in other geographical areas.

It is important to take these results into context. Whilst it may appear that there is some perceived improvement in noise exposure when aircraft utilise the R24 RNP AR Approach, the results must be considered carefully. If the R24 RNP AR Approach is safe, flyable, approved by the regulator it remains unlikely that Edinburgh Airport would be able to utilise the proposed R24 RNP AR Approach for 100% of arrivals utilising the runway; currently only 5% of arrivals could fly this type of approach. Any reduction in use would dilute theoretical potential benefit to Cramond in terms of a reduction in noise exposure for arriving aircraft to R24.

This study has not considered any other consequences of introducing a new route from the north. Even if all aircraft could fly the newly proposed approach, this would potentially mean a deviation from existing route profiles and potentially lead to an increase in aircraft miles flown, increases in fuel burn and so potential an overall increased environmental impact. Over 80% of airliners arriving at Edinburgh Airport do so from the south and the final approach path from the north would require an increase in miles flown to access and enter a curved profile from the north.

Conclusions

Any proposal to alter flight paths or routes must be carefully considered to ensure that any other consequences of any change are captured. Whilst this study does indicate that there might be some benefit to some individual areas if all aircraft were to utilise a curved approach to R24, there are some areas that would be exposed to new noise, or a higher noise level than currently. Any potential benefit must be considered against the likelihood of all aircraft being able to utilise the R24 RNP AR Approach.

The noise contour modelling has indicated that introducing a R24 RNP AR Approach as an alternative to a Straight-In Approach profile has the potential to reduce noise level exposure to a number of households in the Cramond area.

However, it is unrealistic to expect that 100% of aircraft arriving at Edinburgh Airport would be able, or indeed be required, to fly this profile. It is likely that some will simply not be equipped to fly it; some will not be able to accept a Curved Approach due to stabilisation issues and the R24 RNP AR Approach might not be suitable in certain aircraft configurations; resulting in a dilution of any potential reduction in noise exposure.

Operator feedback

The offset arrivals approach was presented to a number of airline operators and Air Traffic Control at the Flight Operators Safety Committee to gather their thoughts and feedback on the procedure. The meeting was attended by representatives from Flybe, Loganair, NATS, ANS, Ryanair, Etihad, Norwegian, Jet2.com, Police Scotland and Edinburgh Airport Airside Operations team and Environmental Noise Advisor.

The feedback given from the airlines was varied. Etihad would not consider it, due to the size of their aircraft and weather conditions at Edinburgh for safety reasons they would always use the ILS. Both Flybe and Ryanair agreed that it could be flown, but would involve extensive training and could be argued against as ultimately it is less safe than flying an ILS approach.

Conclusion

Based on the studies detailed above and feedback from airline operators Edinburgh Airport has decided not to introduce an offset or curved approach onto R24 at this time.

Any change must be considered in terms of overall cost/benefit. The results of the studies indicate that the introduction of a R24 RNP AR Approach might theoretically provide some benefit to a number of households in Cramond. However a significant assumption, that 100% of approaches would be made utilising the curved R24 RNP AR Approach, is highly unlikely and the theoretical gain to Cramond, in terms of noise exposure, would be diluted significantly by any reduction in that utilisation.