Civil Aviation Authority

GEORGE BEST BELFAST CITY AIRPORT

REPORT ON AIR NOISE ASPECTS OF PLANNING APPLICATION FOR RUNWAY EXTENSION

Introduction

1. George Best Belfast City Airport submitted an Environmental Statement (GBBCA, 2008) and two addenda (GBBCA, 2009 a, b) in support of a planning application to extend the main runway 04 – 22 in a north-easterly direction towards Belfast Lough by 590 metres. The extension at this end of the runway is made up of two components: the lengthening of the runway itself by 350 metres and an additional 240 metres comprising a starter strip and turning loop. The application also proposes a retraction of the opposite south-west end of the runway by 120 metres.

2. In 2006 an Examination in Public (EiP) was held to conduct an independent investigation relating the existing Belfast City Airport Planning Agreement, which controls certain aspects of the airport's operations. The background to environmental controls at the airport can be found in Chapter 3 of the EiP panel's report (EiP, 2006). The panel made a number of recommendations and a revised planning agreement (Planning Agreement, 2008) was put in force replacing the previous agreement (Planning Agreement, 1997).

3. The airport produced a master plan as required by the air transport white paper (DfT, 2003), this was the subject of consultation during 2005 and a final version was lodged with the Department for Transport in 2006 (BCA, 2006).

Aim

4. The aim of this paper is:

a) to provide an analysis of the Environmental Statement for the proposed runway extension, Master Plan and Noise Action Plan;

b) to provide an analysis of stakeholder submissions; and

c) to comment on the appropriateness of a role for an indicative contour as a means of controlling future operations at the airport.

Planning Agreement

5. The Environmental Statement (GBBCA, 2008) states that the proposed runway extension will permit increased take-off weights (i.e. an increased passenger, cargo or fuel load) of existing aircraft currently permitted to use the airport under the planning agreement (Planning Agreement, 2008). This agreement limits the number of air transport movements to 48,000 or less in any period of twelve months. It limits the number of seats from the airport offered for sale to no more than 2,000,000 in any period of twelve months. It limits the types of aircraft to those that comply with Chapter 3 of Annex 16 standards adopted by the

International Civil Aviation Organization. A total ban on aircraft that do not meet the Chapter 3 in the European Union has been effective since 1 April 2002 with exemptions granted only exceptionally. The agreement also prevents aircraft which meet the Chapter 3 standards but are only marginally compliant from operating at the airports. Marginal compliance is defined under the EC Operating Restrictions Directive (EC, 2002) as those aircraft that meet the Chapter 3 certification limits by a cumulative margin of not more than 5 EPNdB (Effective Perceived Noise in decibels) whereby this margin is obtained by adding the individual margins at each of the three reference points established for noise certification. This means that the reduction of noise experienced by an observer on the ground by a Chapter 3 aircraft permitted at the airport with respect to a marginally compliant aircraft will be of the order of 1 or 2 EPNdB at most. Most modern aircraft meet a new more stringent Chapter 4 standard that was introduced by ICAO in 2001. The Chapter 4 standard improves on the Chapter 3 standard by a cumulative margin of 10 EPNdB, which is equivalent to an improvement of a little over 3 EPNdB for an observer on the ground.

Aircraft types

6. The Environmental Statement divides aircraft into three categories for the purposes of assessment:

- Narrow Bodied – single aisle, usually twin engine, short to medium range aircraft of between 125 and 200 seats;
- Regional – single aisle, usually twin engine, short to medium range aircraft of between 60 and 124 seats; and
- Small – single aisle, usually single engine, short range aircraft of less than 60 seats

7. The Environmental Statement states that it is not possible to provide more detail in regard to traffic forecasts because the information is commercially sensitive. It is suggested this is a departure from standard practice in submitting planning applications for significant developments. For example, BAA's planning application to increase the capacity of Stansted, in terms of passengers and air transport movements, with its current runway provided an environmental statement that contains a comprehensive analysis of traffic forecasts by aircraft type/engine types/route details. It is noted that Table 12 of the master plan (BCA, 2006) gives a forecast of the traffic mix at five yearly intervals to 2030. It is difficult to understand how similar information in support of the planning application is commercially sensitive but traffic forecast information in the master plan is not.

8. It is suggested that the granularity of aircraft types in the Environmental Statement is too coarse for accurate aircraft noise modelling and that aircraft seat capacity is not a good proxy for aircraft noise. For example, Bickerdike Allen Partners (BAP) and BMI submitted data to the EiP to demonstrate that the noise profile of an A320 is very similar to a BAe146 (EiP, 2006 paragraph 5.7.15) yet the A320 falls in the Narrow Bodied category and the BAe146 falls in the regional category.

9. A letter from Strategic Planning to the Planning Service dated 2 November 2009 repeats the justification for withholding forecast traffic mix data on the grounds of commercial sensitivity. The letter claims that competing airlines/airports could use the information for strategic purposes. This appears to run counter to the Government's guidance on airport master plans (DfT, 2004), which describes the need for traffic forecasts with an explanation of this data in relation to historic trends and expected market developments.

10. The Environmental Statement states that the proposal involves no operations by larger aircraft types than currently operate yet there appears to be no mechanism to prevent an aircraft operator from operating any aircraft it so chooses provided that aircraft meets the Chapter 3 standard and is not marginally compliant. It is noted that the percentage of narrow bodies (the largest aircraft category) increases for all scenarios with respect to the base case (2008). The proposal would provide the capability to use 2,059 metres of runway for landing and up to 2,299 metres for take-off. It is generally the take-off length that is the key constraint that determines the type of aircraft and weight of aircraft that is capable of operating on a runway. There are other constraints such as taxiway configuration and the strength of the runways, taxiways and aprons that are not considered further in this report. Suffice to say that this type of adaptation is unlikely to be subject to the degree of consultation and scrutiny appropriate to a runway extension.

11. In terms of runway length alone it would be possible to operate larger aircraft from the extended runway. This might not be possible without significant adaptation to the ground infrastructure but there appears to be nothing in the planning agreement that would prevent the mix of aircraft changing and developing over time other than the seat for sale condition and the application of a noise exposure contour area limit. Indeed, although the airport claims that larger aircraft types will not be used in future it acknowledges that the traffic mix can and probably will vary over time based on the prevailing commercial conditions (GBBCA, 2009b Paragraph 6.3.1).

12. By way of comparison, Leeds/Bradford airport with a runway length of 2,250 metres and 38,150 air transport movements (2008) operates an Airbus A310 service to Islamabad and a Boeing 757 service to New York. It is not suggested that this is what the airport intends but serves merely to illustrate what could be possible with an extension to the existing runway.

Numbers of aircraft

13. It is noted that the Second Addendum to the Environmental Statement (GBBCA, 2009b Paragraph 6.3.1) explains that under the traffic forecasts used for the noise calculations the number of seats available would exceed the number of seats for sale planning condition. This statement contradicts the introduction of the Environmental Statement (GBBCA, 2008 Paragraph 1.2) which contains an underlined sentence '<u>This application in no way alters or affects the parameters and obligations within the current agreement</u>'. Clearly the assumptions used for noise modelling have included a traffic mix that would breach the seats for sale planning condition. The aircraft movement restriction has been treated as a binding constraint. However, the seats for sale restriction has not been afforded similar consideration despite both appearing to warrant equal attention in the agreement. Thus, it would appear that the airport is implicitly seeking to vary the conditions of the current planning agreement (Planning Agreement, 2008). If that was not the case then it would have been appropriate to present scenarios that were fully compliant with all restrictions in the agreement. Without more detail on the traffic forecast, it is not possible to determine exactly the extent to which the seats for sale condition would be exceeded. However a rough calculation for Scenario D based upon a mid-point estimation of the average number of seats for aircraft in the three categories established for noise modelling and data revealed in the aircraft category mix table (GBBCA, 2008 Table 4.7.3) with traffic assumptions (GBBCA, 2009b Paragraph 6.3.1) is shown in the following table.

Aircraft Type	Proportion of movements	Number of movements	Number of seats per aircraft	Total number of seats
Narrow Body	41%	19,664	162	3,185,568
Regional	57%	27,337	92	2,515,004
Small	2%	959	30	28,770
Total		**47,960**		**5,729,342**

Table 1 – Assessment of number of seats for Scenario D

14. Therefore, an approximate estimate of the seats for sale from the airport is half of the total number of seats shown in the table (5,729,342 divided by 2) or 2,864,671. Thus, Scenario D envisages a breach of the seats for sale planning condition of the order of approximately 850,000 seats equivalent to over 40% of the number of seats for sale permitted under the current planning agreement.

15. The EiP panel made a considered assessment of the relationship between the seats for sale restriction and noise exposure (EiP, 2006 Paragraph 5.6.27). It is not surprising that a substantial breach in the seats for sale condition will result in noise exposure contours that are larger than would be the case otherwise.

16. It is noted that the 2008 baseline makes the assumption that the annual number of movements was 47,818 whereas CAA data (http://www.caa.co.uk/docs/80/airport_data/2008Annual/Table_02_2_Summary_Of_Activity_at_UK_Airports_2008.pdf) indicates that the actual number of air transport movements for 2008 was 41,104 consisting of 40,0287 scheduled and 1,077 charters. The hypothetical 2008 baseline scenario includes 16.5% more air transport movements than actually occurred during 2008. Thus, the baseline noise contours will substantially overestimate the actual noise exposure area. In effect, the hypothetical baseline has been artificially inflated and any comparisons between Scenario A (Baseline 2008) and future scenarios are invalid.

Noise criteria

17. Some aspects of the use of PPG 24, the Government's planning policy guidance on noise (ODPM, 1994) for the purposes of the Environmental Statement are questionable. The Environmental Statement makes the claim the noise exposure categories shown in Table 4.7.1 of the Environmental Statement are applicable. However, PPG 24 states explicitly that ' the noise exposure category procedure is only applicable where consideration is being given to introducing residential development into an area with an existing noise source, rather than the reverse situation where new noise sources are to be introduced into an existing residential area'. PPG 24 explains that this is because the planning system can be used to impose conditions to protect incoming residential development from an existing noise source but, in general, developers are under no statutory obligation to offer noise protection measures to existing dwellings which will be affected by a proposed new noise source. Moreover, there would be no obligation on individuals with an interest in each dwelling to take up such an offer, and therefore no guarantee that all necessary noise protection measures would be put in place. Thus, the Environmental Statement has placed reliance on an aspect of PPG 24 which the guidance itself deems to be inappropriate.

18. This point was highlighted in the Examination in Public report (EiP, 2006 paragraph 5.7.40) where the panel point out that following both Circular 10/73 (the forerunner to PPG 24) and in PPG 24 itself they consider that 'the limits are not relevant to the current discussion of seeking a benchmark for acceptability of the noise climate on current residents'.

19. Furthermore, the Environmental Statement in discussing noise significance criteria claims that PPG 24 states that 'a change of 3 dB(A) is the minimum perceptible under normal conditions'. The Environmental Statement also presents a table (Table 4.7.2) describing the relationship between change in air noise level and subjective impression. The only statement in PPG 24 related to perceptibility is in the glossary. The text introducing the glossary explains that it contains explanations and the content of the glossary does not constitute a set of definitions. The issue of perceptibility is a frequent source of confusion. Statements of the type above claiming that changes of the order of 3 dB are the minimum perceptible under normal conditions relate to single noise events such as one aircraft flying over a particular location. The basis for such claims rests on experimental work conducted in laboratories during which human subjects are asked to differentiate between sounds of fixed frequency played to the subject at different noise levels. Single aircraft noise events are typically defined by either the L_{max} (maximum sound level) or the Sound Exposure level (SEL) – the latter metric takes into account the duration of the aircraft noise event whereas the former simply takes the maximum or peak level recorded during the sound event. More details on noise measurement are available in the CAA's guidance (CAA, 2007 Appendix B Annex 2).

20. Metrics employed for single aircraft noise events are different from those employed for the measurement of long term noise exposure of which the most common is Equivalent Continuous Sound Level abbreviated to L_{eq}. A change of 3 dB in L_{eq} can arise when the noise energy of all of the individual events doubles or the number of those noise events doubles or a combination of the noise energy of the events and the number of events increases. Thus, it is likely that a change of 3 dB will be of greater significance than that stated in the Environmental Statement.

21. Table 4.7.2 of the Environmental Statement does not feature in PPG 24 and its appropriateness in relation to L_{eq} is questioned.

22. It is considered that the claims about the significance of noise criteria misrepresent the Government's planning policy guidance on noise. Noise exposure categories are inappropriate in considering new noise sources to be introduced into existing residential areas. Changes in long term noise exposure are of greater significance than stated in the Environmental Statement.

Noise Exposure Contours

23. The CAA has previously identified four problems with the implementation of noise exposure contours as a control measure in its response (CAA, 2003) to the Government's consultation on air transport policy. First, the difficulty with setting caps or limits is that there could be no assurance that they would be set at an optimal level. Furthermore, having set a cap, it is almost certain that the aviation industry would consider it too low while local residents and environmental groups would argue the reverse. Even in the unlikely event that all parties agreed to the level of the cap there would be no incentive to reduce the impact further.

24. Second, there is a trade-off between various aspects of the environmental impact of aviation. It is not possible to minimise noise, fuel burn and emissions simultaneously. Noise could be reduced both at the aircraft design stage and in operation but at the cost of increased fuel burn and emissions. There is a complex set of interactions between noise, fuel burn and carbon dioxide and oxides of nitrogen. Introduction of a noise contour cap might therefore induce manufacturers and/or operators to increase some other environmental detriment.

25. Third, under European legislation dealing with operating restrictions (EC, 2002) at community airports – performance-based operating restrictions must be based on the noise performance of the aircraft as determined by the certification procedure conducted in accordance with Volume 1 of Annex 16 to the Convention on International Civil Aviation. Noise exposure contours are based on noise levels experienced in operation rather than noise measured during certification in accordance with ICAO regulations. Noise measured during certification will differ from that measured and modelled during contour production for a range of technical reasons. Also, certification levels are measured using a different metric to those shown in noise exposure contours.

26. Last, there is the possibility that improved methods of measuring the impact of aircraft noise will become available over time. The last thirty years have seen the UK change from using the Noise and Number Index (NNI) to L_{eq} (16 hours). More recently, the European Union has introduced the requirement to use L_{DEN} – this metric uses the L_{eq} methodology over 24 hours but applies a 5 dB weighting for the evening period and a 10 dB weighting for the night period.

27. Nevertheless, while contour caps are not seen as the ideal solution and caution is advised over their adoption as an optimal noise control mechanism it is thought that they do have the merit of providing some certainty for affected residents and a degree of assurance that the extent of aircraft noise is subject to some limit.

28. The Government and Planning Inspectorate have made use of limits on the noise exposure contour area in decisions at a number of UK airports. The Government decided to impose noise exposure contour area limits for both Terminal 5 and Runway 3 at Heathrow. The Planning Inspectorate proposed a noise exposure area limit at Stansted and the Secretary of State approved this before granting permission to expand the number of air transport movements on the existing runway above the previously agreed limit. In this case a more stringent noise exposure contour area limit than that proposed by the airport was applied as a planning condition.

29. The Examination in Public Panel (EiP, 2006 paragraph 2.2.10) recommended a new obligation relating to noise should replace the equivalent obligation in the1997 agreement as follows:

> *The latest INM model should be used, noise levels should be monitored over a wider area, contours should be prepared at a range of levels and the control contour should be 57 dBA L_{eq} and set at 15% greater than the equivalent contour for the current ATM level and aircraft mix. The airport operator should install and operate an integrated noise and track-keeping system as soon as possible.*

30. The EiP panel reached this conclusion based on evidence provided by the CAA attached at Appendix A and presented by others at the EiP public hearing and associated technical meeting on noise. The paper at Appendix A was based on traffic forecasts provided in the airport master plan (BCA, 2006 Figure 12) and associated noise exposure contours (EiP, 2006 Figure 16).

31. The master plan states that the 2005 noise exposure contour for 57 dBA $L_{eq,\ 16\ hrs}$ encompasses an area of 2.77 km^2. This was the latest contour available to the EiP panel when it reached its conclusions. The EiP panel intended that an indicative contour of the then current 2005 contour plus 15% would 'give reasonable scope for the growth of the airport, within sound noise management practices'. This would mean that the noise exposure area contour would be limited to no greater than 3.2 km^2.

32. The Environmental Statement is silent on the matter of an indicative contour and the relevant obligation in the planning agreement (Planning Agreement, 2008). The Second Addendum to the Environmental Statement (GBBCA, 2009b Table 6.9) states that the indicative contour (i.e. 2005 + 15%) is 5.1 km^2 without any explanation for its derivation. In a letter from Belfast City Airport Watch to the Planning Inspectorate dated 24 August 2009, it is suggested that the airport is claiming that the 2005 would have been calculated to be 4.43 km^2, presumably using INM version 7.0. The implication of this claim is that the effect of changing from INM version 6.1 to INM version 7.0 caused an increase in the 57 dBA $L_{eq,\ 16\ hrs}$ contour of 59%.

33. Bickerdike Allen Partners' (BAP) report on the 2006 noise contours (BAP, 2006) and the airport's covering memorandum explain that the US Federal Aviation Administration (FAA) Integrated Noise Model (INM) noise model has been upgraded from INM version 6.1 to 6.2. It would seem that the original 2005 contours were produced using INM 6.1 and the 2006 contours were produced using INM 6.2. In their report BAP describe how the contours for 2005 were rerun using INM 6.2. They report that the contours for 57 dBA $L_{eq,\ 16\ hrs}$ for both 2005 and 2006 extend to 3.56 km^2 although there are increases in area for higher L_{eq} levels and a decrease at a lower L_{eq} level. The implication is that the introduction of INM version 6.2 has caused the 57 dBA $L_{eq,\ 16\ hrs}$ contour area to expand from 2.77 km^2 as reported in the airport's master plan (BCA, 2006 Figure 16) to 3.56 km^2 as reported in BAP's 2006 noise contours. This is an increase of 28% that appears to be solely due to changes to the model without any explanation offered. The CAA would expect that a change from INM version 6.1 to 6.2 would increase the 57 dBA $L_{eq,\ 16\ hrs}$ contour area by no more than 5%.

34. The FAA released INM version 7.0 in April 2007 and this is the version that has been used for the Environmental Statement. The CAA would not expect that changing from INM version 6.2 to INM version 7.0 for the same input data would increase the 57 dBA $L_{eq,\ 16\ hrs}$ contour area by more than 5%. Thus, the CAA would not expect a change from INM version 6.1 to INM version 7.0 for the same input data to increase the 57 dBA $L_{eq,\ 16\ hrs}$ contour area by any more than 10%.

35. It would appear from the data presented in the airport master plan and the ES that the 57 dBA $L_{eq,\ 16\ hrs}$ contour has expanded from 2.77 km^2 for 2005 (BCA, 2006 Figure 16) to 5.7 km^2 for 2008 (GBBCA, 2008 Table 4.7.5). Thus, the contour has doubled in area over three years. The total effect of changes to the model would be expected to account for no more than 10% of this increase. The lack of data on aircraft/engine types in the traffic forecasts makes it impossible to carry out any further analysis on reasons why this increase in the contour has occurred. It also makes it impossible to make an assessment of whether and to what extent the noise exposure contour area will increase under the future scenarios (B, C and D) in the ES.

36. The contour data for 2005 remains in the master plan currently available on the airport's web site. There appears to have been no attempt to make any correction or amendment to the data. If the airport believes that previous calculations for 2005 have substantially underestimated the noise impact, for whatever reason, then it is surprising that no attempt has been made to explain the reasons for this and rectify the data.

37. In a letter from Strategic Planning to the Planning Service dated 14 October offers four factors contributing to the increase in contour area:

- software version;
- validation method;
- allowance for acoustically hard surface; and

- aircraft movements.

38. As explained elsewhere in this paper the version of INM will have an effect on contour size. The difference in seasonal mix may well have had an effect on contour area. The assumption that the contour area consists of an acoustically hard surface is not appropriate. According to the INM 7.0 Technical Manual use of an acoustically hard setting is only appropriate if a significant area of the contour extends over water and this is not the case. In the vicinity of the small area of the contour over water aircraft will have an angle of elevation greater than 15 degrees with respect to an observer on the ground within the contour. The use of the acoustically hard setting is only appropriate for angles of elevation less than 15 degrees. In any event, the acoustically hard surface setting is limited to turboprop aircraft in the INM model. The effect of using the acoustically hard setting will result in a systematic overestimate of contour area.

39. The letter of 14 October explains that using INM 7.0, traffic mix for summer 2005 and acoustically hard surface setting results in a 57 dBA $L_{eq,\ 16\ hrs}$ contour area of 4.43 km^2. This provides an explanation for the claim in the Second Addendum to the Environmental Statement (GBBCA, 2009b – Table 6.9) that the 2005 $L_{eq,\ 16\ hrs}$ contour plus 15% is 5.1 km^2.

40. The letter also explains that the contour areas presented in the master plan (BCA, 2006) were calculated based on the traffic levels for winter 2004/05. The implication is the winter contours will encompass a smaller area than summer areas because the number of air traffic movements is lower in winter compared to summer (BCA, 2006 – Figure 6).

41. There appears to be a lack of consistency over the time period used for the assessment of the $L_{eq,\ 16\ hrs}$ contour. The conventional 16 hours period is taken to be the period between 0700 and 2300 (all times local) (DfT, 2003 paragraph 3.14). This is explicit in the Bickerdike Allen Partners report on noise contours for 2006 (BAP, 2006). The Environmental Statement (GBBCA, 2008 paragraph 4.7.3) claims that the conventional use of $L_{eq,\ 166\ hrs}$ has been applied in its analysis. But, the Second Addendum to the Environmental Statement (GBBCA, 2009 paragraph 6.3.1) states that 'the noise contours produced take account of all of the movements forecast to occur during the operating hours of the airport'. The relevant section of the Aeronautical Information Publication (AIP, 2009) states that the operating hours of Belfast City Airport are 0630 to 2130 (all times local). Thus, there appears to be lack of consistency and clarity in the time period used. It is noted that the master plan (BCA, 2006 – Figure 10) indicates that during an average 2005 Friday approximately 7% of daily movements occurred between 0630 and 0700.

42. The current planning agreement states that an indicative control contour shall be agreed in line with the recommendations of the EiP (Planning Agreement, 2008 Paragraph 4.3)

43. It is suggested that the data presented indicates that the airport has already substantially breached the indicative contour as envisaged by the EiP panel. The panel report (EiP, 2006 paragraph 5.7.54) accepted that the 57 dBA $L_{eq,\ 16\ hrs}$ contour encompassed 2.77 km^2 in 2005 and noted that the airport master plan desired an increase in movements to 45,000 by 2020 causing the contour to increase to 3.78 km^2. The panel recommended a limited increase in the noise exposure contour area in order to act as 'an incentive for the airport to introduce quieter aircraft types and for operational procedures to encourage these to be flown as quietly as possible'. The panel considered less stringent options and explain their reasons for adopting a more stringent in their report (EiP, 2006 Paragraphs 5.7.46 to 5.7.49). In their consideration of these matters, it is difficult to conclude that the panel would have been satisfied with the scale of the increase in the noise exposure contour that appears to have occurred over the course of the last three years.

Runway Usage

44. There have been some suggestions that the noise exposure contour area should only consider area over the land. This would be a departure from conventional practice. It may also set a precedent where it is suggested that other area, such as reservoirs or the airport itself should be removed from consideration. This would cause substantial difficulties in defining which areas should be included and which should not. It should be noted that the environmental noise directive (EC, 2002a) makes no distinction between land and sea within the noise exposure contour area. In principle, a noise exposure contour area limit that excluded the sea would provide an incentive for the airport operator to avoid land and arrive and depart over the Lough. However, the uncertainty and lack of clarity surrounding the noise exposure contours would suggest that such an approach would result in even more confusion than currently exists. It is not recommended that the contour area over the sea is excluded from consideration.

45. Environmental Statement scenarios have used a significantly different runway usage regime to that that has taken place over the last three years (GBBCA, 2009b Table 6.2). It is not clear why this has been done or what will cause this significant change in runway usage. In particular, it is not clear whether the 2008 baseline has used the actual runway usage or the runway usage labelled 'All ES Scenarios'. It is conventional to use a long term average runway usage to compare scenarios excluding the annual variability caused by weather conditions

Noise Action Plan

46. The draft noise action plan required under the Environmental Noise Directive (EC, 2002a) is currently under review by the appropriate authorities. It is surprising that there is only a passing reference to the indicative contour.

47. Areas and population data below the contour levels specified in the directive are not required and it is not understand why these data have been presented.

48. It would have been helpful to provide some explanation of the capabilities of the noise and track-keeping (NTK) system that is in the course of being procured. It would also have been helpful for the airport to indicate how they intend to use the NTK system including the type of information that they intend to make available to the public.

49. The directive requires noise maps and action plans to be produced at five yearly intervals and reviewed/revised when a major development occurs that affects the existing noise situation. It is suggested that it would be appropriate to indicate intentions with respect to noise maps and action plans following the proposed runway extension.

50. It is suggested that the scale used for the graphical portrayal of airport noise contours is inappropriate as the map covers a very wide area and makes it impossible to distinguish individual noise contours.

Conclusions

51. It is noted that that the scenarios in the Environmental Statement would probably entail a substantial breach in the seats for sale condition and that this contradicts the claim that the application 'in no way alters or affects the parameters and obligations within the current agreement'.

52. The fact that the 2008 baseline scenario contains 16.5% more movements than actually occurred during that year means that it forms an inadequate reference from which to assess future scenarios. The effect will be to underestimate impact changes with respect to this hypothetical baseline which never actually occurred. This invalidates any comparison between the baseline and future scenarios.

53. The lack of traffic forecast data underpinning the noise exposure contours is contrary to standard practice in environmental assessment. It hinders adequate scrutiny of the proposal and raises questions about its credibility. It is recommended that the airport is required to submit traffic forecast data in support of its case.

54. It is considered that claims about noise assessment criteria misrepresent the Government's planning policy guidance and that interpretation of changes in noise level demonstrates a misunderstanding of the difference between the impact of single aircraft noise events and long term noise exposure.

55. There is much confusion about noise exposure contours compounded by a lack of explanation about the effect of changes between different versions of the INM model. It is very surprising that changes of the model appear to account for significant increases in contour area and it seems likely that there are other factors in operation. However, a lack of transparency in traffic forecast data makes it impossible to gain an adequate understanding of the reasons for the apparent substantial increase in contour area.

56. An ideal solution would be to use INM 7.0 to calculate the 57 dBA $_{Leq,\ 16\ hrs}$ noise exposure contour area for the situation in 2005 without changing anything else other than the model and then add 15% to this area. This would appear to have been partially carried out as indicated in the letter from Strategic Planning to the Planning Service dated 14 October. However, use of the acoustically hard surface setting has caused additional and unnecessary complication that has had the effect of increasing contour area. The use of the acoustically hard surface setting is <u>not</u> recommended.

57. Confusion over the use of winter and summer traffic and the definition of the 16 hour time period have compounded difficulties in assessing scenarios in the Environmental Statement and its addenda.

58. In the absence of a calculation of INM 7.0 noise exposure contours with 2005 summer traffic without use of the acoustically hard surface setting, it is suggested that the indicative or control contour should be set at a level that takes into account changes to the INM model as recommended by the EiP panel (EiP, 2006 Paragraph 5.7.28). It is suggested that an increase of 10% in the contour area is allowed to take account of the differences between INM version 6.1 and INM version 7.0. This would increase the 57 dBA $L_{eq,\ 16\ hrs}$ noise exposure contour area from 2.77 km^2 to 3.05 km^2. This contour area should be increased by 15% to take into account of the recommendation made by the EiP panel that sought to give reasonable scope for growth of the airport within sound management practices (EiP, 2006 Paragraph 2.2.10). This would result in the area of the actual 57 dBA $_{Leq,\ 16\ hrs}$ noise exposure contour over a 92 day summer period being set at 3.5 km^2 (rounded to the nearest 0.1 km^2).

59. As a first step in resolving the confusion surrounding the Environmental Statement, it is recommended that a baseline noise exposure contour is calculated for summer 2005 traffic at Belfast City Airport using INM version 7.0 without the acoustically hard surface setting. A decision will need to be taken on whether to use the conventional 0700 to 2300 time period for calculation of $L_{eq,\ 16\ hrs}$ or whether this is to be varied to include aircraft operating between 0630 and 0700 (all times local). However defined, it is essential that there

is clarity, consistency and transparency in the method used in calculating the noise exposure contour area.

60. A second step would be to establish the indicative control contour based on the 2005 summer noise exposure contour. It is recommended that in establishing this control mechanism the advice offered in the final paragraph of Appendix A, shown below, is revisited:

> *If a noise exposure contour limit were to be proposed then it is suggested that setting this in area terms at some 20 to 25% greater than the area for the current 57 dB $L_{eq,\ 16\ hrs}$ contour would enable the airport to develop in accordance with Government policy. It would protect residents from additional noise burden in the unlikely situation where all permitted movements consisted of the noisiest aircraft. A contour limit of some 15 to 20% greater than the current 57 dBA $L_{eq,\ 16\ hrs}$ contour would probably provide an incentive to introduce quieter aircraft types.*

61. There are significant deficiencies in the Environmental Statement and its addenda. It is considered that the evidence is incomplete and caution is advised in placing reliance upon it. Particular concerns include potential breaches of the extant Planning Agreement in terms of seats for sale and noise exposure contour area. The baseline for impact assessment appears somewhat arbitrary and hypothetical and any conclusion about changes relative to the baseline would be equally arbitrary.

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16 November 2009

Appendix:

A Belfast City Airport: Noise Exposure Contour Sensitivity Analysis – prepared for BCA EiP dated 8 July 2006

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Civil Aviation Authority

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BELFAST CITY AIRPORT: NOISE EXPOSURE CONTOUR SENSITIVITY ANALYSIS

Introduction

1. The purpose of this paper is to examine how noise exposure contours are likely to change with different traffic throughput and fleet mix at Belfast City Airport.

Theory

2. Noise exposure, as measured by equivalent continuous sound level or L_{eq}, is dependent on two variables - number of movements and sound exposure level. This is shown by the discrete[1] version of the formula for calculating L_{eq}:

$$L_{eq} = \overline{SEL} + 10\log_{10} N - 10\log_{10} T \qquad (1)$$

where

$$\overline{SEL} = 10\log_{10}\frac{1}{N}\sum_{i=1}^{N} 10^{\frac{SEL_i}{10}} \qquad (2)$$

is the logarithmic average sound exposure level;
N = number of movements;
T = time period in seconds; and
SEL_i = sound exposure level (SEL) of the i^{th} event

It should be noted that the 'average' value $\overline{SEL}$ is calculated by taking the anti-logarithm of the individual SEL values in bels, where 10 decibels equals 1 bel, then dividing the result by the number of movements before converting back to decibels by taking the logarithm of the result and multiplying by 10. This is completely different from calculating the mean (arithmetic average) which will yield a lower and incorrect figure in this context.

3. Using equation (1) it can be seen that if the L_{eq} value of 57 dB over a 16 hour period is considered with a number of movements equal to 39,198 (Belfast City Airport 2005 current) then:

$$\overline{SEL} = L_{eq} - 10\log_{10} N + 10\log_{10} T \qquad (3)$$
$$= 57 - 10\log_{10}(39{,}200/365) + 10\log_{10}(16 \times 3{,}600)$$
$$= 84.3 \text{ dB}$$

[1] The term 'discrete' refers to the treatment of aircraft noise events as distinct entities. The alternate formulation is continuous where sound level changes within noise events are considered. The continuous formula for L_{eq} is used in noise models and monitors but is not necessary for the purposes of this analysis.

4. If air traffic movements increase to 45,000 - the limit specified in the extant Belfast City Airport Planning Agreement dated 22 Jan 1997 - and there is no change to the traffic mix then L_{eq} at a location previously exposed to 57 dB from all air transport movements will increase as shown below using equation (1) all other things being equal:

$$L_{eq} = \overline{SEL} + 10\log_{10} N - 10\log_{10} T$$
$$= 84.3 + 10\log_{10}(45{,}000/365) - 10\log_{10}(16 \times 3{,}600)$$
$$= 57.6 \text{ dB}$$

Thus, an increase in traffic movements of just over 5,000 using the same mix of aircraft will generate a 0.6 dB increase L_{eq} at 57 dB in the circumstances described.

5. Equation (1) is used to calculate the change in L_{eq} at the 57 dB level for different numbers and types of aircraft. This entails estimation of logarithmic average value of SEL defined in equation (2). However, the SEL values of individual aircraft movements (SEL_i) are unknown and must be estimated.

6. The numbers and types of aircraft operating at Belfast City Airport are known. For this analysis, it is assumed that SEL is directly proportional to certification values measured in effective perceived noise levels (EPNdB) in energy terms and that a coefficient 'm' can be found that will enable noise energy to be apportioned between aircraft types. It is assumed that the coefficient 'm' is relatively insensitive to changes in traffic mix.

$$m = \frac{N10^{\frac{\overline{SEL}}{10}}}{\sum_{j=1}^{K} n_j 10^{\frac{EPNdB_j}{10}}} \qquad (4)$$

where N = number of movements;
K = number of aircraft types;
n_j = number of movements of j^{th} aircraft type;
$EPNdB_j$ = certification value in EPNdB of the j^{th} aircraft type; and
$\overline{SEL}$ = logarithmic average of SEL is as defined in equation (2).

7. The coefficient 'm' can be used in the following equation to estimate the logarithmic average SEL from certification values in EPNdB.

$$\overline{SEL} = 10\log_{10}\frac{m}{N}\sum_{j=1}^{K} n_j 10^{\frac{EPNdB_j}{10}} \qquad (5)$$

Equation (5) is then used to calculate L_{eq} using equation (1).

8. The change in L_{eq} value relative to 57 dB can then be used to estimate the increase or decrease in contour area.

9. This methodology provides an estimate of the relative change in L_{eq} and contour area but does not provide absolute values. Hence, there remains a requirement for noise contour modelling based on accurate input data before the relevant parties form any agreement on noise contour limits.

Inputs

10. Belfast City Airport has produced traffic forecasts of air transport movements from 2005 to 2030 at five year intervals in its current master plan and these are reproduced in the following table:

	2005	2010	2015	2020	2025	2030
A321	4,600	5,000	5,000	5,000	5,000	5,000
A320	740	800	800	800	800	800
A319	200	300	500	800	800	800
Emb 195		4,000	8,500	9,550	9,550	9,550
BAe146-300	6,400	2,500				
BAe146-200	1,100					
Dash8-400	16,100	21,500	22,250	23,750	23,750	23,750
Dash8-300	4,100					
ATR 72 and 42	1,400	1,800	1,500	1,200	1,200	1,200
Other types	2,460	3,000	2,500	2,100	2,100	2,100
General Aviation	2,100	2,100	1,900	1,800	1,800	1,800
Total	**39,200**	**41,000**	**42,950**	**45,000**	**45,000**	**45,000**

11. In the absence of measured or modelled SEL values, it was found necessary to use noise certification values as a proxy during this analysis. A table of certification values for relevant aircraft types is shown below:

	EPNdB		
	Takeoff	**Sideline**	**Approach**
A321	88.2	95.2	95.8
A320	84.8	92.9	95.9
A319	82.4	92.9	94.2
Emb 195	84.3	94.3	89.3
BAe146-300	86.5	86.7	95.6
BAe146-200	85.2	87.3	95.8
Dash8-400	78.6	84.0	94.8
Dash8-300	80.0	86.9	94.5
ATR 72 and 42	74.2	80.8	93.0
Other types	84.4	83.7	89.9
General Aviation (proxy)	84.4	83.7	89.9

Some assumptions have been made about the values for the Embraer 195, which has yet to undergo the noise certification process and actual values are not yet available. The noise certification process for most general aviation aircraft differs from that for commercial aircraft and the values for these aircraft are not comparable. It has been assumed that the certification values for general aviation aircraft are the same as the Shorts 360 used in the 'other types' category. For all other aircraft, certification values are derived from noise certificates or the ICAO noise certification database or as presented to the Panel at the public meeting held 14-16 June.

12. Certification values are stated in effective perceived noise levels (EPNdB). The departure EPNdB value is calculated as the arithmetic mean of takeoff and sideline values. The arrival value has a correction factor of -9 dB applied. The reason for this is to take equal account of departure and arrival noise. Certification values for arrivals and departures are measured at different distances from the runway and failure to take this into account would produce a bias towards noise from arrivals. There has been much debate about the appropriateness of correction factors. The latest research on this matter is reported in *ERCD Report 0204 - Review of the Quota Count (QC) System - Re-analysis of the Differences between Arrivals and Departures* and the principle continues to be accepted by the Government.

13. The EPNdB values for arrivals and departures are shown in the following table:

	QC values (EPNdB)	
	Arrival	**Departure**
A321	86.8	91.7
A320	86.9	88.9
A319	85.2	87.7
Emb 195	85.1	87.7
BAe146-300	86.6	86.6
BAe146-200	86.8	86.3
Dash8-400	85.8	81.3
Dash8-300	85.5	83.5
ATR 72 and 42	84.0	77.5
Other types	80.9	84.1
General Aviation (proxy)	80.9	84.1

14. Using 2005 traffic data shown in the table in paragraph 10 and EPNdB values for arrivals and departures with equation (4) reveals an estimate for 'm' of 0.7089. It has been assumed that movements comprise 50% arrivals and 50% departures.

Changes in noise exposure

15. The following table shows the estimated change in noise exposure relative to the 57 dB $L_{eq,\ 16\ hrs}$ contour based on traffic forecast and certification data using the methodology previously described. Results are reported for the base year 2005 and at five yearly intervals to 2020 when the master plan indicates that traffic will approach the limit specified in the current planning agreement. It is noted that the forecast noise exposure contours described in Figure 17 of the master plan are based on assumptions about aircraft types that are different to those published in Figure 12 of the same document. The penultimate row of the following table shows the effect of this different mix of aircraft containing some older and noisier types. The final row reports the hypothetical and unlikely situation where all 45,000 movements would consist of Airbus A321 aircraft as a sensitivity test. This sensitivity test may not be as robust as other scenarios because the assumption that the coefficient 'm' is constant for all combinations of aircraft types may not hold. Nevertheless, it provides an indication of the likely impact under this hypothetical condition.

Year	ATMs	dB $L_{eq,\ 16\ hrs}$	Change in dB $L_{eq,\ 16\ hrs}$
2005 Base Year	39,198	57	0
2010	41,000	57.3	+ 0.3
2015	42,950	57.8	+ 0.8
2020	45,000	58.0	+ 1.0
2020 (Figure 17 of master plan)	45,000	58.3	+ 1.3
All Airbus A321s	45,000	61.7	+ 4.7

16. An often-used rule of thumb is that a change in noise exposure of 1 dB will generate a change of approximately 20% in contour area. Therefore, the results demonstrate that a noise exposure contour area limit of some 20 to 25% greater than the current 57 dB $L_{eq,\ 16\ hrs}$ area would enable the airport to develop in accordance with Government policy in the white paper[2] and the airport's master plan. It would also protect residents from the additional noise burden caused by a higher percentage of noisier aircraft. If it were decided that the noise contour area limit should provide an incentive to introduce quieter aircraft types then a limit of some 15 to 20% greater than the current 57 dB $L_{eq,\ 16\ hrs}$ area would probably be more appropriate.

Conclusions

17. This paper sets out a methodology for examining the impact of a change of numbers and types of aircraft at Belfast City Airport. It provides a method for estimating the relative change to $L_{eq,\ 16\ hrs}$ caused by additional air traffic movements and changes to the fleet mix. It does not attempt to assess the impact in absolute terms. Assessment in absolute terms requires the production and validation of noise exposure contours and it is recommended that this be carried out as part of the process in reaching agreement on noise exposure contour limits.

18. If a noise exposure contour limit were to be proposed then it is suggested that setting this in area terms at some 20 to 25% greater than the area for the current 57 dB $L_{eq,\ 16\ hrs}$ contour area would enable the airport to develop in accordance with Government policy. It would also protect residents from additional noise burden in the unlikely situation where all permitted movements consisted of the noisiest aircraft. A contour area limit of some 15 to 20% greater than the current 57 dBA $L_{eq,\ 16\ hrs}$ contour area would probably provide an incentive to introduce quieter aircraft types.

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[2] DfT, The Future of Air Transport, December 2003