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THE PROBLEM OF AVIATION NOISE POLLUTION OF THE TERRITORY AROUND AIRPORTS

Abstract. *This article presents a study of the problem of noise pollution near airports. It includes: the definition of the concept of noise (its nature, evaluation, causes of occurrence), the effects of impact on the human body (a short list of diseases caused by noise) and ways to reduce the level of aviation noise. This problem arose/ appeared in the middle of the 20th century, but as some examples of history show, it was not only solved, but even ignored. However, over time, the aircraft noise problem has become perhaps the most powerful argument of communities and politicians against any expansion or construction of a new airport. Of course, if it follows the established sanitary standards (the noise level does not exceed a specific value or airspace traffic is organized in such a way that the planes are not in a residential or other built-up area) or is not in the immediate vicinity of populated areas, it will not cause any problems.*

Airport designers have a huge array of tasks that they must solve when designing airports. Aircraft noise pollution is a serious problem also because its real effects can manifest themselves after years. It can be both the expansion of the airport and residential development in the direction of the airport. The ideal solution would be an airport located at many kilometers from any city. But this is not always the case.

Airports must look to the future to be "good neighbors" and avoid resistance from an "annoyed" society.

Key words: *airport, noise pollution, aircraft noise, environment, decibel (dB), A-weighted decibels (dBA), airspace planning, annoyance, Heathrow, Equivalent Continuous Sound Level (L_{eq}).*

Журавель Дмитро. ПРОБЛЕМА АВІАЦІЙНОГО ШУМОВОГО ЗАБРУДНЕННЯ ТЕРИТОРІЇ НАВКОЛО АЕРОПОРТІВ

Анотація. *У статті представлено дослідження проблеми шумового забруднення поблизу аеропортів. До неї входить визначення поняття шуму (його природа, оцінювання, причини виникнення), наслідки впливу на організм людини (короткий список захворювань, спричинених дією шуму) і способи зменшення рівня авіаційного шуму. Ця проблема виникла ще в середині XX ст., але, як показують деякі приклади історії, вона не тільки не вирішувалася, а й навіть ігнорувалася. Проте з часом саме проблема шуму повітряних суден стала чи не найвагомішим аргументом як громад, так і політиків, проти будь-якого розширення чи будівництва нового аеропорту. Звісно, якщо він відповідає встановленим санітарним нормам (рівень шуму не перевищує конкретне значення або рух повітряним простором організовано так, щоб літаки не перебували в зоні житлової чи іншої забудови) чи не перебуває в безпосередній близькості до населених пунктів, це не спричинить ніяких проблем.*

Перед проєктувальниками аеропортів стоїть величезна кількість завдань, які вони повинні вирішити під час проєктування аеропортів. Шумове забруднення літаків є серйозною проблемою ще й тому, що його реальні наслідки можуть проявлятися через роки. Це може бути як розширення аеропорту, так і житлова забудова в напрямку аеропорту. Ідеальним рішенням був би аеропорт, розташований за багато кілометрів від будь-якого міста. Але це не завжди так.

Аеропорти повинні дивитися в майбутнє, що бути «добрими сусідами» й уникати опору з боку «роздратованого» суспільства.

Ключові слова: *аеропорт, шумове забруднення, авіаційний шум, навколишнє середовище, децибел (дБ), А-зважені децибели (дБА), планування повітряного простору, роздратування, Хітроу, еквівалентний безперервний рівень звуку (L_{eq}).*

Introduction. There's no getting away from the fact that aviation can be noisy. When aircraft land and take off, depending on the aircraft and its altitude, as they fly overhead, they produce a considerable amount of noise [2].

Aircraft noise is usually the key environmental concern for communities impacted by aviation operations, whether it's from major international airports, night-time freight operations, business aviation facilities, helicopters, airfields with repetitive activities like circuits or aerobatic practice, or the result of flightpath changes [1].

There's good evidence to suggest that more people are annoyed at lower levels of aircraft noise today than in the past, despite the introduction of relatively less noisy planes. The CAA's 2014 study into attitudes towards aircraft noise showed the same percentage of respondents highly annoyed at 54dB L_{eq} as were previously affected at 57dB L_{eq} (in 1982) [1].

Some researchers agree with the view of many communities that this could be, in part, related to the increase in the number of noise incidents experienced. While airport noise maps may show noise 'contours' shrinking over time there has been no evidence of a reduction in community concerns [1].

Materials and methods. Were used materials of aviation organizations of the UK, USA and ICAO; their reports and standards for noise pollution were researched. There was also used historical literature about Heathrow airport.

Disscussion. *Noise – definition*. Sound is energy transferred through the air that our ears detect as small changes in air pressure. The more energy put into making a sound, the louder it will be. Try whispering. Then yell. You can feel how much more energy goes into yelling [3].

Noise is sound that is unwanted. Some sounds, like a distant train whistle, can be a pleasant sound for some, while being considered noise by others. Other sounds, like a neighbor's barking dog in the middle of the night, are more universally found to be annoying. Even sounds that are pleasant at one volume can become noise to us as they get louder. Noise, then, has both an objective, physical component; as well as a subjective component that takes account of a person's individual perception, or reaction, to a sound [3].

The decibel (dB) is the unit used to measure the intensity of a sound. The human ear hears sound pressures over a wide range. Decibels, which are measured on a *logarithmic* scale, correspond to the way our ears interpret sound pressures [3].

Some examples of typical loudness are near total silence (0dB); normal conversation (60dB); a heavy lorry passing 15m away (80dB); a jet aircraft taking off at a distance of 300m (100dB) [4].

The human ear also responds to different pitches or frequencies of sound differently. We are less able to hear low frequencies like the rumble of thunder but hear high frequencies like the cry of a baby more strongly [3].

To account for differences in how people respond to sound, the "A-weighted" scale (dBA) is used. This scale most closely approximates the relative loudness of sounds in air as perceived by the human ear and provides a more useful way to evaluate the effect of noise exposure on humans by focusing on those parts of the frequency spectrum where we hear most [3].

'A-weighted decibels' (dBA) are often used in measurements of aviation noise [4].

For noise sources in motion, like aircraft, noise levels can change over time. For example, the sound level of a plane increases as it approaches, and then as it flies away the sound level decreases. It can be useful to measure the maximum sound level, abbreviated as L_{max}, of a particular noise "event". While L_{max} notes the moment of maximum sound level, it does not account for the duration of a sound event. The maximum sound level of a gun firing a bullet is high but very brief; a freight train can have the same maximum sound level, if you are very close to it, but the sound has a long duration [3].

To account for the differences in duration and loudness of sounds, different metrics are used. These metrics are used to compare individual noise events as well as many events that take place over an extended period [3].

Two basic measures for assessing noise impact are [4]:

- L_{eq} which means the 'equivalent continuous sound level'. This is the average sound level for a specific location over a defined measurement period.

• L_{den} which uses an annual average of the L_{eq} but also takes into account the additional annoyance/disturbance of noise generated in the evening and at night. 5dB is added to noise made in the evening (7:00pm–11:00pm) and 10dB for the night (11:00pm–7:00am).

L_{eq} is the preferred method to describe sound levels that vary over time, resulting in a single decibel value which takes into account the total sound energy over the period of time of interest [5].

L_{eq} noise levels are Logarithmic (dB) values and cannot be added directly [5].

There are also numerous factors that determine how much aircraft noise is experienced on the ground [6]: what model aircraft and what type of engines are being used for each flight? Are the aircraft taking off or landing? What is the flight path of the flights going overhead? How quickly does each plane ascend and descend? Is the aircraft operating at full power or partial power?

Noise experienced on the ground also depends on flight schedules, which can vary depending on the time of day, season of the year, or other operational factors. Weather also plays a large role, since sound attenuates (dissipates) differently depending on weather conditions (wind speed and direction, temperature, etc.) [6].

Determining how to capture the effects of all these considerations can become extremely complex very quickly. A house one-half mile north of an airport may experience very different aircraft noise exposure over a day, week, and year than a school one mile south of that airport [6].

The effects of noise on the human body. Aircraft noise is a public health issue. It can impact memory and learning in children, disturb sleep, and cause serious long-term health problems including cardiovascular disease. A large scale study around Heathrow Airport found that people living under the flightpath were 10–20% more at risk of stroke and heart disease than those not living under the flight path. There is also emerging evidence of impacts on mental health, linked to increases in stress and anxiety. A large body of health evidence is reviewed in AEF's 2016 report Aircraft Noise and Public Health: the Evidence is Loud and Clear. The World Health Organization (Europe Region) issued its Environmental Health Guidelines in October 2018 which make specific health-based recommendations for limiting night and daytime exposure to aircraft noise [1].

To represent the effect of aircraft noise exposure on people, researchers in the 1960's and 1970's developed the concept of noise annoyance. This concept proved useful in understanding how communities felt about the noise from the new jet age aircraft. There are several factors that affect the extent of annoyance that noise causes. How loud is the noise? How long did it last? How often did the noise occur? When did the noise occur: was it during nighttime? Did the noise occur against a backdrop of other noises or did it occur in an otherwise quiet place [6]?

Annoyance. It is a cumulative measure of the general adverse reaction of people to noise that causes interference with speech, sleep, the desire for a tranquil environment, and the ability to use the telephone, radio, or television satisfactorily. The results from annoyance surveys can then be used to better understand how people respond to different types of noise exposure [6].

Cognitive impairment. There has been considerable research into the effect of aircraft noise on cognitive performance in school children, due to the interruptive nature of high levels of aircraft noise. Research has suggested effects on reading comprehension and memory. Cognitive performance affects attention, perception, mood, learning and memory [7].

Sleep disturbance. Aircraft noise is intermittent in nature and exposure to it during the night may result in sleep disturbance. Noise-induced sleep disturbance refers to awakenings, changes to sleep structure such as changes to sleep stages, arousals in heart rate, and body movements. People can be aware of such disturbance, such as when they remember being awoken by noise, or the disturbance can go unnoticed at the time but may result in next-day fatigue [7].

Cardiovascular disease. Aircraft noise at high levels can be considered a stressor on the body, and research has found an association between high levels of aircraft noise and an increased risk of developing Cardiovascular disease (CVD). It is thought that this occurs due to the way such stressors interact with the body, and the fact that

the cardiovascular response to noise does not decrease, even though the individual may no longer consciously notice or react to the noise. Cardiovascular disease includes all the diseases of the heart and circulation including coronary heart disease, angina, heart attack, congenital heart disease and stroke [7].

Ways to reduce the level of aviation noise

1. Land-use planning and management. It is an effective means to ensure that the activities nearby airports are compatible with aviation. Its main goal is to minimize the population affected by aircraft noise by introducing land-use zoning around airports [8].

Compatible land-use planning and management is also a vital instrument in ensuring that the gains achieved by the reduced noise of the latest generation of aircraft are not offset by further residential development around airports [8].

ICAO's main policies on land use planning and management are contained in Assembly Resolution A-41-20, Appendix F, which urges States, where the opportunity still exists to minimize aircraft noise problems through preventive measures, to [8]:

a)locate new airports at an appropriate place, such as away from noise-sensitive areas;

b) take the appropriate measures so that land-use planning is taken fully into account at the initial stage of any new airport or of development at an existing airport;

c)define zones around airports associated with different noise levels taking into account population levels and growth as well as forecasts of traffic growth and establish criteria for the appropriate use of such land, taking account of ICAO guidance;

d) enact legislation, establish guidance or other appropriate means to achieve compliance with those criteria for land use;

e)ensure that reader-friendly information on aircraft operations and their environmental effects is available to communities near airports.

2. Improvement of aviation technologies. The ICAO Assembly Resolution A41-20 requests the Council, with the assistance and cooperation of other bodies of the Organization and of other international organizations, to continue with vigor the work related to the development of Standards, Recommended Practices and Procedures and/or guidance material dealing with the impact of aviation on the environment [9].

Annex 16 Volumes I, II and III contain the environmental certification standards that shall be observed by aircraft and engine designs. The development and update of the environmental certification Standards ensure that the benefits offered by technology are reflected in real reductions of aviation environmental impacts, while balancing environmental benefit with technological feasibility, economic viability, and the interdependency between environmental factors [9].

To foster the development of new technologies, ICAO regularly sets technology goals, with the purpose of providing targets for industry research and development, in cooperation with States. Once the State of the Art of technology reaches these goals, consideration is given to updating the ICAO Environmental Standards to ensure the latest technologies are incorporated into aircraft and engine designs [9].

Technological progress continues to push the aviation community to deliver on the ICAO goal of limiting or reducing the number of people affected by significant aircraft noise. ICAO continually monitors research and development in noise reduction technology, and this complements the Standard-setting process [10].

In its eleventh cycle (2016–2019), CAEP conducted an independent expert (IE) review to evaluate airplane noise goals by 2027 and 2037. More information on the IE review can be found in ICAO Doc 10127 (2019). The main IE conclusions regarding noise reduction technologies are as follows [10]:

- For modern large aircraft, Single Aisle and Twin Aisle, jet noise is a secondary noise source even at departure, with fan noise dominating. For smaller aircraft, business jets and small regional jets, the noise from the jet may still dominate at departure, as it does for many older aircraft. Jet noise has been reduced by reducing jet velocity to improve fuel burn, but because jet noise is now a secondary source, further improvements in fuel burn will not bring automatic substantial reductions in noise.
- A key technology for reducing fan noise is acoustic wall treatment, and liners in the inlet and

bypass duct provide essential attenuation. Work continues to improve liner performance, but the task of maintaining current levels of liner attenuation will be challenging, given the incentives to make the intake and bypass duct shorter in relation to diameter, and to reduce nacelle length for fuel burn reasons.

• Airframe noise is the largest noise source at approach for modern large aircraft, mostly from the landing gear. Potential airframe noise reductions are very dependent on aircraft category, design and operational characteristics, and the exploitation of this potential will be driven by multiple constraints.

• As engines get larger in relation to aircraft size, corresponding to lower fan pressure ratio, it becomes more important for the engine and the aircraft to be designed together as an integral unit. The optimization of the aircraft needs to include acoustic design as well as design for minimization of fuel burn and emissions.

The scope for noise technology reductions of the conventional tube and wing configuration, particularly in large aircraft, now appears to be limited, and the potential additional benefits of acoustic design optimization will need to be properly assessed. Novel configurations, or even some very advanced tube and wing configurations, may bring new noise reduction opportunities, but at the same time these will introduce significant challenges of different nature, which will also need to be addressed [10].

3. Involvement of the environmental community. As part of proper land-use planning and management, community engagement by airport operators and other aviation stakeholders is the key link between environmental stewardship and mitigating environmental constraints to aviation operation and growth. Recognizing the importance of community engagement, CAEP undertook a task in 2013 to collect case studies of airport outreach programmes around the world and developed an ICAO Circular in 2016 highlighting both lessons learned and good practices. The Circular, *Community Engagement for Aviation Environmental Management,* was developed to assist and encourage States and the aviation industry, in particular airports, airlines, and Air Navigation Service Providers, to engage local communities early in airport development projects to address environmental matters [11].

The report *Environmental Community Engagement for Performance-Based Navigation* highlights the importance of effective community engagement and provides good practices that should be considered when undertaking airspace modernization. As a work item under the Committee for Aviation Environmental Protection (CAEP), the report was developed by garnering information from industry stakeholders as well as a detailed literature review and an assessment of ICAO State PBN Action Plans. It is intended to share and promote practices that have supported improved community understanding and effective airspace development. It serves as a reference point, complementing ICAO's Balanced Approach to Aircraft Noise Management, as the industry continues to modernize airspace in accordance with ICAO Global Air Navigation Plan (GANP) and Aviation System Block Upgrades (ASBU) [11].

4. Airspace planning. Controlling where planes fly during take-off and landing has an important impact on noise pollution. The placement and use of runways is fundamental, for example, planes travelling at night can travel overseas or lakes to reduce the impact of noise [12].

Air traffic management maps out flight tracks that avoid the most densely populated areas. Recent developments in navigation performance mean that aircraft can now follow precisely designated tracks. This avoids track spreading and the resulting ‘spaghetti’ radar flight track maps but can mean that a smaller number of residents are subjected to a higher number of flyovers. Air traffic management therefore needs to be undertaken in close consultation with community groups. Issues such as the relative benefits of track concentration versus track dispersion need to be considered [12].

The Figure 1 [19] shows airspace planning helps to avoid densely populated areas like London. His flight tracks really look like ‘spaghetti’.

With support from the air navigation service providers and airport operators, airlines and pilots can implement noise reduction procedures, such as reduced thrust take-off, displaced

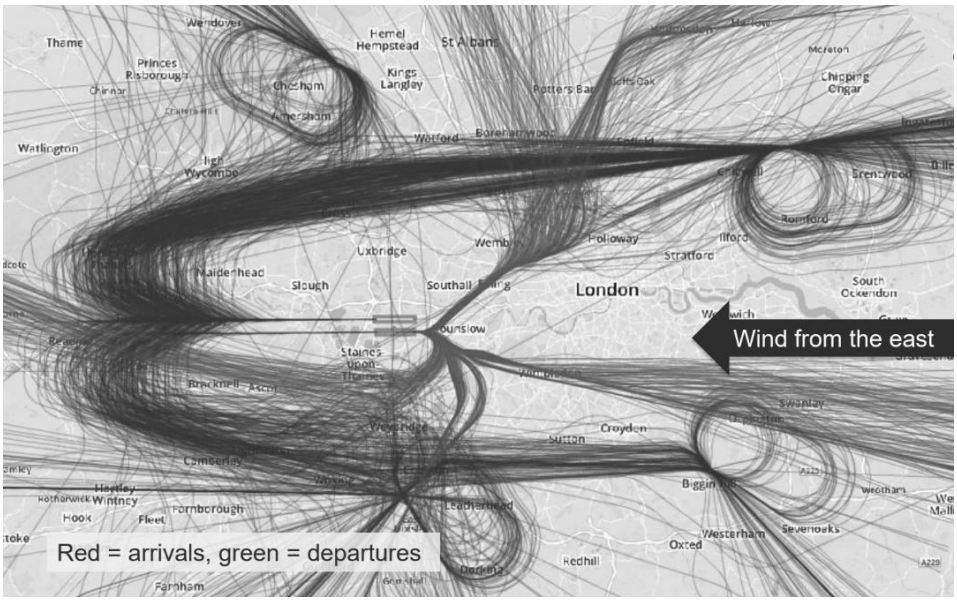

Fig. 1. This map shows a day of easterly operations flight tracks (Heathrow airport)

landing thresholds and continuous descent operations [12].

The problem of noise in the history of Heathrow Airport. As now, aircraft noise was a problem when the airport was opened.

Noise: In view of the major problems caused by aircraft noise it is quite extraordinary that there is no mention of noise anywhere in the files and the problem seems to have been entirely ignored. Colin Buchanan has commented on this strange omission and one can do no better than to quote him on this [13]:

"There were so many unbelievably noisy aircraft around in 1944 that it seems incredible that a so potent side-effect of aviation could have been overlooked. But overlooked it was. Heathrow was developed with a pair of parallel runways running due east-west pointing in one direction at point-blank range straight into the huge housing mass of West London and in the other direction, straight at Windsor only six miles away – Windsor of all places, historic town, royal residence, famous school, glorious stretch of river, parks and gardens beyond compare. Heathrow is fifteen miles from the middle of London. This comparatively close proximity to the heart of a big city has presumably paid dividends over the years in respect of reduced travelling time to and from the airport, but the misery which the fight paths have spread, also over many years, far and wide over a huge part of London and the Home Counties, must surely make that decision in 1943 the most disaster planning disaster to hit our country.

In this disaster area live half a million people, whose daily lives are constantly disrupted by aircraft noise. The very layout of Heathrow is an affront to the rights and well-being of those who live under the air-port's flight paths. 'Tolerate or emigrate' are not options for these people or places. (Here are Windsor Castle, Hampton Cor, Chiswick Hose. Ke Gardens, Richmond Park, Syon Park and Osterley Park all historic and attractive places severely disturbed by overflying aircraft)" [13].

Aircraft noise consists of a build-up to a peak level, occurring at intervals, as opposed to the continuous but fluctuating noise from heavy traffic. The annoyance caused by aircraft depends on the peak perceived noise levels and on the number of aircraft heard within a given period [13].

The index used in this country (UK), until 1990, to define the annoyance was the so-called 'Noise and Number Index' (NNI) [13].

$$NNI = \text{Average peak noise level} + 15\log_{10}N - 80$$

Where N = number of aircraft heard in a defined period [14].

An exposure of 35 NNI corresponds to aircraft overflying at intervals of 15 minutes with intrusive levels of noise inside houses. 55 NNI

means aircraft flying overhead at intervals of 1–2 minutes at noise levels which can interfere with conversation within houses [14].

This index has since been replaced by the 'Equivalent Continuous Sound Level' (L_{eq}) with 57 L_{eq}, which represents the equivalent continuous sound level measured in A-weighted decibels' (dBA). The L_{eq} method of assessment averages out exposure to noise over a number of hours. On that basis a figure of 57dBA L_{eq}, which corresponds approximately to 35 NNI, is claimed to correlate to the onset of annoyance. Contours of noise exposure in terms of NNI or L_{eq} can be mapped out around an airport in a similar manner to the contour lines used on maps to signify differences in height (see below). An official committee set up to consider the problem of noise concluded, well before aircraft noise had become a widespread problem, that extensive annoyance is caused when the noise exposure exceeded 35 NNI and the noise became intolerable above the range 50–60 NNI. However, more recent research has brought this figure into question and this showed that [13]:

- For areas with L_{eq} less than around 43dBA, the proportion of respondents who were at least very annoyed was less than 12%.
- The proportion of respondents at least very annoyed generally increased with L_{eq} for values of L_{eq} over 43dBA, although there was a relatively large spread in percentages for most L_{eq} values.
- For areas with L_{eq} greater than 57dBA, more than 6o% of respondents were at least very annoyed.

This more recent study showed that 50 dBA would be a more realistic figure to use as 60% of respondents were very annoyed at a noise level of 57dB. This should be compared with the 1990 study that gave a value of 57dB as merely the onset of annoyance. Perhaps not surprisingly the Department for Transport was very reluctant to see this report published. This difference of 7dB might suggest a difference of only 14% in noise levels but this is grossly misleading as the decibel is not a linear scale. It is in fact a logarithmic scale and a perceived noise level of 57dB is perceived by the human ear as being four times as loud as a level of 50dB [13].

It is estimated that 2.25 million people around Heathrow live within the 35 NNI contour which stretches from Maidenhead in the west to Fulham in the east. For those living close to the airport the situation is of course much worse and the Inspector reporting on the 4th Terminal Inquiry concluded that, “In my view the present levels of noise around Heathrow are unacceptable in a civilized society” [14].

The map (Figure 2) [15] shows the area affected by daytime noise in 1991, and as predicted for 2016 with and without a fifth terminal. This is a considerable improvement on the position 10 years earlier because of the introduction of less noisy aircraft. BAA claims that it will improve still more because of the introduction of what euphemistically calls 'quieter' aircraft even with the construction of a fifth terminal and the extra traffic that this would bring. However, even BAA must admit that some of these improvements would be negated if a fifth terminal were to be built. On its own figures, 560.800 people were adversely affected by aircraft noise in 1991. This would drop by 59 per cent to 231.800 by 2016 if a fifth terminal were not built, but only by 35 per cent to 363.400 with a fifth terminal [15].

Indeed, previously mentioned BBA’s statement about the number of people who will get hurt by noise to 2016 can be claimed euphemistic, if it is not only idealistic.

In 2017 was published Survey of Noise Attitudes (SoNA) [16; 17] that was ordered by Department of Transport in 2014.

The overall aims of SoNA were to [16]:

- Obtain new and updated evidence on attitudes to aviation noise around airports in England, including the effects of aviation noise on annoyance, wellbeing and health.
- Obtain new and updated evidence on what influences attitudes to aviation noise, and how attitudes vary, particularly how attitudes vary with LA_{eq}, but also other non-acoustic factors that may influence attitudes, such as location and time of day, and socioeconomic group of respondents.
- Examine whether the currently used measure of annoyance, LA_{eq}, is the appropriate measure of annoyance for measuring the impact on people living around major airports.

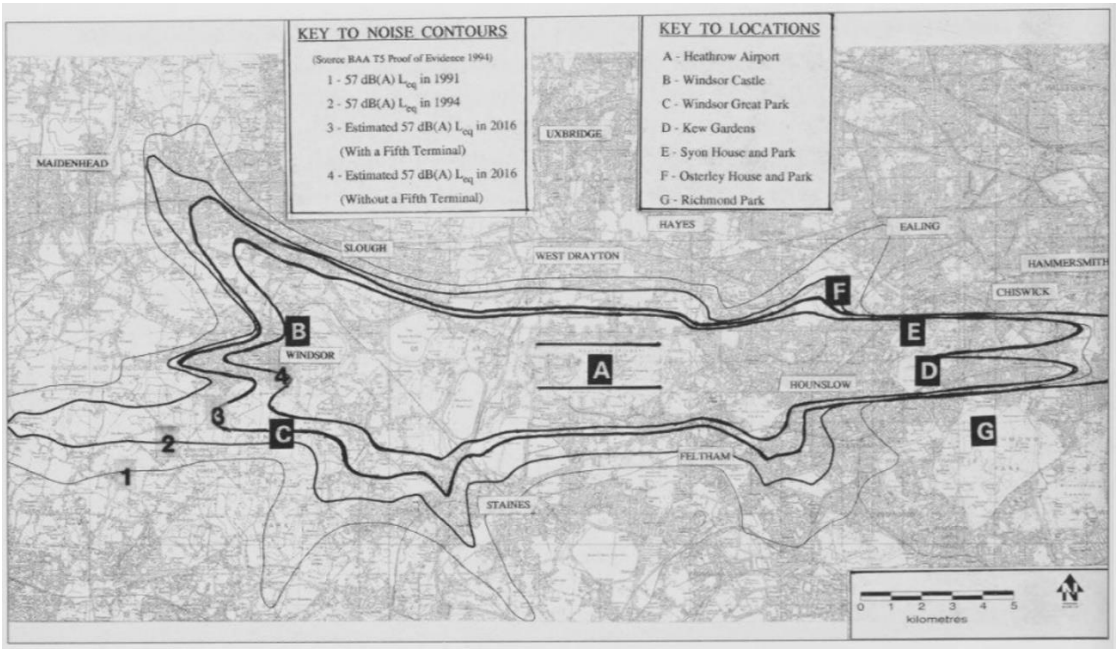

Fig. 2. Forecast of noise levels around Heathrow Airport from 1991 to 2016

• Consider the appropriateness of the policy threshold for significant community annoyance from aviation noise.

• Provide baseline results that can be used for a programme of regular surveys of attitudes to aviation noise.

In the UK has already been same research: Aircraft Noise Annoyance Studies (ANIS, 1982) and The Attitudes to Noise from Aviation Sources in England (ANASE, 2001–2007). Previous research has found the threshold in significant community annoyance 57dB L_{eq}. One of the SoNA's question was: is 57dB threshold correct for current requirements (in 2014).

SoNA's research result was: "The same percentage of respondents said by ANIS to be highly annoyed at 57dB LAeq,16h now occurs at 54dB" [16].

Table 1 [17] demonstrates increasing per cent of highly annoyed people in 1982 compared with 2014.

The Table 2 [18] was taken from Report: "Strategic Noise Maps for Heathrow Airport 2016".

Remember that BAA declared 363 400 people who will get hurt by the aircraft noise in 2016 if Terminal Five is built. Map (Figure 2) shows noise contour 57dB(A) L_{eq}, that noise level in 1991 was the threshold in significant community annoyance as ANIS confirmed. However, in 2016 this threshold is 54dB(A) L_{eq}. That mean populations in 246,600 (>57dBA) (Table 2) must be watched, not 533,000 (>54dBA) (Table 2). Thus, even if BAA get a little indulgence, all the same it mistakes on 100,000 people!

Probably some criticism or accusation BAA about noise level forecast in the future

Table 1

Percentage highly annoyed as a function average summer day noise exposure, LA_{eq},16h

Average summer day noise exposure, LA_{eq},16h (dB)	% highly annoyed	
	ANIS 1982	SoNA 2014
51	3%	7%
54	5%	9%
57	9%	13%
60	14%	17%
63	23%	23%
66	34%	31%
69	48%	39%

Table 2

Heathrow 2016 annual LA_{eq},16hr area, population and dwelling estimates

$L_{Aeq,16hr}$ (dBA)	Area (km²)	Population	Dwellings
> 54	179.2	533.000	217.500
> 57	95.5	246.600	92.700
> 60	52.9	110.800	38.700
> 63	30.8	38.800	13.000
> 66	17.2	9.900	3.400
> 69	8.5	2.100	750
> 72	4.6	100	<50

is wrong, because they could not know about changes in noise standards (but they should suggest it). However, critics in 1991 had the right to do this. They saw a lot of times hypocrisy and crazy statements of aviation' spokesmen.

Results. The problem of noise pollution is real and it can't be perceived as an ordinary discomfort.

The annoyance is caused by the periodic noise of airplanes is considered to be a detriment to quality of life, well-being and ultimately, health. The World Health Organization's (WHO) definition of health is [16]:

"Health is a state of complete physical, mental and social well-being, and not merely an absence of disease and infirmity".

Annoyance from any source represents a diminished state of well-being and noise is often referred to as the stressor that is implicated in a variety of responses [16].

The airport is responsible for aircraft noise. How airport is planned, location of runways, organization of airspace, use of "quieter" aircraft, traffic and type of aircraft, permission or prohibition of night flights, limitation of the annual number of takeoff and landing operations, etc. All these factors must be taken into account, and not only considered.

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