
Brisbane
Aircraft Noise
Killing Us Slowly
Kingaroy
Kumbia
Nanango
Jandowae
Yarraman
Blackbutt
Bell
Chinchilla
Dalby
Oakey
Highfields
Cecil Plains
Gatton
Millmerran
Warwick
ALTITUDE (ft)
0
500
1 000
2 000
4 000
6 000
8 000
10 000

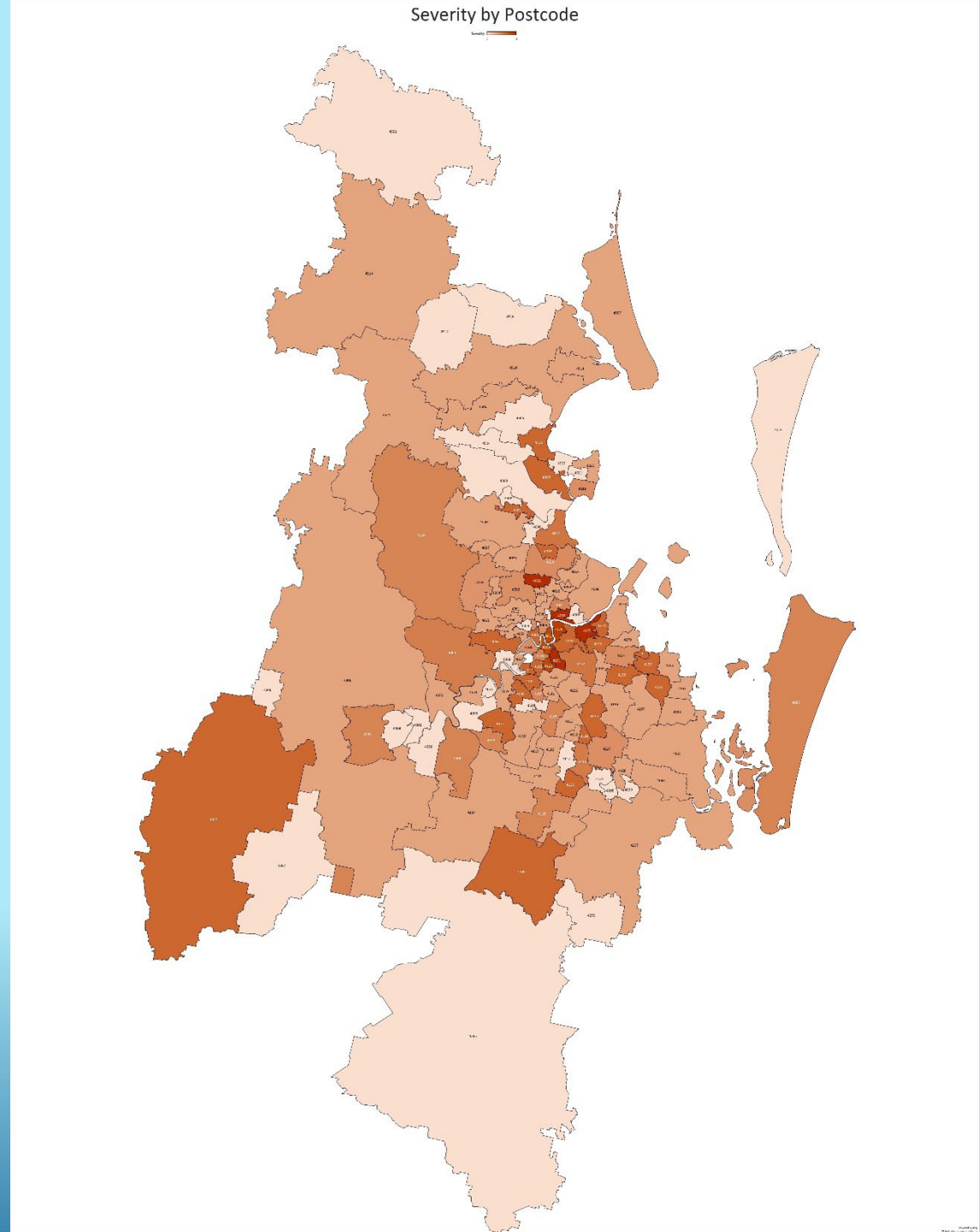
Noise Severity Index & Afflicted Population

There are many ~10 km wide swathes of aircraft noise across Brisbane, each much wider than the average suburb.
Very few Brisbane suburbs are not afflicted by aircraft noise.

Complaints	Flight Paths	Severity Index	No. of Suburbs	Population (est.)
No complaints	Not under flight path?	0	?	?
Complaints received	Not under flight path	1	74	**472,000 (18%)**
Complaints received	Under one flight path	2	62	**671,000 (26%)**
Complaints received	Under two flight paths	3	28	**242,000 (9%)**
		Total	**164**	**1,385,000 (54%)**
Notes: Percentage (%) of Brisbane total population. NB noise exposure data continues to be refined.				

Brisbane – Extent & Severity Index of Aircraft Noise – 2023

Darker = More Severe



Flight Numbers & Noise Levels - June 2023

dBA	Annerley	Bulimba	Cannon Hill	Carina	Hamilton	New Farm	St. Lucia	Tingalpa
65	329	1121	433	35	137	1417	793	769
70	26	1763	817	174	1,141	1105	90	1821
75	2	107	63	2	1,607	86	10	78
80	2	12	5		107	37	1	14
85			4		7	18		
Total	359	3,003	1,322	211	2,999	2,663	894	2,682
Monthly	30	1892	889	176	2862	1146	101	1913
Daily	**12**	**100**	**44**	**7**	**100**	**89**	**30**	**89**

Note: Figures in red result in health damaging (>50 dBA) ground-level interior noise pollution.
Based on AsA Monitoring Data.

Words People Use About BAC & AsA

Deliberate

Torture

Harrowing

Disheartening

Powerless

Harmful

Irresponsible

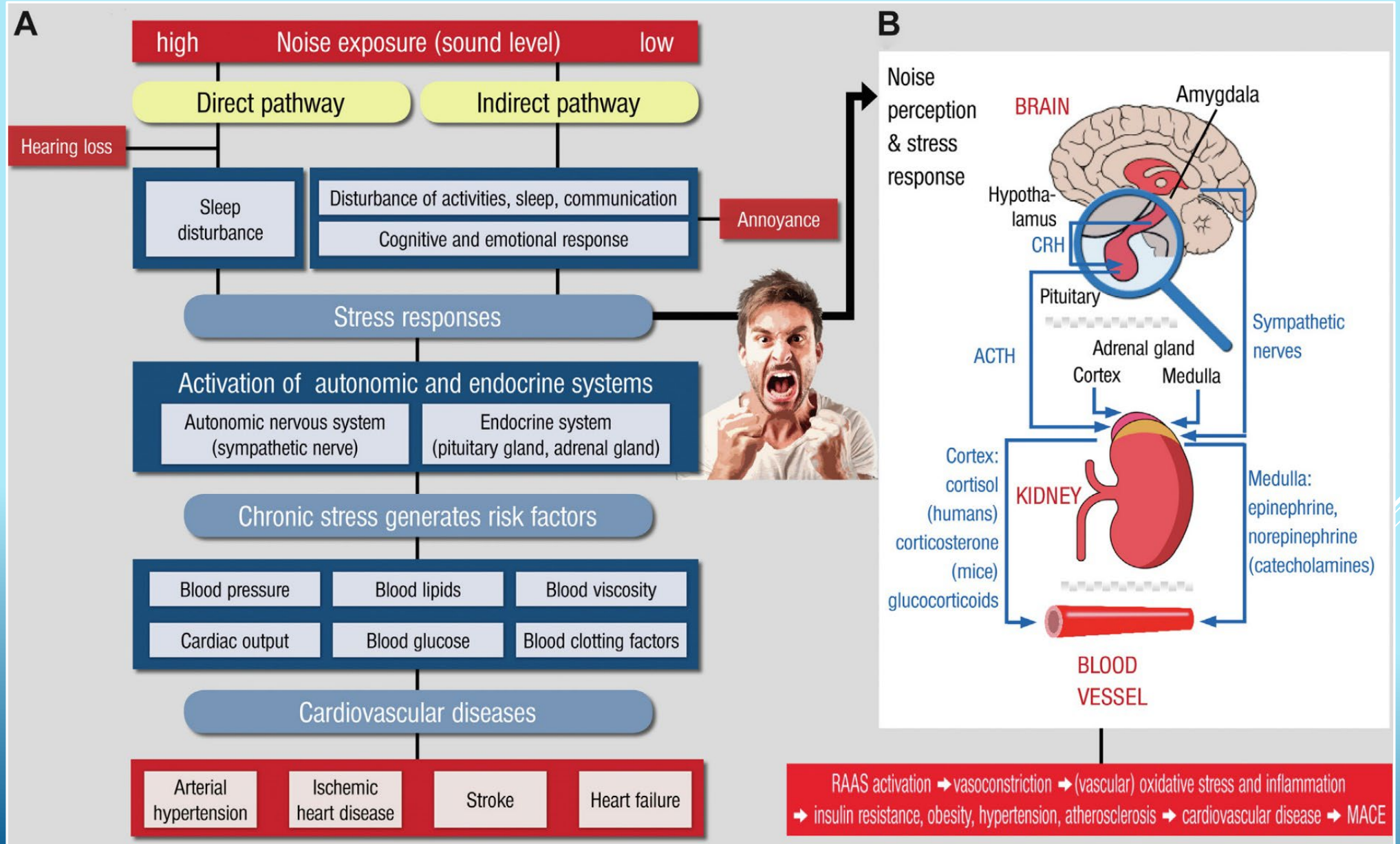
Criminal

Deceitful

Immoral

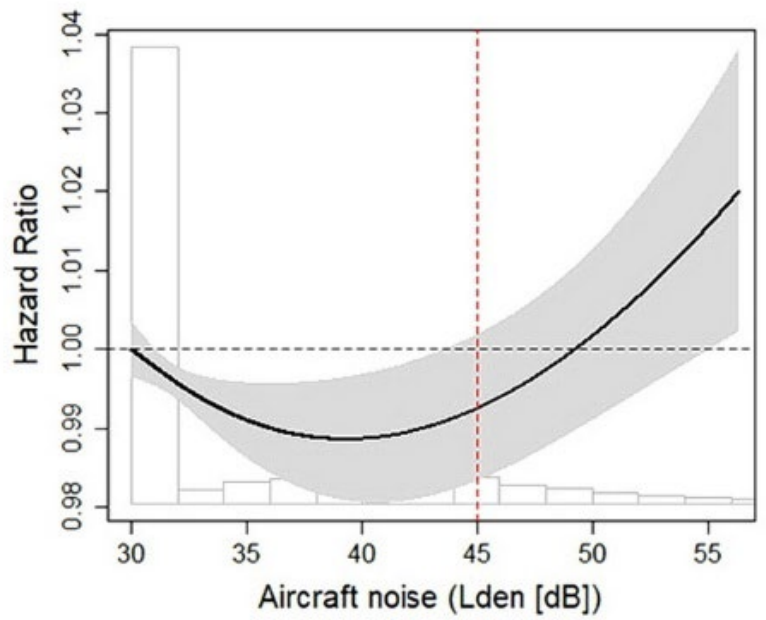
Unethical

Biophysical Damage – How it Happens

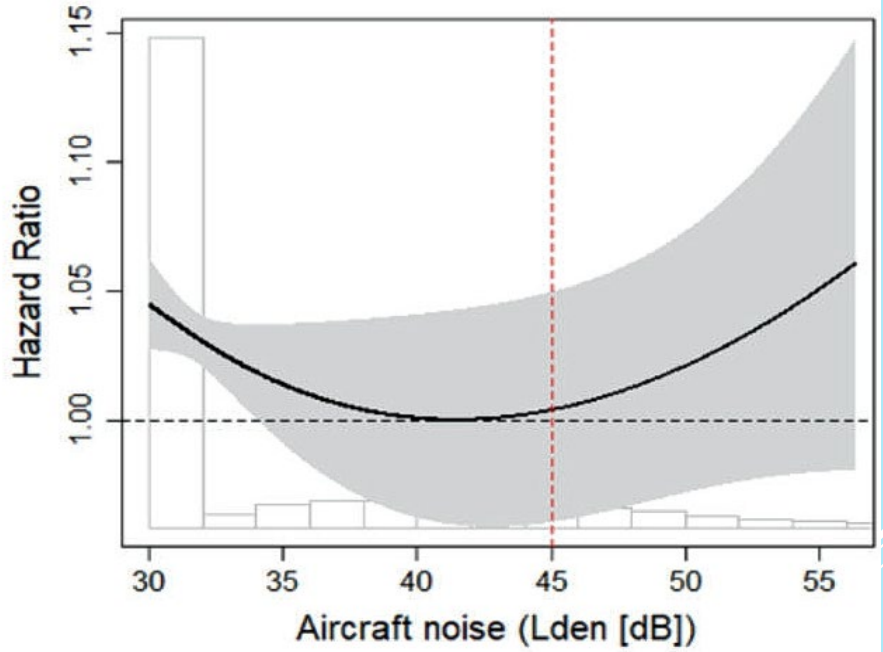


Biomedical Risks & Aircraft Noise

All Cardio Vascular Disease



Suicide Risk



Biomedical, Mental & Social Effects

Biomedical	Mental & Social
Cardiovascular diseases	Delays student learning
Endothelial dysfunction	Delayed cognitive development
Blood pressure elevated	Psychological/social stress
Increased stress hormone	Depression, anxiety, suicide
Ischemic heart disease	Migraines, headaches
Myocardial infarction	Sleep disturbance
Heart failure	Cognitive impairment
Haemorrhagic stroke	Annoyance
Ischemic stroke	Reduced deep sleep
Dysregulates genes	Disrupts communications
Diabetes mellitus	Disrupts social activities

Health Costs & BAC 'Contributions' Preliminary Estimates

Noise Annoyance, Sleep Disturbance, Cardiovascular Diseases

'Externalities' borne by Communities (2023)

DALYs Lost ~13,880/annum

Severely afflicted cost = ~$11,843/person/annum

BCA's Claimed Contribution to Qld. Economy v Health-Economic Costs 2019 & 2041

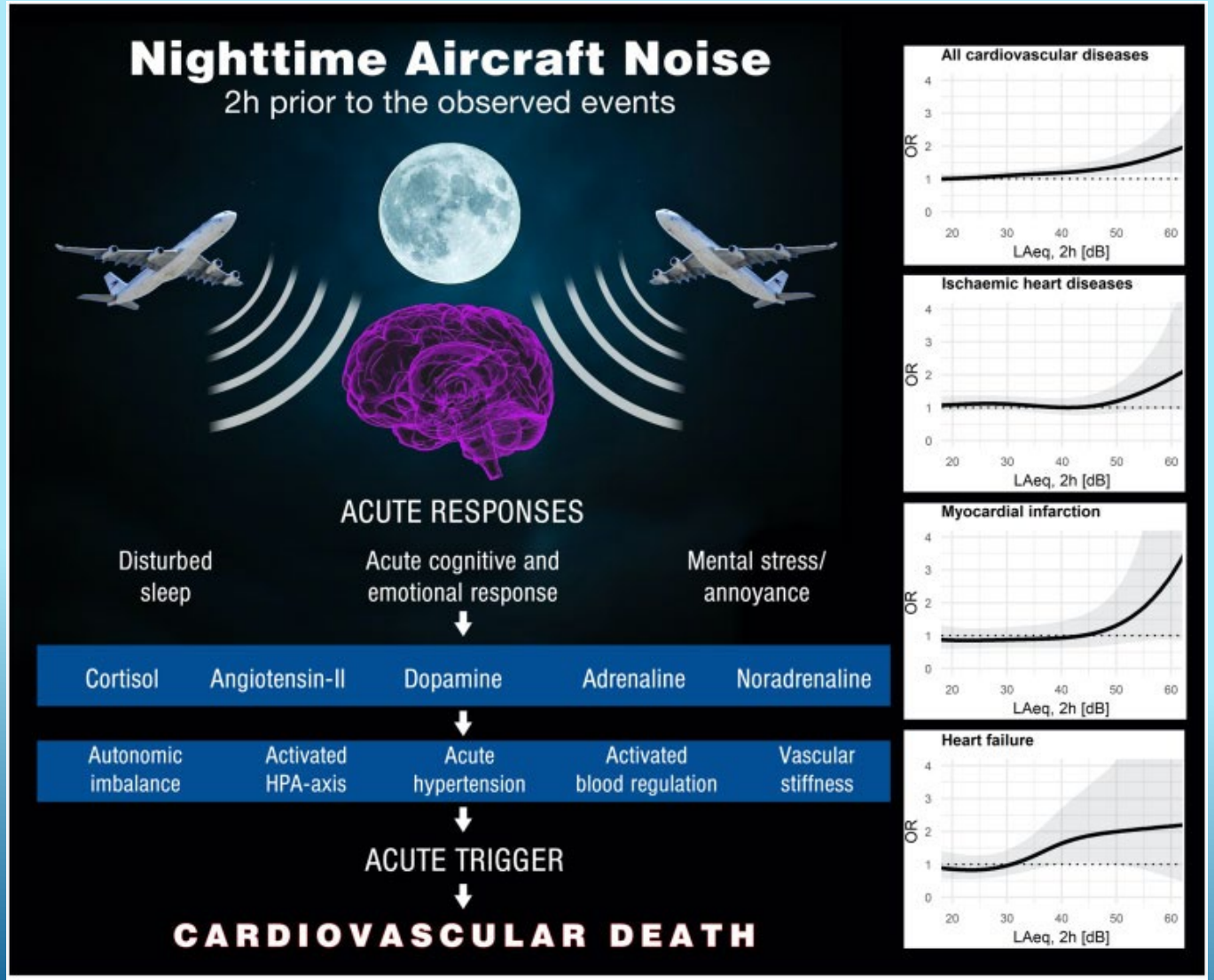
Year	Aircraft Movements / Year	BAC's Claimed Economic Contribution	Calculated Community Health Cost
2019	213,000	~$4.3 bn	~3.9 bn
2041	380,000	~$8 bn	~~8 bn

Brussels: flight path data (2022) from Belgian aviation authorities, health and other cost data from WHO Europe's database, population 1.3 million (half Brisbane's) severely afflicted estimate: ~220,000 people suffer annoyance (4,830 DALYs), ~109,000 sleep disturbance (6,000 DALYs), ~6,800 cardiovascular risks (6,800 DALYs) = Total 19,260 DALYs. Health-economic cost/annum : annoyance EUR 0.578 bn, sleep disturbance EUR 1.007 bn, cardiovascular risk EUR 0.900 bn = Total EUR 2.485 bn (~AUD 3.997 bn/annum). Severely afflicted people: Brussels EUR 7,402/person/annum, ~AUD 11,843/person/annum.

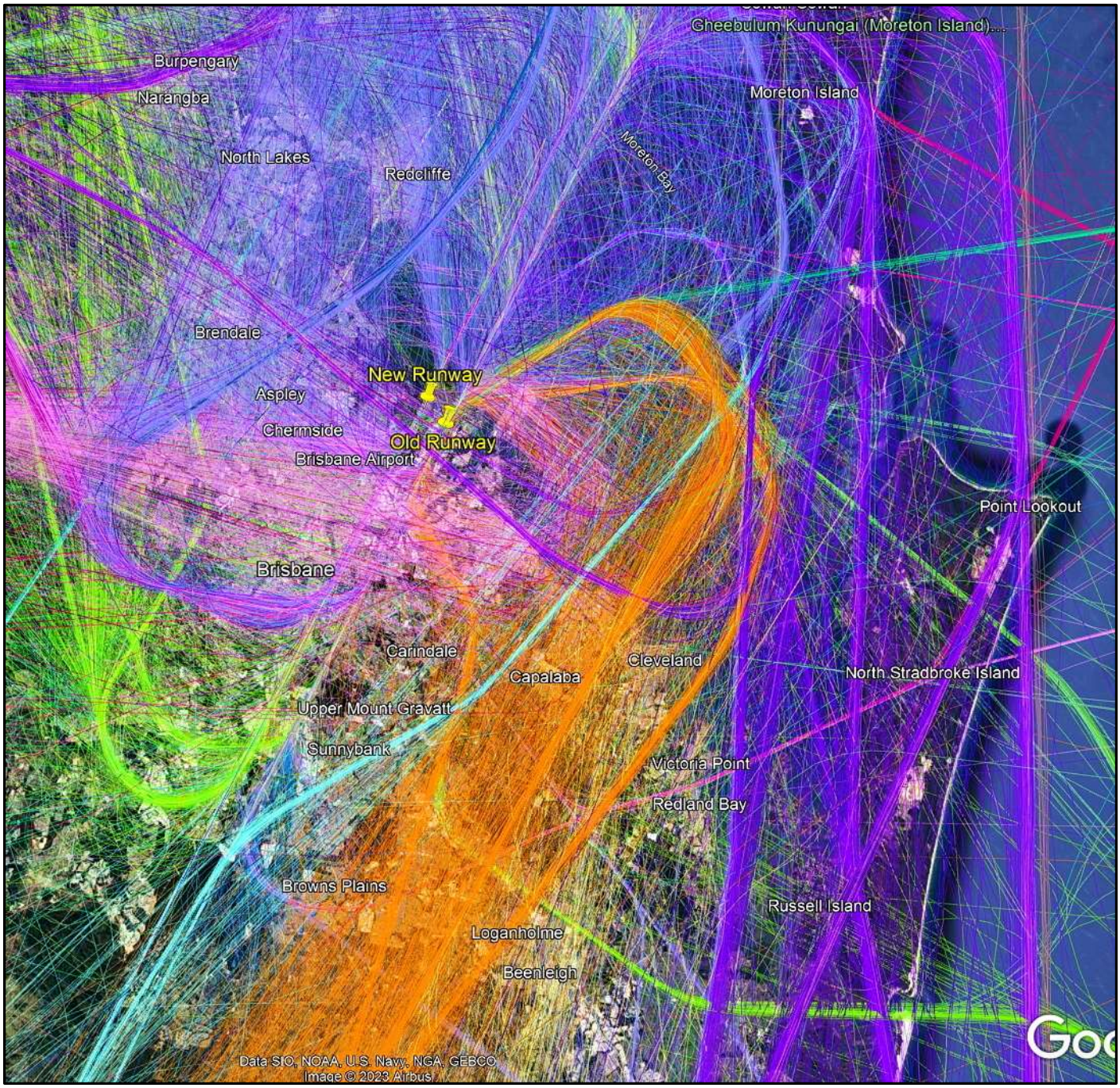
DALY = Disability Adjusted Life Years. Brussels, ENVISA 2023. Brisbane Airport data from BAC Master Plan (2020)

Aircraft Noise Pollution and Community Health

Aircraft Noise is Killing People



Brisbane – Aviation Noise Pollution, Public Health & Wellbeing



Sean Foley BSc (Hons) PhD FRGS, August 2023

Brisbane - Aviation Noise Pollution and Health & Wellbeing

> Scientists believe that pronounced fluctuations in noise levels like this might compound the effects on the body. They suspect jarring sounds that break through the ambience — recurring jet engines, a pulsating leaf blower, or the brassy whistle of trains — are more detrimental to health than the continuous whirring of a busy roadway, even if the average decibel levels are comparable. (NYT, 09Jun23)
>
> Aircraft noise, the most health-threatening source of noise pollution among all modes of transport, is a stressor with identifiable effects on occupants' well-being and social behavior at airports and environs. (Faiyetole & Sivowaku, 2021)

This briefing note is a first step in a process of estimating how Brisbane residents are afflicted (afflicted, not just affected) by aircraft noise pollution from the operations of Brisbane Airport Corporation's (BAC) airport and the aviation industry. The briefing sketches some preliminary estimates of health-economic costs ('externalities') imposed on Brisbane residents by this uncontrolled aviation noise pollution.

The briefing is in three main parts:

- Part I, description, illustration and analysis of the aviation noise pollution that is afflicting about half of Brisbane's residents, including dangerous noise levels as recorded by the aviation industry;
- Part II, review of recent scientific literature explaining the effects of chronic and excessive aircraft noise on human physical and mental health; and
- Part III, summary selection of narrative responses by residents submitted to BFPCA for the Project Implementation Review (PIR) conducted by AsA of the new runway.

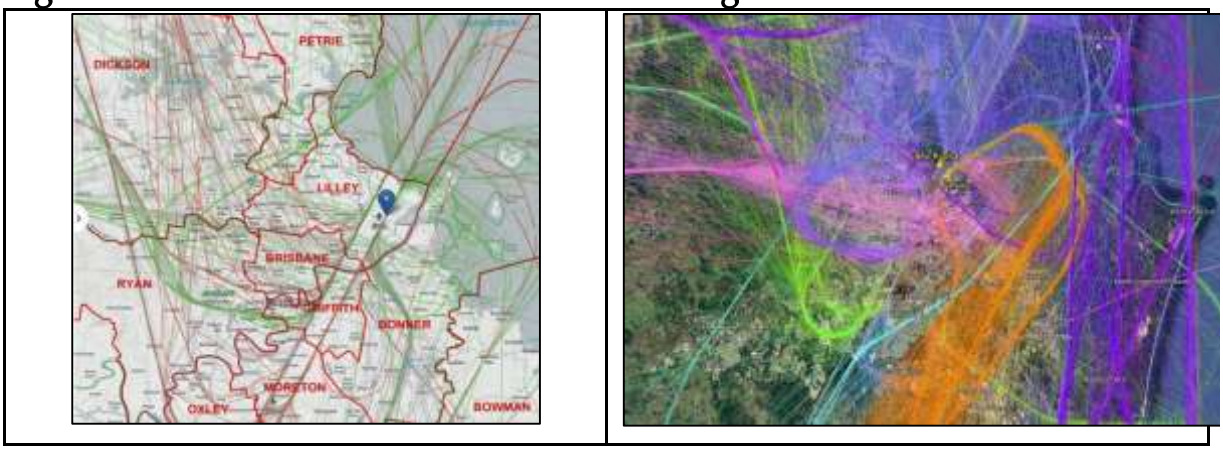
Introduction

We are not concerned with aircraft noise per se, but with the effects of chronic and excessive noise and other aviation pollution on the health and wellbeing of Brisbane residents. The scientific literature available prior to Brisbane Airport Corporation (BAC) preparing the Environmental Impact Statement (EIS), specifically the Health Impact Assessment in 2005-06, partially identified the health and social impacts of aircraft noise. By 2020 when the new runway started operating, the scientific evidence was overwhelming. Ironically, a substantial part of the scientific work (epidemiology) was based on Schiphol airport in the Netherlands, home of a major shareholder (~20%) in BAC, previous employer of the current CEO, Gert Jan de Graaff. There is no plausible way, since at least 2002, that Schiphol senior management could not have been aware of this evidence regarding the serious health impacts of chronic exposure to aircraft noise. In planning the new runway and flightpaths it is clear they chose to ignore this evidence, and the damage and suffering that operation of the new parallel runway would certainly cause, in favour, they probably thought, of greater profits.

Two maps below illustrate the extent of aircraft noise pollution that afflicts Brisbane residents. These clearly show aircraft noise is experienced all across the city, not just under the major flight paths - it 'blankets' Brisbane. For far too many people it severely affects their physical and mental health, wellbeing and amenity, as evidenced by BFPCA's online surveys in 2021 and 2022. In brief, for Brisbane aircraft noise is a *major public health issue*.

The maps below approximate the extent of aviation noise pollution for Brisbane for 2020-21, even when the pandemic severely restricted air travel. The map on the left shows nominal flight paths – 'nominal' as aircraft deviate from these for a variety of reasons, on the right the swathes of actual flight paths recorded by Open Sky Network.

Figure 1 - Brisbane – Nominal and Actual Flight Paths – 2020-21



Brisbane - Nominal Flight Paths – 2020-21 | Brisbane – Actual Flight Paths – 2020-21

Sources: AsA 2020-21(left), Open Sky Network 2020-21 (right). Notes: the AsA diagram fails to show the complexity and density of flight paths across Brisbane. However it clearly illustrates a significant number of suburbs, and people, lie under major flight paths to and from the airport.

In Brisbane most residential suburbs are blanketed by aviation noise pollution from operations at Brisbane airport – only a minority are free of aircraft noise. Many are exposed to noise levels far greater than those considered safe by WHO Europe, the UK Civil Aviation Authority (CAA) and many independent, peer-reviewed and published research studies, a number of which will be referenced later in this briefing paper.[1]

In summary, there can be no doubt that Brisbane residents, even those in periurban locations 30-35 km from the airport, are subjected to chronic, frequent, excessive levels of aviation noise pollution.[2] The residents most affected are those closest to the airport and under the main flight paths (really swathes). But as commercial flights increase, with flight paths criss-crossing the city, there are ever fewer locations free of aviation noise pollution. The extent of these quiet areas will shrink further, if BAC and major airlines are allowed to realise their ambitions for endlessly increasing the number of flights. As a consequence 'externalised' health, social and economic costs will continue to increase, while the airlines and BAC's incomes and profits will likely climb.

Part I – Brisbane: Extent and Severity of Aircraft Noise Pollution

Table 1 below provides preliminary estimates of the number of Brisbane residents afflicted by aircraft noise in 2023, overall, over of half Brisbane residents, some 1.39 million people (54%). We estimate about 671,000 (26%) people are moderately afflicted and some 242,000 (9%) severely afflicted. This is far greater than predictions made by BAC in their 2007 EIS, which AsA and the federal government accepted without comment or question. The methodology for making these estimates is described below. Table 2 provides a summary of the number of suburbs afflicted by different levels of aircraft noise.

These are deliberately conservative preliminary estimates. They illustrate that about half of Brisbane's residents are afflicted by aircraft noise, and almost 10% afflicted by severe aircraft noise caused by dozens of low altitude overflights each day. Given the physical and mental effects of excessive, chronic aircraft noise are well known (see Part II) Brisbane is now faced with a major public health problem that has yet to be recognised and addressed effectively.

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[1] Apologies for any mistakes or oversights that remain. Substantive issues will be addressed in the following briefing notes.

[2] Aviation noise pollution is used as a short-hand, and includes noise, toxic gasses and toxic particulates.

Table 1 - Brisbane – Preliminary Estimates of the Number of Brisbane Residents Afflicted by Aircraft Noise 2023

Flight Path	North & West			Southerly			Overall Total	
Severity	Arrivals	Departures	Sub-Total	Arrivals	Departures	Sub-Total	No. People	% BNE pop.
Slight							472,000	18%
Moderate	144,000	193,000	337,000	173,000	178,000	333,000	671,000	26%
Severe			183,000			58,000	242,000	9%
Totals	**144,000**	**193,000**	**510,000**	**173,000**	**178,000**	**391,000**	**1,385,000**	**54%**

Sources: Based on list of suburbs from AsA Senate Estimates listing of complaints (~14,000 total) by suburb, ibid; flight paths logged from FR 24 radar tracks in mid 2023; population, ABS Census 2021. Notes: Numbers have been *rounded down* to nearest thousand to minimise possibility of over counting; 'slight' is from AsA list of suburbs and not under flight paths, 'moderate' from suburbs under one major flight path, 'severe' from suburbs under two major flight paths.

Table 2 -Brisbane - Suburbs Afflicted by Aircraft Noise 2023

Flight Path	N & W	Southerly
Slight	74	
Moderate	30	32
Severe	22	6
Sub-Total	**52**	**38**
Overall Total	**164**	

Sources: as above

Residents Afflicted by Aviation Noise Pollution

The preferred approach, as used for a similar exercise with Brussels airport (see below), is using detailed aircraft noise contours overlain with urban population within each contour to estimate the population afflicted by differing noise intensities. Because reliable and up-to-date noise contour maps are not available for Brisbane, either from AsA or BAC, we needed to develop an approach by making use of limited information available. It is clear people living in suburbs overflown by the main flight paths are more seriously afflicted than others, and suburbs overflown by both arrivals and departures flight paths the most severely afflicted.

At Senate Estimates in late 2022 AsA identified 226 suburbs in greater Brisbane from which they had received some 14,000 aircraft noise complaints. This is more than the total number of suburbs in Brisbane City (190), as AsA also received complaints from Redlands, Logan and Moreton Bay communities. We assumed these are, at a minimum, the suburbs afflicted by aircraft noise from overflights at least some of the time. The city-wide extent of complaints makes it clear Brisbane is indeed 'blanketed' by aircraft noise.

We assumed people in suburbs identified by AsA are at a minimum '*slightly afflicted*", while those overflown by a major arrival or departure flight path are '*moderately afflicte*d', and those overflown by both arrival and departure flight paths are '*severely afflicted*' by aircraft noise. We recognise these categories are broad but they are probably the best approximations that can be made without public access to accurate and reliable noise contour maps based on actual field measurement, as opposed to models.

Approximately 242,000 people in 28 suburbs are estimated to be severely afflicted, and overflown up to 80-100 times per day on average, according to AsA's own data (see Table 3). This underlies the fact it is *chronic, frequent, excessive (>55 dBA) aircraft noise* that research has definitively shown is the cause of major physical and mental ailments. This was locally evidenced by data from BFPCA's two online surveys in 2021 and 2022 (op cit) in which some 75% of respondents reported mental health problems for themselves and their families associated with frequent, chronic, excessive aircraft noise.

In summary, aviation pollution is causing major, unaddressed and largely hidden public health problems in Brisbane. Here we are only dealing with the effects of aircraft noise, but overseas research makes it clear toxic gases and, especially ultra-fine particles ($PM_{2.5}$), which can contain harmful chemicals and heavy metals, also pose significant health problems. The EIS prepared by BAC, and signed-off by AsA without comment in 2015, clearly failed to accurately estimate the actual extent and severity of noise problems, with noise pollution blanketing most of Brisbane, and toxic particulates affecting north-western suburbs, for example. Figure 2 illustrates the extent and severity of noise pollution in Brisbane caused by aviation operations.

It is now over three years since a new pattern of operations at Brisbane airport commenced. Despite continual efforts by community groups, especially Brisbane Flight Path Community Alliance (BFPCA) there has been little progress in resolving the problems caused by significant increases in aircraft noise. Indeed, the addition of middle-of-the-night flights by Qatar's and Emirates' A380/B777 services to Doha and Dubai, for example, the situation for night time noise has significantly worsened. The federal, state and local governments and BAC strenuously oppose the imposition of curfews, movement caps or operating plans, measures that would begin to address these public health problems that especially afflict children.

The airlines and BAC attempt to remain invisible behind lack of effective government regulation and performance standards regarding aviation pollution control, reduction and management, covertly shifting health and other pollution costs onto Brisbane residents. While it is true government regulation is almost totally lacking - a deliberate 'design feature' of the Australian aviation industry - this does no absolve aviation corporations from their responsibility for taking

substantive initiatives to protect Brisbane residents, and those of other cities, rather than exploit this lack of regulation and control for private profit.

Estimation Methodology

We do not consider AsA's list of afflicted suburbs to be complete, as there are other suburbs where residents have reported to BFPCA that they are afflicted by aircraft noise (see Annex 3). Despite these omissions we used AsA's listing as a *minimum* starting point in our analysis; the list may be refined in later analyses.

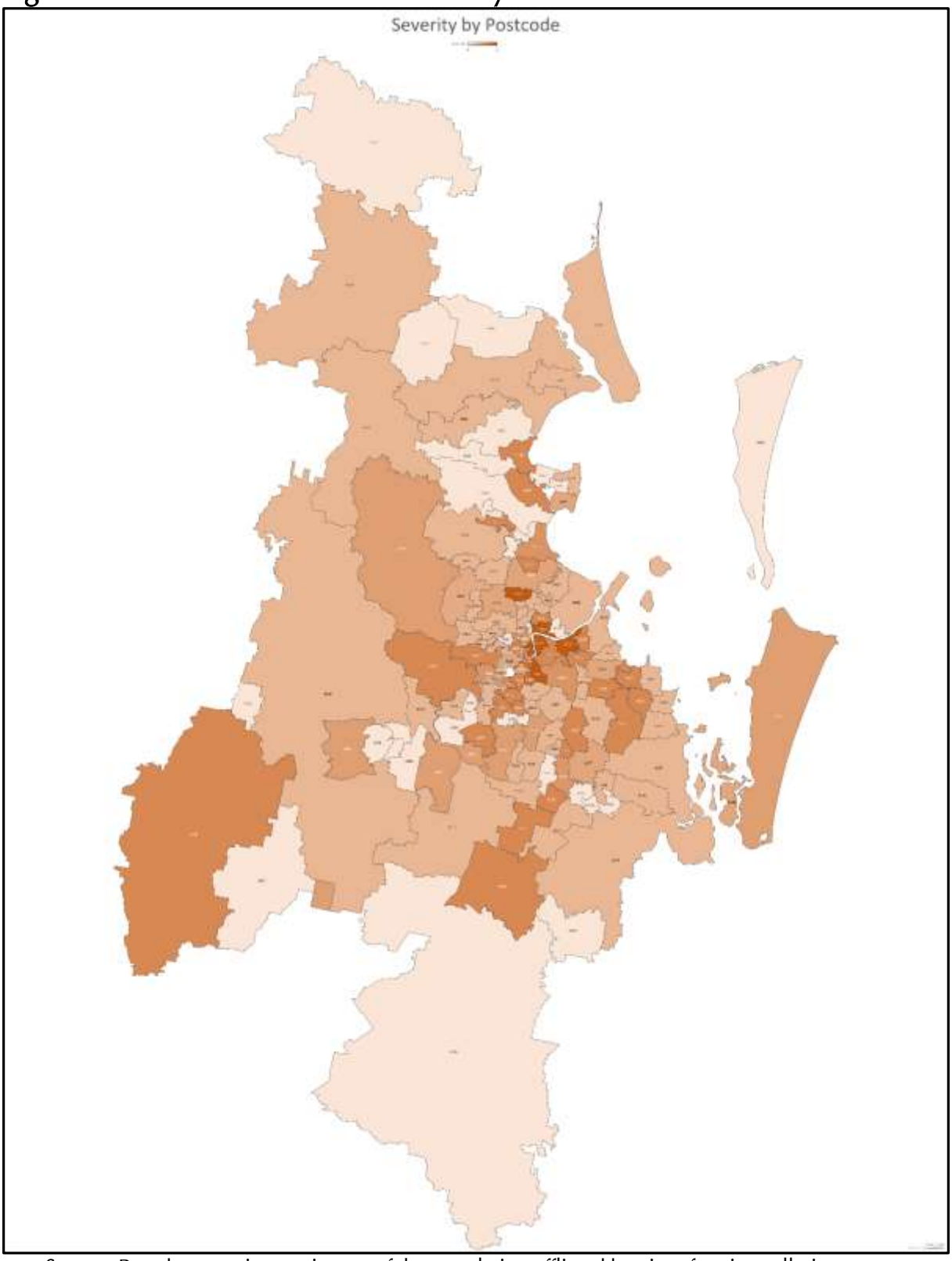
As a necessarily conservative judgement for this preliminary assessment, we class all the suburbs identified by AsA as being at least '*slightly afflicted*' – i.e. with overflights, noting there can be considerable variation in noise levels within a suburb, depending on whether aircraft pass directly overhead or adjacent; this can change unpredictably depending on the weather and other factors. Topography, for example, can also affect perceived noise levels, as valleys appear to amplify noise levels. The slightly afflicted suburbs do not include the moderately or severely afflicted suburbs, as discussed below.

There are two large groups of people who are more significantly afflicted. First, residents whose suburb is under one of the main flight paths overflown by either arrivals or by departures, but not by both flight paths. We assess these suburbs as being '*moderately afflicted*', there are some 62 suburbs under either major arrival or departure flight paths. Second, there are suburbs under both major arrival and departure flight paths, we assess these as being '*severely afflicted*', there are about 28 suburbs under both major flight paths. We note that in at least some cases, possibly many, this may be an underestimate of the extent of moderate and severe noise pollution that people experience, and this list will probably need to be revised in later analyses.

There is, in fact, another sub-category of suburbs severely afflicted suburbs close to Brisbane airport which are overflown by both arrivals and departures at much lower altitudes and usually more frequently. In future analyses we will class these suburbs as being '*critically afflicted*' by aircraft noise, however these are not discussed further in the current briefing.

These three categories are important, as the severity of physical and mental effects are quite directly (linearly) linked to the degree of chronic noise pollution, also because these categories provide an indication of how many people in Brisbane are having their lives and wellbeing disrupted by aircraft noise. These three categories will also provide the basis for making preliminary estimates of the health-economic cost burden imposed on Brisbane residents by aircraft noise, to be discussed in a later briefing. These are uncompensated costs, in economic terms 'externalities'.

Figure 2 - Brisbane – Extent and Severity of Aircraft Noise Pollution ~2023.



Source: Based on previous estimates of the population afflicted by aircraft noise pollution; some postcodes include more than one suburb. Legend

slight	moderate	severe	no data

To make these estimates we used Flight Radar 24 (FR24) to separately track the flight paths of arriving and departing *scheduled* flights across Brisbane in mid-2023. These were divided into two groups: flights arriving or departing from and to the north and west, and flights arriving and departing in a southerly direction. The flightpaths shown on FR24 were used to identify and list the suburbs which were overflown – this list was compiled over several weeks, so as to ensure that a reliably complete list of suburbs was identified.

Data from the 2021 population census were accessed for all the suburbs on AsA's list, plus suburbs which were observed using FR24 as being overflown. The list of suburbs was divided into three classes, as described above, for the moderately and severely afflicted suburbs the total number of people afflicted by arrivals and departures estimated separately for each of the two main flight paths to and from the airport (see Annex 3).

To avoid double-counting the population in suburbs overflown by one major flight path was only counted once, as were those suburbs under both arrivals and departure flight paths. It is obvious suburbs under major arrival and departure flight paths suffer more frequent overflights, especially suburbs closer to the airport. Noise levels in these suburbs experience are higher, as planes are flying at lower altitudes. Interestingly, overall measured noise levels for arriving and departing flights at a given location are quite similar, but have different frequency spectrums.

Brisbane – Estimated and Measured Aircraft Noise Levels

We have illustrated that aircraft noise pollution is pervasive across Brisbane, we now provide some technical data on its severity.

Australia relies on overseas aircraft and engine manufacturers to provide sound level data for approving use of specific types of aircraft in Australia. As far as is known we have no national facilities for validating data provided by manufacturers. Nor does Australia have any laws and regulations limiting the levels of aviation noise pollution allowed, for either urban or rural areas. To 'guesstimate' indoor sound levels caused by aircraft overflights AsA relies on data compiled in the 1980s primarily for use in land use zoning, not human health. This data assumes that structures (homes) built to Australian standard (AS 2021:2015) reduces (attenuates) external sound levels by about 10 dBA, i.e. 70 dBA external will be reduced to an internal sound level of about 60 dBA. Probably the majority of homes in sub-tropical Brisbane would not meet this standard. As far as can be determined no more recent research has been conducted by relevant agencies or independent researchers in Australia to confirm this assumption. It remains an unscientific 'guesstimate', an example of misgovernance of aviation impacts by successive governments and the industry itself.

Summaries of aviation noise pollution data collected AsA from monitoring stations are posted online and clearly shows that virtually every aircraft arriving or departing Brisbane airport causes (average) sound levels at ground level in the range 60-70 dBA. Given these are 'average' sound levels, rather than instantaneous levels, the actual sound levels are very probably some 20 dBA higher, i.e. *over four times*, greater than publicly reported by AsA (see Ancich Report 2019).[3]

Maps of aircraft flight paths (AsA) and maps from Open Sky (Figure 1) illustrate that more than a majority (226 of 209) of Brisbane's suburbs are overflown almost daily, and many dozens of times per day and a smaller, but significant number, also during most nights.

In June 2023 noise level monitors at Bulimba (beside the Brisbane river) and Hamilton (close to the city end of the runways) recorded the greatest number of flights per month and per day, the monitor at New Farm nearly as many. The monitors at Bulimba and New Farm record flights to and from the north and west, those at Tingalpa flights to and from the south and at Hamilton

[3] [3] https://bfpca.org.au/14-noise/

flights in all directions across the city (see below). These monitors are located relatively close to the airport (7-15 km), whereas the majority of low level arrivals (~2,500-3,000') overfly Brisbane city to or from the outskirts 30-40 km away. Consequently, no noise data is collected for the great majority of the suburbs (and population) being afflicted.

In reality, the number and location of AsA's monitors is wholly insufficient to provide reliable, comprehensive coverage of the major flight paths to and from Brisbane airport, especially for locations more distant from the airport, as illustrated in Figure 2. Hence AsA is *not capable* of providing comprehensive monitoring of the full extent of aviation noise pollution occurring in Brisbane.

This lack of coverage is important, as for Brisbane about half all flights – from north, south and west – overfly residential areas on arrival flight paths at about ~2,500-3,000' for about 25-30 km right across the city. Tens of thousands of people are afflicted by noise from each of these flights many times each day. Data from field studies in 2019 in Sydney showed that flights a this altitude – planes usually 'flying dirty' with flaps extended and landing gear down - generating noise at ground level of 70-80 dBA (Ancich 2019) – well into the 'danger zone' for human health damage.

Table 3 - Brisbane – Number of Flights & Noise Levels - June 2023

From BNE	~15 km	~7 km	~7 km	~9 km	~6 km	~10 km	~15 km	~8 km
dBA	Annerley	Bulim-ba	Cannon Hill	Car-ina	Hamil-ton	New Farm	St. Lucia	Ting-alpa
65	329	1121	433	35	137	1417	793	769
70	26	1763	817	174	1,141	1105	90	1821
75	2	107	63	2	1,607	86	10	78
80	2	12	5		107	37	1	14
85			4		7	18		
Total	359	3,003	1,322	211	2,999	2,663	894	2,682
Daily	**12**	**100**	**44**	**7**	**100**	**89**	**30**	**89**

Source: AsA, Flights in your area, Brisbane noise monitoring report, 10-11Jun23; https://aircraftnoise.airservicesaustralia.com/2020/10/29/brisbane-noise-monitoring-. Notes: Figures in red result in health damaging ground-level noise pollution.

Cedar Creek and Balmoral

BAC provided us with recording from two noise monitors. One on the NW outskirts of the city at Cedar Creek 26 km as the crow flies (~40 km flight path, alt. ~110m) distant from the airport, the other located close to the airport at Balmoral (7 km, alt. ~40m).

BAC's EIS did not envisage any flights overflying Cedar Creek or other locations NW of the city, a major oversight that AsA failed to call attention to. In contrast, Balmoral is located in almost a straight line with the new runway and is overflown at low altitude by hundreds of arriving and departing flights each month.

The data reveal (at least) two important insights. First, despite Cedar Creek being some 40 km distant from the airport, mean aircraft noise levels – both arrivals and departures - are still in excess of 60 dBA and maximum noise levels over 80 dBA on occasions. The topography of Cedar Creek appears to cause reflections and resonances, making noise levels appear louder and more prolonged. Second, these data amply demonstrate that even 40 km from the airport

communities are still being afflicted by noise levels well in excess of those recommended by WHO Europe, UK's CAA and independent experts, and despite aircraft being at 6-11,000' in altitude.

These data strongly support the contention that Brisbane is 'blanketed' by aircraft noise dangerous for residents' health and wellbeing. It is clear that hundreds overflights across Brisbane at 3-4,000', typical for arrivals, are inflicting noise on residents far in excess of maximum levels recommended by WHO Europe or UK CAA (Table 4).

Table 4 - Cedar Creek & Balmoral – Aircraft Noise & Altitudes – 2021-23

Cedar Creek Arrivals (n=1104)				**Balmoral Arrivals** (n=1647)			
37 flights/day		1,104 flights/mth.		55 Per flights/day		1,648 flights/mth.	
dBA		Altitude	Correlation	dBA		Altitude	Correlation
Mean	63	6,375	dBA-alt	Mean	80	1,349	alt-dBA
Median	63	6,457	-0.033	Median	78	1,368	-0.047
Max	84			Max	89		
Cedar Creek Departures (n=582)				**Balmoral Departures** (n=712)			
12 flights/day		347 flights/mth.		24 flights/day		713 flights/mth.	
dBA		Altitude	Correlation	dBA		Altitude	Correlation
Mean	63	10,435	dBA-alt	Mean	77	3,400	alt-dBA
Median	63	10,904	-0.022	Median	78	3,346	-0.047
Max	75			Max	90		

Source: Data from BAC Noise Monitoring Terminals; calculations and analysis by author. Note: Average sound levels recorded by BAC have been adjusted to approximate instantaneous sound levels by multiplying by 1.1. Altitudes in feet. There are insignificant correlations between altitude and noise levels, possibly due to dominance low frequency sounds carrying further.

For Balmoral, in June 2023 there were an average of 79 arrivals and departures per day, 2,361 overflights during the month. Mean arrival and departure noise levels were far in excess of what is considered safe by WHO Europe and other authorities, a majority of overflights close to or exceeding 80 dBA. Despite the median altitude of departing flights being significantly higher than arriving flights, arrivals were substantially noisier than departures, probably due to the fact they were 'flying dirty' with flaps extended and wheels down, resulting in more 'airframe' than engine noise.

For Balmoral BAC's EIS (Aircraft Noise Assessment) estimated some 5-31 overflights/day in summer daytime over 70 dBA (N70) and 2-12 additional overflights/day on a summer evenings a total 7-43 flights/day, and 0-1 night overflights/day, these would afflict 40-80% of the suburb, contrasting sharply with flight and noise data from BAC's own noise monitoring in June 2023. The BAC monitor recorded an average of 79 flights/day with a median noise level of 78 dBA (arrivals) and 78 dBA/day (departures).[4]

This data clearly illustrates BAC's flight path modelling significantly underestimated both the number and severity of the impact on communities of flights using the new runway. It is difficult to consider errors of this magnitude as not being due to professional incompetence and/or the

[4] These noise levels compare closely with hundreds recorded over 2020-23 in Balmoral by the author using a semi-professional sound meter. However, altitudes for departures at Balmoral are, in general, substantially higher than reported on FR24, where 2,500'-3,000' is usual, with heavy long-haul aircraft (A380/B777) typically at 2,000'-2,500' at this location.

result of a failure by BAC, and AsA, to conduct a thorough, independent expert peer review of BAC's EIS, especially with regards to such critical issues as anticipated impacts of aircraft noise on Brisbane communities.

In addition, Balmoral and the many suburbs along the major north-westerly departure flight path are experiencing an increasing number of late night (2000-2400 hours) and early morning (0000-0600 hours) overflights by heavy (A380/B777), long-haul departures.

Brussels Airport – Health and Social Costs

The health-economic costs of aviation noise pollution for residents of major urban areas with airports are significant. Our following briefing note will provide a preliminary estimate of health-economic costs ('externalities') of aircraft noise pollution on Brisbane residents. Below, as an example, we have summarised recent results from Brussels, a city of some 1.3 million residents. This is the kind of work we might expect the Australian or Queensland governments to initiate and support, out of a 'duty of care' for Australian cities with major airports and air traffic.

In 2022 a Belgian NGO Bond Beter Leefmilieu[5] contracted ENVISA a French aviation consultancy to prepare estimates of social and health costs to residents of Brussels airport, a major European hub.[6] They used flight path data collected and analysed by Belgian aviation authorities, and health and other cost data from WHO Europe's database to make estimates.

In Brussels they estimated a total of some ~220,000 suffer annoyance, ~109,000 sleep disturbance, and ~6,800 cardiovascular risks.[7] For each of these groups they calculated the DALY (Disability Adjusted Life Years), a standard statistical measure used to estimate the costs of annual health effects (EUR/year) in 2022. The total annual cost came to EUR 2.485 bn (annoyance EUR 0.578 bn, sleep disturbance EUR 1.007 bn, cardiovascular EUR 0.900 bn).

This is equivalent to ~EUR 11,295/person/year (~AUD 18,299/person/year) averaged out across the total population. Risk of cardiovascular illness would be more serious for older people, while annoyance was more likely to affect families and younger people, particularly students, and sleep disturbance affect shift workers trying to sleep during daytime, and children. Further, people living closer to the airport or flight paths are more affected than those living further away.

Direct comparisons with Brussels are not possible as there are income and cost-of-living differences between Belgium and Australia. To make an initial comparison we halved per capita cost estimates for Brussels to roughly approximate those for Brisbane residents (i.e. ~AUD 9,000/ person/year). This represents a significant, continuing financial burden, especially for lower income families (who are less likely to fly); for a family of four this is about AUD 36,000/year). These are real, but hidden, costs ('externalities' in economic speak), being shifted to families and the general economy without compensation.

[5] Union for Better Environment.
[6] Brussels population was 1.209 million in 2019, about half Brisbane's.
[7] 'Annoyance' is a poorly defined term too commonly used in regard to aircraft noise, in general it refers to sound levels in excess of 60 dB, which cause resentment, displeasure, discomfort, dissatisfaction or offence" (CAA 2020). However, whether this is a maximum or an average and over what time period (1 second, or one day) is not specified.

Part II – Review of Scientific Literature

Review of Relevant Literature

Research into and understanding the effects of aviation noise pollution (aircraft noise) can be divided into two main phases. The first begins in the early 1970s at about the same time mass air travel commenced its rapid increase with the arrival of wide-bodied jets (e.g. B747) making long-haul international travel cheaper, leading to mass tourism. Not long after this health and environmental professionals started to become alert to the 'externalities' of mass aviation, e.g. noise and other forms of pollution – afflicting both people and communities on the ground and local environments.[8] The first phase of research was ended, arguably, by three publications in 2017-19.[9]

First Phase – What Happens

In 2017 and 2019 ICAO (International Civil Aviation Organisation (a UN special agency) sponsored publication of two white papers reviewing the state of the science for 'Aviation Noise Impacts'.[10] The first of these two white papers usefully defined noise as 'unwanted sound' – a clear definition that had long been missing from the literature. The second paper defined and reviewed evidence on a series of topics: Community Noise Annoyance, Sleep Disturbance, Health Impacts (cardiovascular, hypertension, ischaemic heart disease (IHD) and heart failure, metabolic effects, and mental health); evidence for a causal relationship was strongest for cardiovascular disease. On all these topics aircraft noise was associated with negative health impacts, although the evidence was not definitive the findings were consistent with those for road traffic noise. The paper also reviewed evidence on effects on children's learning, via effects on cognitive development. In summary, their conclusion was:

- There is robust evidence for an effect of aircraft noise exposure on children's cognitive skills such as reading and memory, as well as on standardized academic test scores. (Sparrow et al (2019), p. 53)

The 2019 paper also made a brief survey of approaches to assessing the economic and financial costs of aircraft noise, as these are important in policy formulation and decision making. Later in this briefing we will discuss we will present a preliminary estimate of the Disability Adjusted Life Years (DALYs) approach pioneered by WHO for cardiovascular disease, sleep disturbance, tinnitus and annoyance.

The third of these papers was publication in 2018 of the "Environmental Noise Guidelines for the European Region" by UN World Health Organisation (WHO) Europe, which included a section on aviation noise.[11] This publication critically reviewed peer-reviewed research up to that time and made several recommendations, which have formed the basis for EU policies on managing aircraft noise. The two main recommendations were:

- For average noise exposure, the GDG[12] strongly recommends reducing noise levels produced by aircraft below 45 dB Lden, as aircraft noise above this level is associated with adverse health effects.

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[8] The word 'afflicting' is used rather than the softer term 'affecting' as it has become increasingly evident millions of people suffer physical and mental harm and loss of amenity due to aviation-related pollution.
[9] Where available we have used systematic reviews of particular aspects of the effects of aircraft noise on adults and children, as these provide an assessment of the quality of evidence in the papers reviewed.
[10] Basner, M. et al (2017) "Aviation Noise Impacts: State of the Science" Noise Health. 2017 Mar-Apr; 19(87): 41–50. doi: 10.4103/nah.NAH_104_16. Sparrow, W. et al (2019) "State of the Science 2019: Aviation Noise Impacts" https://www.icao.int/environmental-rotection/Documents/ScientificUnderstanding/EnvReport2019-WhitePaper-Noise.pdf
[11] WHO Europe (2018) "Environmental Noise Guidelines for the European Region."
[12] GDG = Guideline Development Group.

- For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night time below 40 dB Lnight, as aircraft noise above this level is associated with adverse effects on sleep. (WHO 2018 p.61)

In the Australian context it's important to note WHO's '*strong recommendation*' in 2018 was for daytime noise exposure to be reduced to below 45 dBA and night time levels to below 40 dBA. Aircraft noise exposure across most of Brisbane, even levels measured by AsA and BAC, are consistently well above 60 dBA, day and night.

These three papers identify and review hundreds of peer-reviewed research reports published since about 1970. The WHO Guidelines, for example, cites some 60 select references, plus a dozen systematic reviews. The 2017 ICAO white paper cites 70 sources, and 2019 ICAO white paper devotes a whole annex to listing 198 references. (See the footnotes and references for links to these papers.) See Annex 4 for a summary of effects.

For the first phase epidemiological studies were used to illustrate and evidence the impacts of aircraft noise on a range of key health factors. Although links between aircraft (and other) noise and these aliments became increasingly clear over time the mechanisms by which this occurred was not well understood. Further work since then has identified the physiological and biochemical pathways activated by aircraft noise. By about 2020 there could be no further doubt about aircraft noise being the cause of a range of serious ailments. That is, 'what happens' had been definitively identified, but not 'the how'. This is the second phase of research, one still underway.

Second Phase – How it Happens

The work done in this second phase is summarised below. One of the most recent results is from a Swiss study, and three from complementary German work. For the Swiss researchers this was possible, in part, because of comprehensive national health records maintained by Switzerland, facilitating elimination of confounding factors from the analysis, combined with comprehensive long-term noise data. For their German colleagues, the authors had been working for some years to elucidate body and brain causative mechanisms and the resulting effects.

Until a few years ago the harmful effects of noise, particularly aircraft noise, were known mainly through epidemiological studies of affected populations, the complex pathways behind the effects was still being disentangled. Some recent advances in medical science has now made it possible. Neurological and biochemical pathways in the human body and brain are now better understood, removing any lasting doubts of causal linkages between (aircraft) noise and: heart attack, stroke, high blood pressure, dementia and cognitive decline and other harmful effects. The diagrams below, taken from recent studies, illustrate, better than words, these causal pathways in the body and brain.

In late 2021 the results of a 15-year long study of health effects on some 1.4 million Swiss residents of road, rail and aircraft noise was published.[13] The focus of the study was on associations between measured aircraft noise levels and myocardial infarction deaths ('heart attacks'), ischemic stroke mortality and blood pressure. In brief, the more (aircraft) noise the more deaths from heart attacks and strokes. With harmful effects starting below 40 dB L_{den} and increasing approximately linearly, higher levels of intermittency – e.g. aircraft noise - was associated with increased harmful effects.

Their conclusions were that:

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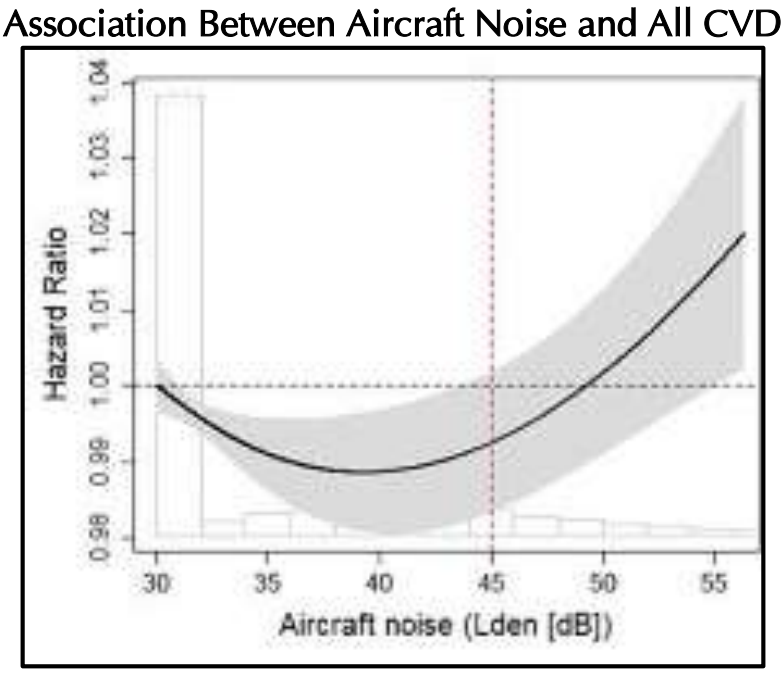
[13] Vienneau, D. et al (2021) "Transportation noise exposure and cardiovascular mortality: 15-years of follow-up in a nationwide prospective cohort in Switzerland."
https://www.sciencedirect.com/science/article/pii/S0160412021005997?via%3Dihub

> Independent of air pollution, [aircraft] noise exposure is associated with all and cause-specific CVD mortality, with effects starting below current [WHO] guideline limits.

For aircraft noise the increase in the hazard ratio, i.e. the likelihood of occurrence, for cardiovascular disease is illustrated in the diagram below. The vertical red dashed line is WHO's recommended day-night (L_{den}) maximum noise level of 45 dBA. Values above 1.0 indicate an increased hazard ratio of all types of CVD caused by aircraft noise.



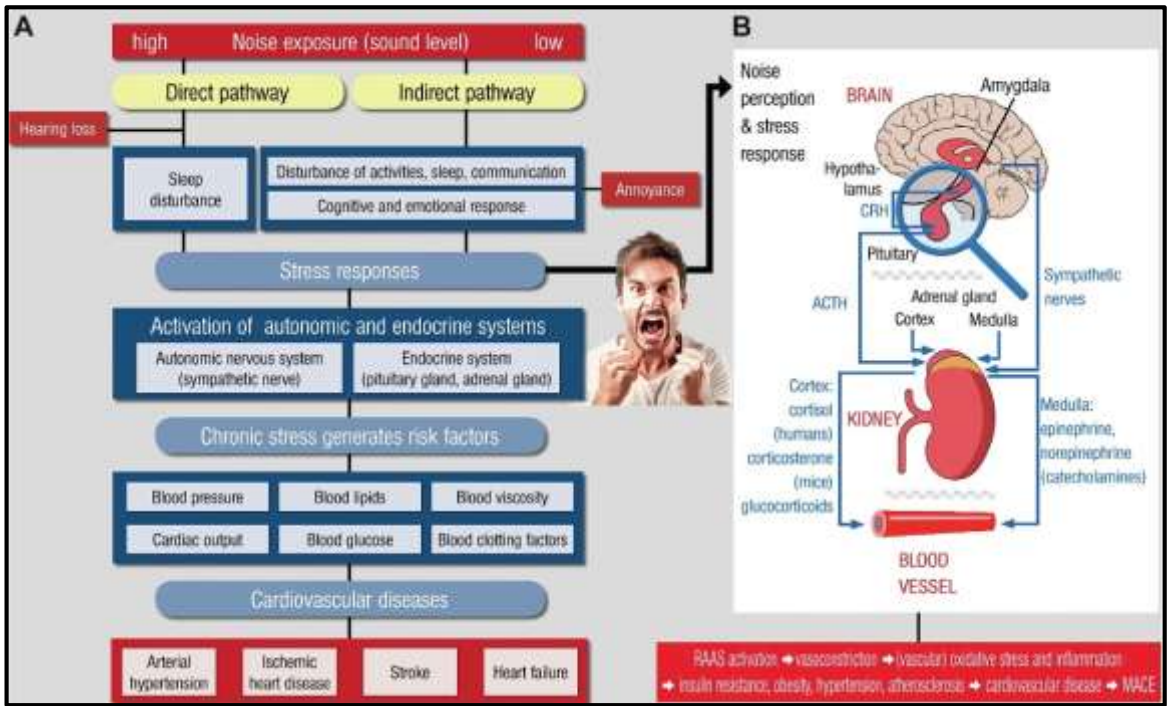
Source: Vienneau et al 2021, Fig. 1

The following diagram provides additional detail on responses to biochemical and neuronal pathways responding to high and low level noise exposure; high level noise is >100 dBA which damages hearing, while low level noise is 50-60.

Münzel (2023) and his colleagues uncovered additional chains of biochemical and hormonal causation underlying ailments related to aircraft noise, and noise generally. These are 'whole body' responses to the stress caused by noise. Adding mental health effects, such as depression and anxiety, to the list of ailments. In brief aircraft noise:

> … sleep, and communication, which in turn will result in emotional stress responses such as annoyance or even anger characterized by increased levels of cortisone or activation of the sympathetic nervous system [see diagram below]. Chronic stress response will promote the formation of cardiovascular risk factors such as hypertension, increased glucose and cholesterol levels … (Münzel et al, 2023)

Stress Signalling by Noise



Notes: Stress signalling by noise. (A) Noise-stress concept and the adverse health consequences in humans. Noise reaction model for the direct (auditory) and indirect (nonauditory) effects of noise exposure. (B) Neurohormonal activation induced by noise.
Source: Münzel et al (2023) "Too Loud to Handle? Transportation Noise and Cardiovascular Disease" Canadian Journal of Cardiology - (2023) 1-15, https://doi.org/10.1016/j.cjca.2023.02.018

The diagram below provides a schematic overview of hormonal and cerebral responses to noise – the activation pathways that initiate the brain's and then the body's responses. It is clear many aspects of human coordination, cognition and behaviour can be and are affected by noise.

Brain-body Interaction in Response to Noise

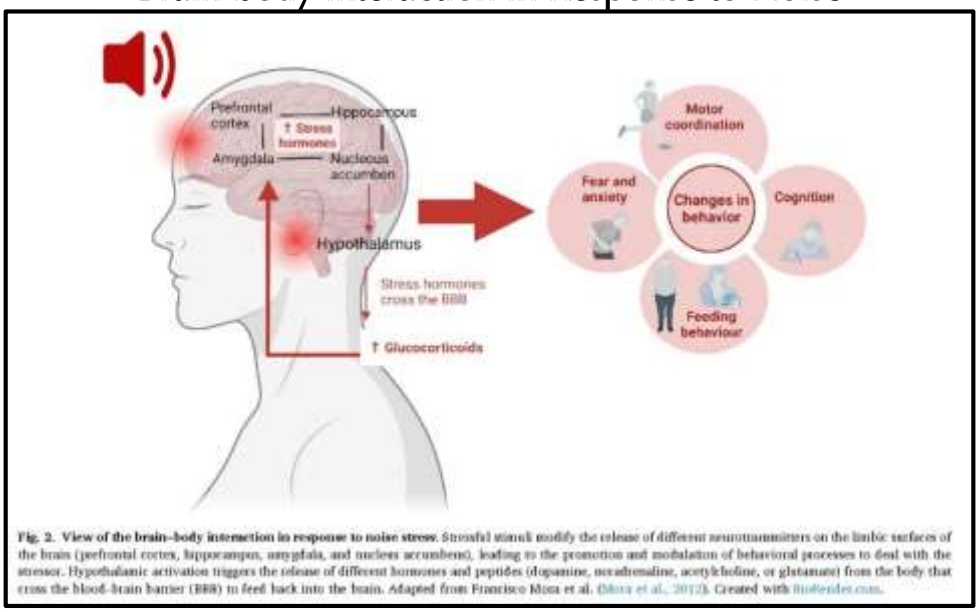
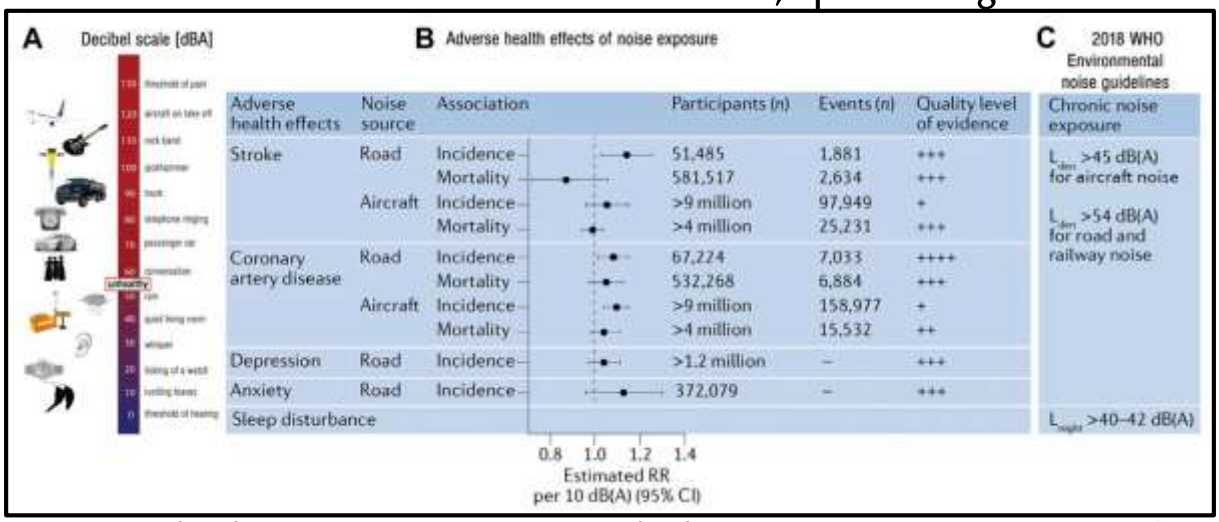


Fig. 2. View of the brain–body interaction in response to noise stress. Stressful stimuli modify the release of different neurotransmitters on the limbic surfaces of the brain (prefrontal cortex, hippocampus, amygdala, and nucleus accumbens), leading to the promotion and modulation of behavioral processes to deal with the stressor. Hypothalamic activation triggers the release of different hormones and peptides (dopamine, noradrenaline, acetylcholine, or glutamate) from the body that cross the blood–brain barrier (BBB) to feed back into the brain. Adapted from Francisco Mora et al. (Mora et al., 2012). Created with BioRender.com.

Source: Hahad et al (2022) Cerebral consequences of environmental noise exposure. Environment International 165 (2022) https://doi.org/10.1016/j.envint.2022.107306

Based on epidemiological studies the following diagram and table provides a summary of the health risks associated with different noise levels from several sources. Note that the WHO recommendations are, implicitly, for average chronic aircraft sound pressure (noise) levels to be kept below 45 dBA, significantly lower than for road and railway noise. This is a clear indication of the severity of the effects of chronic aircraft noise – as experienced by Brisbane residents - as compared to other transport sources.

Noise sources and levels - adverse health effects, epidemiological data



Source: Münzel et al (2023). Notes: (A) Sound pressure levels concerning various noise sources. (B) The incidence of stroke, coronary artery disease, depression, and anxiety increases in response to chronic exposure to road or aircraft noise (expressed as relative risk [RR] estimates for every 10 dBA increase in exposure). Level of evidence: + very low; ++ low; +++ moderate; ++++ high. (C) According to the 2018 WHO environmental noise guidelines for the European region, the non-auditory adverse health effects of noise, such as psychological, cardiovascular, and cerebrovascular diseases, are triggered by chronic noise exposure to day-evening-night noise level (L_{den}) of 45-54 dB(A). Adverse effects of noise on sleep are observed in response to A-weighted equivalent noise level for the night period (L_{night}) of 40-42 dB(A).

Vienneau et al (op cit) independently confirmed that noise exposure well below WHO's recommendation of 45 L_{den} – a day-night average - is associated with cardiovascular disease-related (CVD) causes of death.

> Independent of air pollution, road traffic and railway noise exposure were associated with the majority of CVD causes of death, often with risk increases starting well below the WHO guideline limits. (Vienneau et al, 2022)

This clearly indicates the 'rough and ready' Australian 'standard' of 60 dBA interior sound level for aircraft noise is excessive, dangerous to health and needs to be revised, based of a wealth of scientific research.

One of the most concerning recent findings is that exposure of CVD patients to aircraft noise >50dBA in the 2 hours preceding was significantly associated with their death.

> For night-time deaths, exposure levels 2 h preceding death were significantly associated with mortality for all causes of CVD [OR = 1.44 (1.03–2.04) for the highest exposure group (LA_{eq} > 50 dB vs. <20 dB)]. Most consistent associations were observed for ischaemic heart diseases, myocardial infarction, heart failure, and arrhythmia. ... Our findings suggest that night-time aircraft noise can trigger acute cardiovascular mortality. The association was similar to that previously observed for long-term aircraft noise exposure. (Saucy et al 2021)

This suggests that even within the protected environment of a hospital aircraft noise >50 dBA has the potential to cause mortal harm to cardiac patients. In the Brisbane context this may be a matter of real concern, given that night-time external aircraft noise often exceeds 70 dBA (e.g.

late night A380 and B777 flights) overflying major hospitals where internal noise may well exceed 50 dBA.

Aircraft Noise and Children

Many researchers have emphasised the need for gaining a better understanding of the effects of aircraft noise pollution on children, especially how it affects cognitive development and learning. The reasons for this are simple, children have their lives before them and delays in development or in learning are likely to affect their whole life. Children are also known to be more easily affected, as their bodies and nervous systems are still in the process of rapid development until their late teenage years. Noise that disrupts children's sleep is known to be particularly harmful.

> "Arguably, the effect on student learning in schools is the worst harm. This is because any lack of attainment is detrimental to health and wellbeing for the rest of the students' lives. Addressing noise is particularly important for equality, because schools in disadvantaged areas are usually on noisier sites." Prof. Trevor Cox, at the University of Salford in England

Work on this issue has been going on for some fifty years. The issue is considered important enough that scholars have returned to reanalyse data collected nearly twenty years previously using new techniques. Possibly the largest study collected data from schools adjacent to three airports: Heathrow (UK), Schiphol (Netherlands), and Barajas (Spain) in 2002-03 as part of the RANCH study.[14] A recent re-analysis showed that:[15]

> "… a 1dB increase in aircraft noise exposure at school was associated with a -0.007 (-0.012 to -0.001) decrease in reading score and a 4% increase in odds of scoring well below or below average on the reading test. .. [it] also found that a 1dB increase in aircraft noise exposure at school was associated with a 0.017 (0.007 to 0.028) increase in hyperactivity score."

A meta-analyses of these three studies confirms existing evidence for effects of aircraft noise exposure on:

> "… children's reading comprehension, providing a pooled estimate and exposure-effect relationship, as well as additional estimates and relationships for effects on scoring 'well below or below average' on the reading test offering flexibility for taking reading comprehension into account in HIA and monetisation methodologies in a wide-range of contexts." (ibid)

The relationship between aircraft noise and reading comprehension is linear (after adjusting for many factors), hence reducing noise exposure at any level should lead to improvements in reading comprehension. In practical terms:

> "… reading falls below average (a Z-score of 0) at exposures greater than 55dBA $LA_{eq,16h}$" (ibid)

In the Australian context, given the aviation industry's unfounded assertion that 70 dBA external aircraft noise will be attenuated to about a 60 dBA internal, strongly suggests much greater attention needs to be directed to reducing external noise levels. This would ensure internal aircraft (and other) noise levels remain below about 50 dBA, so as to eliminate impacts on children's reading skills.

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[14] RANCH = Road traffic and aircraft noise exposure and children's cognition and health.

[15] Clark et al (2021) "A meta-analysis of the association of aircraft noise at school on children's reading comprehension and psychological health for use in Health Impact Assessment." Journal of Environmental Psychology 76:101646. DOI: 10.1016/j.jenvp.2021.101646

In addition to its effects on reading and other skills development aircraft noise also has a psychological effect on children. A study near the recently relocated airport at Munich, Germany airport showed, in summary:

> significant decrease of total quality of life 18 month after aircraft noise exposure as well as a motivational deficits operationalized by fewer attempts to solve insoluble puzzles in the new airport area. Parallel shifts in children's attributions for failure were also noted. At the old airport parallel impairments were present before the airport relocation but subsided there after. These findings are in accord with reports of impaired psychological health after noise exposure and indicate the relevance of monitoring psychological parameters as a function of environmental stressors among children. (Hygge, S. et al (1999))[16]

[16] Hygge, S. et al (1999) "The psychological cost of aircraft noise for children." Zentralblatt für Hygiene und Umweltmedizin •September 1999. DOI: 10.1121/1.425878, PubMed

Part III - Resident's Contributions to the Post Implementation Review of the Impacts of the New Brisbane Runway - A Qualitative Perspective

> "Gradually, as the unrelenting nature of the distressful situation began to dawn, my brain started to anticipate the noise and sure enough it arrives. This kind of cat and mouse, hope there will be a break soon, no, dear God here is another one; the ongoing see-saw of a life being totally captive to such an imposition callously foisted upon you, totally destroys one's happiness at being at home with massive implications for health, well-being, productivity and quality of life" (extracted from The Lived Experience of Brisbane's Sudden and Invasive Flight Path Imposition: Notes).

A Noise and Environmental Nightmare - Health Consequences.

What follows are de-identified quotes extracted from a small sample of individual PIR responses and correspondence that were copied to BFPCA. These are intended to provide a qualitative perspective, to the foregoing qualitative analysis and literature review. They are brief glimpses of the extent to which excessive aircraft noise and its sequelae are afflicting the physical and mental health of countless Brisbane residents.

The PIR responses were numerous and drawn from an astoundingly wide range of suburbs. Due to the limiting constraints of meeting agendas, this brief synopsis does not encompass nor does it do justice to all of the high quality, substantive, insightful and thoroughly sincere submissions to which BFPCA was privy. Nevertheless every submission plainly demonstrated that Aviation Noise Pollution is having hugely deleterious effects on our community's health and well-being.

> "AsA engagement methods should be face-to-face so you can see the distress on people's faces and hear it in their voices"

1 "I live in Seven Hills for last 14 years in the same house as I am living right now. Prior to NPR there used to be sometimes only 5-10 planes in day going over my house which is not even on direct flight path. Hence aircraft noise was not an issue at all. I do not even recall hearing planes going over 24/7 prior to NPR. Now in a day I have 120+ planes flying over with 70+ decibels 24/7. Majority of the time it is every 2-5 minutes. This has huge mental impact which is underestimated by AsA. Even in today's date nothing has change. I demand someone from AsA come out to my house to experience the nightmare caused by AsA…. Per those paperworks there should have been almost next to nothing flights going over my house. I trusted what was mentioned. I will say that was total lie and now AsA robbing me of living a stress free life"

2 "The noise of planes flying overhead in Upper Brookfield has destroyed residents' previously peaceful lives….As I write this submission, I am listening to plane after plane fly near my house at Upper Brookfield. While some residents experience noise levels equivalent to suburbs much closer to the airport (due to the height of their houses), others suffer because of the funnel effect of the noise. When I walk in the area or visit other people's houses or local businesses it is impossible to ignore the constant drone of so many planes, with each plane audible for as long as 5 minutes. Flights late at night over Upper Brookfield, including international flights from Brisbane airport late at night and early morning, and from Archerfield (lower, noisier and often using leaded fuel)

wake us up, and are causing me long term sleep issues. I'm just glad I no longer have small children at home or at school (with both Upper Brookfield and Brookfield State Schools directly under the flight paths".

3 "I live in the rural area of Cedar Creek, just north of Samford. I am approx 30km from the airport. Airservices Australia have ruined our country lifestyle. We gave up the modern conveniences of the city suburbs and moved to the country to retire and for peace and quiet. We are on tank drinking and bathing water. We have several Fauna and Flora Protection Overlays on my property. The near by Cedar Creek is protected, especially for the Platypus. I believe you are endangering the lives of my family, fauna and flora and also our food bowls, farming and organic farming by stacking seven levels of aircraft traffic over us".

4 "I live in between the two Southerly ILS approaches approximately 16km out and get smashed by a totally unreasonable and huge numbers of flights when there is a Northerly. Anything that can be done to separate the two paths, increase the height at this location, delay landing gear coming out are things that will make a difference. I am concerned that some of the recommendations will increase the noise we experience.

5 "We have been severely disrupted in Taringa/St Lucia by excessive aircraft noise due to departing aircraft (to the point of it having a detrimental effect on our health and well-being). After this runway opened we were shocked, in disbelief and experiencing horror at the extent of the noise we were suddenly being exposed to. Gradually we worked out that this horrendous imposition occurred when the wind was unfavourable to us. This can mean that for days on end we are robbed of the enjoyment of being at home in our normally quiet neighbourhood ambience".

6 "I have built my life here with my family and thing it is disgusting that you can place a major flightpath over my head all day and night without notification or compensation. Especially after deception during the planning stages saying there would be no impact. I am still waiting for an apology to the communities".

7 "Brisbane residents are giving up their idyllic out-door lifestyle, sleep, even health (mental and physical) so BAC can realize their Master Plan, and this is not an equal and just transaction".

8 "Placing money and development ahead of people's lives is no longer acceptable in many other countries around the world. Any government that allows such a large part of a major city to be completely screwed over by one big business will eventually pay the price. There can be no doubt that AsA is completely captive to BAC".

9 "…the Noise section of the PIR shows that noise levels over many of the sound monitors exceed the 70dB figure for a significant number of events. I contend that the 70dB figure is too loud to be acceptable, and that the PIR report of noise levels is misleading in that although it reports on events at 70dB, and on the number of events exceeding 70dB, it averages the sound levels and reports the result as though it had some virtue. For people suffering these sound levels, this is a completely misleading way of representing the impact of noise levels. It is quite clear that if community consultation both during the EIS and during the final flight path design process had demonstrated to residents exactly what 70DNL sounded like, no-one would have accepted the current plans".

10 "With the new runway I have experienced an increase in noise and disruption not experienced prior in Yeronga. I am recording decibels as high as 88decibels, this is causing me and my family great distress. Flights in the 70-90 decibel range is abhorrent and is abuse especially overnight".

11 "Noise sharing is not a solution it is an admission that the original design is a failure, that too many in the community have been adversely affected. Giving existing suffering residents some respite by adversely affecting even more people in the community is ludicrous, how can AsA seriously put this recommendation forward and expect support? The only way to reduce the frequency of flights over communities is to fly over the bay as was the original AsA design".

12 "Get the redesign of flightpaths right and done by overseas professionals. You have tried and failed. You have turned this experience over the past 2.5 years into a nightmare. You promised SODPROPS, then deliver it. STOP deceiving me and my family".

13 "I don't know how many times I have poured out my heart in various submissions and forums regarding the horrific impact this aircraft noise is having on my and my family's health and well-being. It is sickening to think so many people have also had to put themselves 'on show' in order to try and convey how upset they are with the noise incursion on their daily living, and yet all of that emotional outpouring is fobbed off and derided. Can you imagine what that does for one's psyche? The sense of grief and loss at no longer being able to relax in one's hard earned home is immense."

14 A unique opportunity to demonstrate world's best practice in flight path design was handed to AsA during the Brisbane airport development and they failed miserably. The proposed changes still result in aircraft flying over inner city suburbs with unacceptable noise & emission levels.

15 most days we suffer a constant barrage of noise coming from departing flights directly over our house, from first thing in the morning till late at night and many times in the very early hours of the morning. We cannot escape the noise as our house is a typical Queensland-style house made of timber with a tin roof. This continual and invasive noise pollution has been imposed on us and countless other residents of Brisbane by a seemingly uncaring and unscrupulous organisation. It is severely impacting our quality of life and happiness. It is well documented that jet noise is responsible for some of the loudest sounds ever produced by humans. Brisbane residents can attest to that as this city has literally become the aircraft noise capital of the world and in doing so has destroyed its pleasant amenity for tens of thousands of people, including us".

16 Can you imagine your distress at your home suddenly being subjected to incessant jet noise day in day out, month in month out, year in year out?! Plane noise is there on wakening, continues all day every few minutes until you retire at night. Imagine too how you would feel if when you and countless others complained about this nightmare scenario to a government organisation that was supposed to listen carefully and impartially, recognise the gravity of the situation, acknowledge a problem exists, apologise and work quickly with industry to fix the problem… brushed you aside in a cavalier manner … feeding you 'spin' presumably in the hope that after so many months and years 'you would go away'. The resentment and anger that accompanies such a stance towards people by authorities that are supposed to be there to protect them, on top of the relentless and excessive nature of the noise incursion, eventually causes illness and depression which in turn causes a myriad of other distressing social outcomes.

17 People do NOT get used to excessive aircraft noise. Studies clearly demonstrate damaging long-term effects of aircraft noise exposure on vascular oxidative stress, endothelial function and blood pressure, while also demonstrating there is no evidence for human adaptation or for tolerance development to the noise incursion"
(see Frenis et al. 2022 *Long-Term Effects of Aircraft Noise Exposure on Vascular Oxidative Stress, Endothelial Function and Blood Pressure: No Evidence for Adaptation*

or Tolerance Development, Front. Mol. Biosci., 31 January 2022Sec. Cellular Biochemistry https://doi.org/10.3389/fmolb.2021.81492).

From Excessive Noise to Water Pollution

18 "A number of the areas (Brookfield, Upper Brookfield and Samford) over which there are now concentrated flight paths are dependent on roof-collected tank water for drinking and household use. Residents in Upper Brookfield have been raising this as a matter of concern for the last two years, without receiving any satisfactory response. There is now evidence that of tar like deposits appearing on solar panels in our area – something not previously experienced. This situation is being made worse by decisions to route piston engine aircraft from Archerfield directly over our suburb. These aircraft use leaded fuel, which is a major contaminant highly detrimental to human health Overseas research is starting to show that aircraft exhaust does create hazards to human health (LA Airport study), and in addition, the EPA in the USA is moving to ban lead in aircraft fuel because of detrimental health impacts".

19 "…no-one is taking any responsibility for the potential effects on our water supply….there are also increasing numbers of studies which suggest that there are health effects associated with emissions from aircraft. I guess at least we will know who to sue when we end up with cancer clusters down the track. See for example: A review of health effects associated with exposure to jet engine emissions in and around airports (biomedcentral.com). Just last month, the U.S. Environmental Protection Agency (EPA) took a major step "to curb the largest remaining source of airborne lead pollution. The agency has proposed a so-called endangerment finding that aircraft that use leaded fuel cause or contribute to pollution that could harm public health and welfare. No safe blood lead level has been identified for children, who can suffer irreversible health effects from lead exposure. Low levels can affect IQ, ability to pay attention and academic achievement. Adults can experience heart problems, increased blood pressure, decreased kidney function and reproductive issues from lead exposure".

20 "The flightpaths are concentrated and cause the lead based fuel, piston engine aircraft to fly lower over us as low as 500 feet when you take into account our topography. We are affected by aircraft from all airports in and around South East Qld. Enclosed is a report sampling our experience…Your complaints method is flawed. Your noise monitoring is flawed".

21 "Health impacts from pollution are long term and can take many years to appear, by which time the responsible parties will all be long gone, but the precautionary principle says that this issue must be taken seriously, and that aircraft should not overfly areas dependent on tank water for household supplies. There's also a good case that low altitude flights over environmentally sensitive areas should be avoided".

Terrible Today, Unbearable Tomorrow – Fearing for the Future

22 "We live in abject fear of the power of this Corporation to operate with impunity and for the situation to worsen along with our physical and mental health"

23 "At present, the State Government and local government entities effectively say "so sad for your troubles but this is not our responsibility". All levels of government are involved in this debacle. Numbers of complainants have probably so far seemed manageable, but the anger is growing. We are not going away and there are more of us every day. It

is the responsibility of government to really listen to the concerns being expressed and do their job to ensure that plane noise and emissions are appropriately managed".

24 I am extremely concerned about the volume in both noise and number of flights we are going to experience in Yeronga in the future.

25 "As a resident …who is already significantly impacted by aircraft noise, I am very nervous of what is to come, particularly given:

- The predicted growth of air traffic for Brisbane Airport
- The plans to make Archerfield a cargo hub with significant implications in terms of flight paths for our area
- The redirection of light aircraft traffic for Archerfield over Upper Brookfield in order to fit in with flight paths for Brisbane Airport
- The reduction in minimum altitudes for light aircraft
- The apparent lack of concern exhibited by Air Services and BAC in changing Upper Brookfield from a very quiet area to one in which regular and intrusive aircraft noise is a given
- The assumption by AS and BAC that sound levels below 70dB are tolerable, even in environments with low ambient noise
- The complete lack of any duty of care as regards potential pollution of our only water supply".

Final Quote:

"Hell, it's been terrible. I am slowly losing my mind. I cannot believe what an uphill battle this is".

Conclusions

If you live in a Brisbane community that is frequently overflown by aircraft at a low level (i.e. below 5,000 feet, ~1,500 metres), especially below 3,000' (~1,000 m), then you are almost certainly being frequently exposed to excessive aircraft noise. This is especially the case if your community is located within 10-15 km of a major airport, in Brisbane, Sydney or Melbourne.

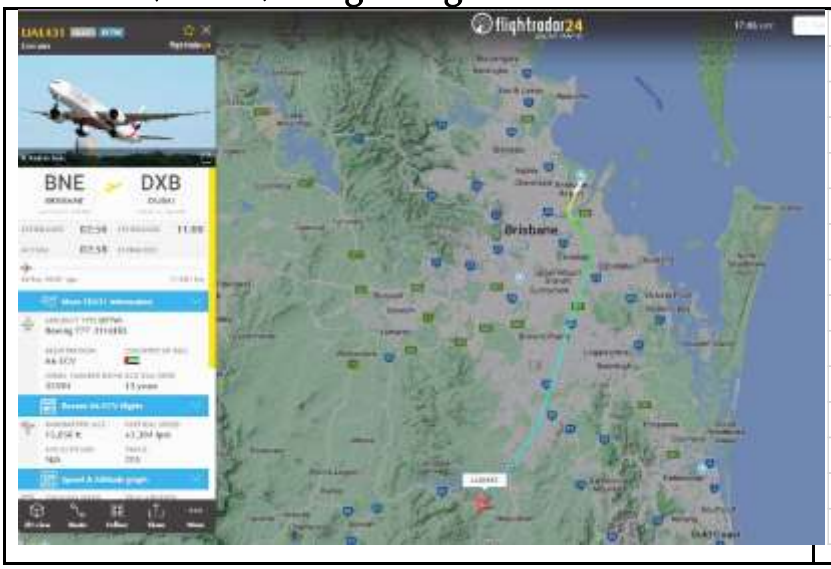
We have concluded Part II of this analysis with a brief discussion of the effects of excessive aircraft noise on children's learning progress, because, in Brisbane at least, many schools are frequently overflown by aircraft below 3,000' arriving and departing Brisbane airport. The negative effects on children's development, at school and at home, is one of the most distressing effects of the current flight paths across Brisbane city.

Part III – A selection of a score-plus of the hundreds of resident's narrtives reminds us of the very human impacts of chronic, excessive aircraft noise pollution. These personal narratives were received late in the process of preparation, but thought important enough to warrant a revision and 'extension' of the briefing note, so as to ensure that readers are alert to human suffering, and the need to minimise or eliminate it, and so remains front-of-mind when dealing with the consequences on Bribane residents, and other people in far too many other cities in Australia and other countries.

While these narratives were being incorporated into this note a Qantas's partner Emitates B77W flight (UAE431) for Dubai departed at 3 am from the old runway and flew below 10,000' southwest across 63 km of Brisbane's urban area; there were no other aircraft within about 300 km. This is just one example of the the suffering inflicted on Brisbane residents by unregulated

air traffic, and AsA's continuing mismanagement and disregard for the health and welfare of residents. We estimate this single flight may well have disturbed the sleep/awakened some 130,000 people under its flight path.[17]

Emirates (EK431) - Night Flight Last Week



BNE-DXB – 0300 hours, 02Sep23

Carina	12,003
Carindale	16,782
Cannon Hill	7,028
Murarrie	4,946
Tingalpa	8,992
Rochedale	11,201
Underwood	6,914
Mackenzie	2,336
Wishart	11,584
Slacks Creek	10,566
Springwood	9,968
Eight Mile Plains	15,479
Park Ridge	10,329
Heritage Park	4,930
Approx. Total	**133,058**

Population Overflown

Recent research has also confirmed that particulate pollution ($PM_{2.5}$) from burnt jet fuel is a health hazard for people working at airports and living in the vicinity and under flight paths. In the north-western rural part of Brisbane, when residents rely on collecting rainwater, particulate pollution from leaded turboprop fuel is also a problem. These issues are not discussed further, as no reliable data has been collected for northwest Brisbane. However, many studies clearly indicate ultra-fine particulates – from jets and leaded fuel - are a serious environmental health hazards.[18]

The effects of aircraft noise are recognised by WHO, CAA and other major public organisations and researchers as a *public health issue*, one with very real health, economic and social costs for families and society. It is an issue that, to its shame, is being studiously ignored by Australian federal and state governments – a continuing failure of Duty of Care.

Estimating health costs is a complex process requiring knowing which locations (suburbs) are overflown at what altitude and frequency, up-to-date census information on each location, and the likelihood of aircraft noise causing specific ailments. Estimating economic costs/losses for industry and service sectors requires similar information, but orientated towards the likelihoods, for example, of worker's being sleep deprived or shift workers not being able to get a good

[17] The noise-swath is ~11 km wide. The following Brisbane suburbs we under the flightpath: Carindale, Cannon Hill, Murarrie, Tingalpa, Carina, Rochedale, Underwood, Mackenzie, Wishart, Slacks Creek, Springwood, Eight Mile Plains, Park Ridge, Heritage Park – estimated population 133,058.

[18] Mazaheri, M et al (2011) "An inventory of particle and gaseous emissions from large aircraft thrust engine operations at an airport." Atmospheric Environment 45(20):3500-3507, DOI: 10.1016/ j.atmosenv.2010.12.012. Masiol & Harrison (2014) "Aircraft engine exhaust emissions and other airport-related contributions to ambient air pollution - A review." Atmos Environ (1994). 2014 Oct; 95: 409–455. doi: 10.1016/j.atmosenv.2014.05.070. Owen, B et al (2022) "Review: Particulate Matter Emissions from Aircraft." *Atmosphere* **2022**, *13*(8), 1230; https://doi.org/10.3390/atmos13081230.

nights sleep, resulting in reduced productivity, for property owners, reduced land values, and for children and students disruption of cognitive development and learning progress.

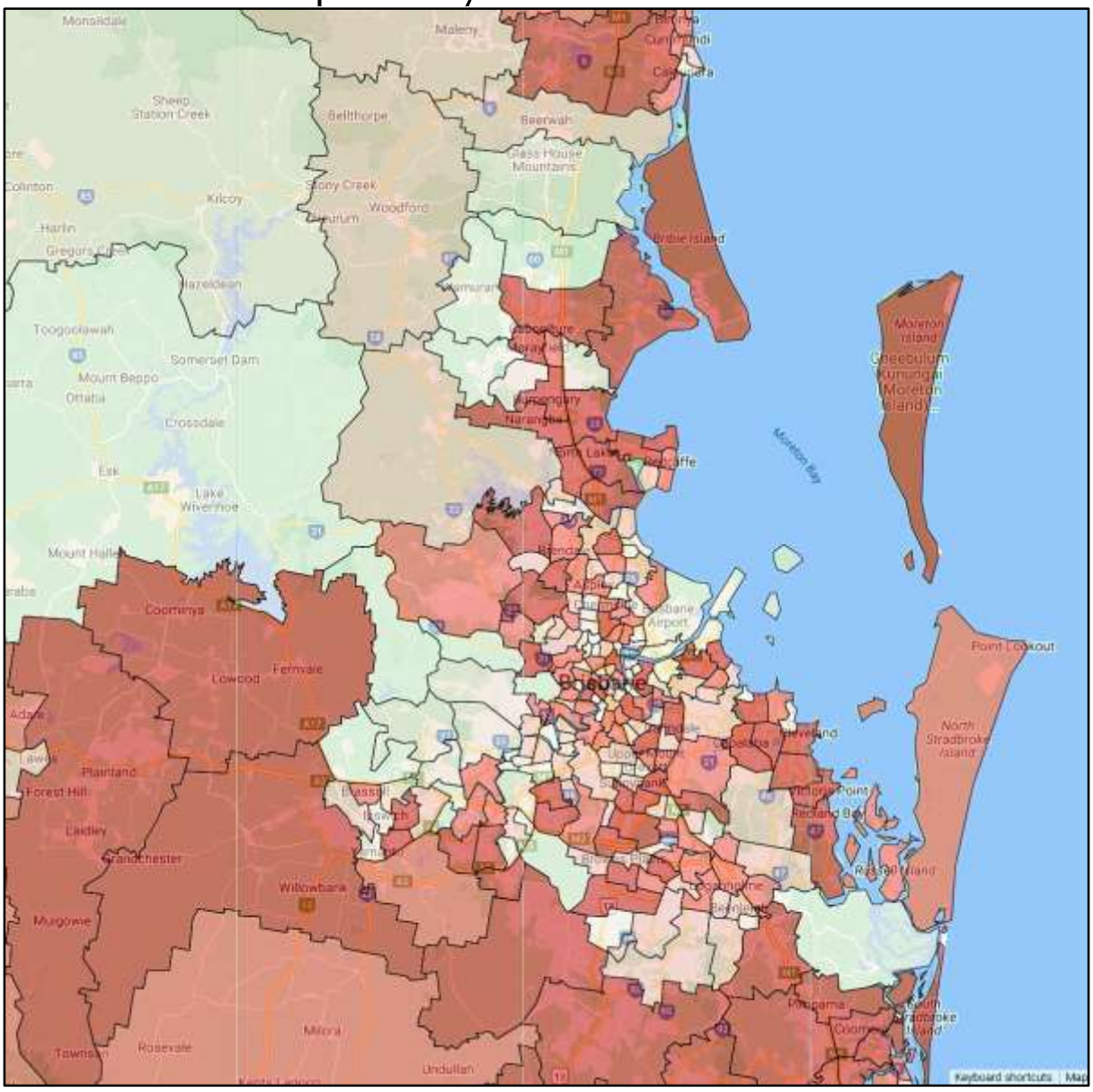
Sean Foley: BSc (Hons) PhD FRGS – Scientist, August 2023

Annexes

Greater Brisbane – Thematic Maps

Annex 1

Greater Brisbane – Population by Suburb 2021-22



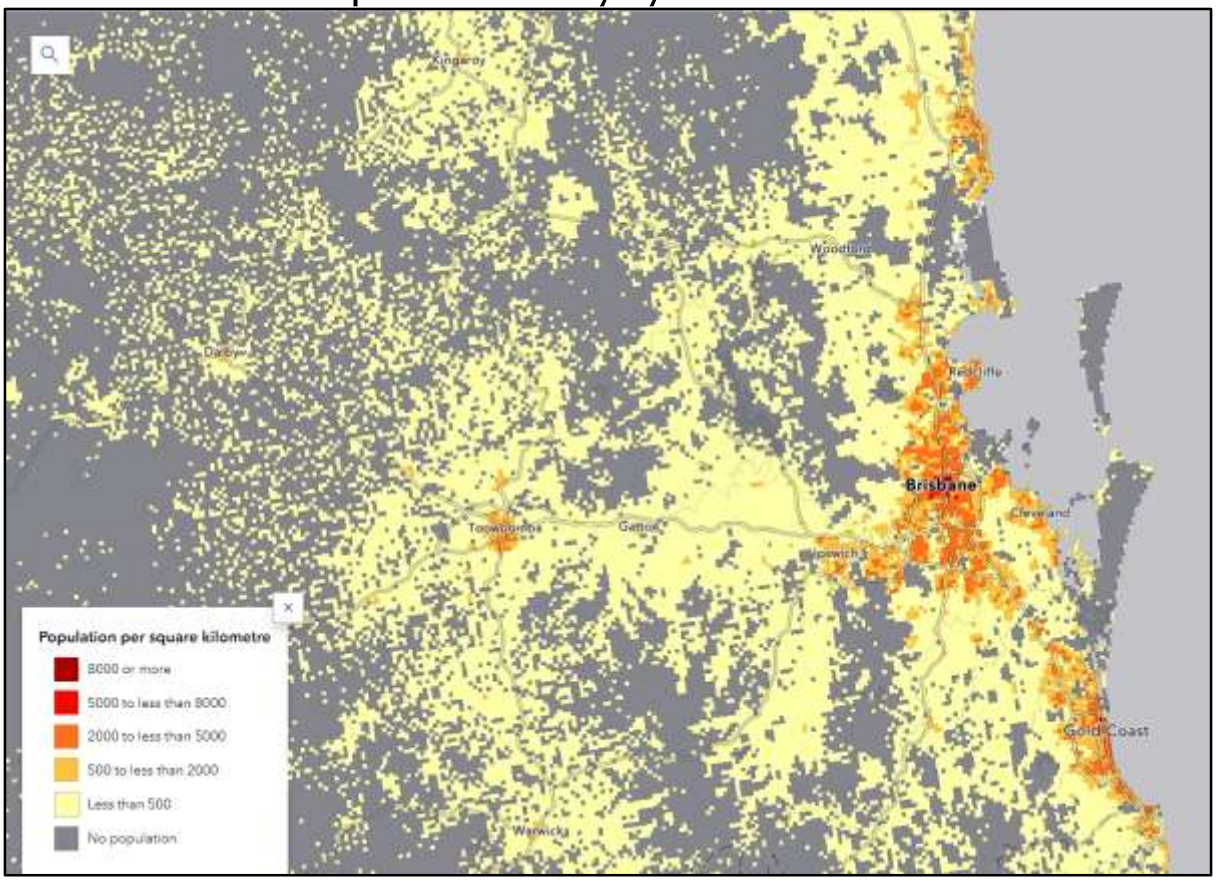
Source: ABS, Regional population, various editions (https://www.qgso.qld.gov.au/statistics)

Population 2021-22

- less than 5253
- 5253 to less than 7694
- 7694 to less than 10323
- 10323 to less than 14566
- 14566 or greater

Annex 2

Greater Brisbane – Population Density by Suburb 2021-22



Source: ABS Story Maps, Regional Population 2021-22: Population Grid

Annex 3

Brisbane - Assessed Aircraft Noise Severity by Suburbs

Suburb	Slight	Suburb	Slight	Suburb	Moderate	Suburb	Moderate	Suburb	Severe
Acacia Ridge	1	Lota	1	Alexandra Hills	2	Samford	2	Ascot	3
Aderley	1	Lutwyche	1	Annerley	2	Samford Village	2	Balmoral	
Albany Creek	1	Macgregor	1	Aspley	2	Samsonvale	2	Brisbane City	3
Armstrong Creek	1	Mackenzie	1	Birkdale	2	Sandgate	2	Brookfield	3
Banksia Beach	1	Macleay Island	1	Bracken Ridge	2	Slacks Creek	2	Bulimba	3
Banyo	1	Manly	1	Camp Hill	2	Springfield Lakes	2	Cedar Creek	3
Bellbowrie	1	McDowall	1	Camp Mountain	2	Stafford Heights	2	Chapel Hill	3
Bongaree	1	Milton	1	Cannon Hill	2	Sunnybank Hills	2	Chermside West	3
Boondall	1	Moggill	1	Carina	2	Taringa	2	Coorparoo	3
Bowen Hills	1	Mount Cotton	1	Carindale	2	Thorneside	2	East Brisbane	3
Bridgeman Downs	1	Mount Gravatt	1	Carseldine	2	Tingalpa	2	Hamilton	3
Buccan	1	Mount Gravatt East	1	Chandler	2	Underwood	2	Hawthorne	3
Bunya	1	Mount Mee	1	Deception Bay	2	Upper Kedron	2	Hendra	3
Burbank	1	Mount Ommaney	1	Dunwich	2	Wakerley	2	Inala	3
Carbrook	1	Mount Samson	1	Fairfield	2	Woodridge	2	Murarrie	3
Clontarf Beach	1	Nathan	1	Fitzgibbon	2	Woody Point	2	Norman Park	3
Closeburn	1	New Beith	1	Forest Lake	2	Woolloongabba	2	Pullenvale	3
Coochiemudlo Is.	1	Nudgee Beach	1	Fortitude Valley	2	Woongoolba	2	Rochedale	3
Cornubia	1	Ocean View	1	Greenslopes	2	Yeerongpilly	2	Samford Valley	3
Delaneys Creek	1	Ormeau	1	Hemmant	2	Yeronga	2	Stones Corner	3
Draper	1	Pallara	1	Hendra	2			Upp. Brookfield	3
Dutton Park	1	Park Ridge	1	Highgate Hill	2			Teneriffe	3
Ellen Grove	1	Parkinson	1	Indooroopilly	2			Toowong	3
Ferny Grove	1	Pinkenba	1	Jimboomba	2				
Gumdale	1	Point Lookout	1	Kangaroo Point	2				
Heathwood	1	Ransome	1	Lawnton	2				
Heritage Park	1	Redland Bay	1	Logan Central	2				
Highvale	1	Salisbury	1	Mango Hill	2				
Hillcrest	1	Sandstone Point	1	Marsden	2				

Suburb	Slight	Suburb	Slight	Suburb	Moderate	Suburb	Moderate	Suburb	Severe
Joyner	1	Seven Hills	1	Moorooka	2				
Kalinga	1	Shorncliffe	1	Morningside	2				
Karana Downs	1	Stretton	1	Mount Coot-Tha	2				
Kenmore Hills	1	Thornlands	1	New Farm	2				
Kippa Ring	1	Virginia	1	North Lakes	2				
Kobble Creek	1	Waterford	1	Rocklea	2				
Laceys Creek	1	Wights Mountain	1	Russell Island	2				
Logan Reserve	1	Yugar	1						

Annex 4

Aviation noise and health

The effects of aviation noise

Aviation noise can affect human health and wellbeing in a variety of ways. Here are some of the most common adverse health effects associated with aviation noise:

Annoyance

The most widespread and well documented subjective response to noise is annoyance; which can be defined as a feeling of resentment, displeasure, discomfort, dissatisfaction or offence which occurs when noise interferes with thoughts, feelings or activities. The annoyance of populations exposed to environmental noise varies not only with the sound itself (such as how loud it is, or its pitch), but also with social, psychological or economic factors.

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.

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.

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.

Source: UK Civil Aviation Authority

Further sources of information on aviation noise and human health

Reports on relationship between aviation noise and human health and wellbeing cover:

Sleep Disturbance
Annoyance
Cardiovascular disease and daytime health effects
Children's cognitive performance
Other relevant reports to noise and health
Aircraft noise and biodiversity
Updates on recent work and finding

(Source: UK CAA)