

Brimbank City Council

Submission to the Aviation Green Paper – Towards 2050

1. Introduction

Brimbank City Council (Council) welcomes the opportunity to provide feedback about the Aviation Green Paper Towards 2050 (Green Paper). Council acknowledges the range and depth of issues included in the Green Paper however is disappointed that some of the key matters outlined in Council's Submission to the Aviation White Paper Terms of Reference (White Paper TOR Submission) in March 2023 will not be addressed as part of the Aviation White Paper (White Paper).

The White Paper creates an opportunity to achieve a more equitable balance between facilitating the appropriate growth and development of airports and protecting the health and wellbeing of communities that surround them.

The City of Brimbank (Brimbank) is located approximately 11 to 18 kilometres west and north-west of the Melbourne Central Business District. Covering 123 square kilometres, Brimbank is a culturally diverse community of 196,712 residents who speak over 90 different languages. Notably, 57.3% of residents speak another language other than English at home (Brimbank Profile ID 2021).

Melbourne Airport is located within the City of Hume and just north of the Brimbank local government boundary. It has a substantial presence and interface with the Tullamarine and Keilor Park industrial precincts, the Brimbank Green Wedge area, as well as Brimbank's established residential areas including Keilor, Keilor Park, Taylors Lakes, St Albans, Sunshine North and Sunshine. These areas are impacted by the Melbourne Airport Environs Overlay (MAEO), Schedule 1 and Schedule 2 due to existing flight paths and noise contours (N Contours), with Keilor also being impacted by the Public Safety Area. The impacts cover a combined area of 3547 hectares and 23,750 dwellings. Neighbouring suburbs are also impacted by these flight paths and N Contours.

Council acknowledges that aviation plays a significant role in supporting economic development, commerce and trade and the visitor economy at an international, state, regional and local level. Aviation also provides a catalyst for infrastructure investment such as Melbourne Airport Rail which could transform parts of Brimbank.

Notwithstanding, the expansion of aviation cannot come at the expense of community health and wellbeing.

The development of Melbourne Airport and its impact on Brimbank has informed this submission to the Green Paper. In May 2022, Council resolved to oppose the 2022 Draft Melbourne Airport Master Plan (Master Plan) and Preliminary Draft Major Development Plan for the Third Runway (MDP), predominantly as it:

- Didn't adequately identify the environmental impacts reasonably expected to be associated with the proposed development on the Brimbank community
- Would impose unreasonable and unacceptable health risks to the Brimbank community
- Didn't include adequate plans for dealing with the environmental impacts, specifically including prevention and amelioration of aircraft noise.

Council is seeking the Federal Government, through the Green Paper (and ultimately the White Paper) to give greater regard to the health and wellbeing of communities that surround airports and that are impacted by aircraft noise. A summary of the key recommendations includes:

- Undertaking a review of the aircraft noise system to minimise harm to human health and provide health impact guidance to protect community from aircraft noise. This should include the establishment of appropriate noise metrics that accord with health guidance established by World Health Organisation Environmental Noise Guidance 2018 (WHO Noise Guidance), and best practice noise prevention and amelioration measures to address noise exceedances, including the establishment of a noise insulation program and compensation scheme.
- Requiring airports to prepare a Health Impact Assessment (HIA) for the development and expansion of runways as part of the Master Plan and MDP, that are assessed against WHO Noise Guidance; mandating that the HIA undergoes an independent and expert peer review to ensure its veracity; and requiring that the HIA and peer review are made available for public review as part of the statutory consultation.
- Establishing an independent and expert advisory committee, or similar, to provide a transparent, independent and public review process that enables impacted stakeholders to present their submissions for independent consideration, and which can make recommendations to the Federal government about an airport master plan or major development plan.
- Providing clear guidance that requires prevention and amelioration measures to adequately address noise exceedances beyond the WHO Noise Guidance, including setting out the range of options including, but not limited to - a federally funded noise insulation program, a noise curfew, voluntary property acquisition or other measures to ensure that the impacts are adequately addressed and minimised.

- Requiring a review of the current noise management system, including the composition and management of Aviation Community Consultation Groups, Airservices Australia noise complaints system and the purpose of Environmental Noise Units surrounding airports.
- Establishing a policy framework that outlines a compensation scheme for airport-impacted communities. This should be provided either by means of a noise amelioration program or to owners of dwellings and buildings accommodating sensitive land uses (i.e. schools, places of worship, childcare centres and hospitals) adversely affected by aircraft noise. Such a compensation scheme aligns with the legislated requirement under the Aircraft Noise Levy Act 1995 which aims to recover the costs incurred in providing noise amelioration programs to airport-impacted communities.

2. Submission Feedback

Council's submission responds to those key drivers and policy directions identified in the Aviation Green Paper that are most relevant to Council, and therefore doesn't include responses to all parts of the Green Paper, which are technically specialised and not within the expertise of Council.

Areas that Council's submission has focused on include:

- Airlines, airports and passengers – competition, consumer protection and disability access settings
- Maximising aviation's contributions to net zero
- Airport development planning processes and consultation mechanisms
- General Aviation
- Emerging aviation technologies: a leadership role for Australia
- Future industry workforce

In some cases the recommendations that Council make can apply to more than one section of the Green Paper, however for the purposes of brevity, are only reflected once.

3. Issues and Recommendations

3.1 Airlines, airports and passengers – competition, consumer protection and disability access settings

A competitive airline industry is supported by Council as it increases choice and generally provides consumers with better outcomes.

Council recognises the significant role aviation plays in supporting economic development, commerce and trade, and the visitor economy at an international, state, regional and local level. A competitive airline industry allows Council to take advantage of its proximity to Melbourne Airport and provides the opportunity to:

- Attract supply chain uses in sectors including manufacturing, tourism, transport and logistics, construction, wholesaling, warehousing and distribution.
- Attract investment and employment growth in activities that require direct access to Melbourne Airport.
- Provide the potential for Brimbank to be part of the Aerotropolis surrounding Melbourne Airport

Increased competition, particularly the introduction of new operators, will provide consumers with greater choice, and can contribute to more affordable options and increase consumer protections. In a competitive market airlines tend to increase service performance, improve dispute resolution processes and provide better consumer protections or risk losing market share.

This is especially important in Brimbank which overall, has a lower Socio-Economic resident cohort than the metropolitan average with a SEIFA¹ Index of Disadvantage of '913' in 2021. Brimbank is also a diverse community with 7.7% (2021) of the population reporting needing help in in their day to day lives due to disability. Increased competition should result in an improvement to transport services and standards that make air travel more accessible.

Council believes that airports should make a greater contribution to the development of transport infrastructure to support access to and from airports. This includes making a financial contribution to infrastructure that supports their operation, in the same way other major state projects are required. In the case of Melbourne Airport, many off-site transport improvements and upgrades have been identified in their Master Plan to support their growth and development, however there is not investment by the airport into the improvements required off-site.

3.1 Council Position / Recommendations:

1. Council supports a competitive aviation sector, greater consumer protection and air travel that is accessible to people of all abilities.
2. Airports should contribute to the development of transport infrastructure that is required to support their growth and development.

¹ SEIFA - Socio-Economic Indexes for Areas

3.2 Maximising aviation's contributions to net zero

The aviation industry generates approximately 2.5% of global carbon emissions and can be a difficult sector to abate emissions. Council's Brimbank Climate Emergency Plan 2020-2025 is seeking emissions reduction targets of:

- Zero net carbon emissions for Council operations by 2030
- Zero net carbon emissions for the Brimbank municipality by 2040
- An interim aspirational target of 70% less emissions for the Brimbank municipality by 2030.

Council supports efforts to reduce carbon emissions and the decarbonisation of the aviation industry. The use of sustainable aviation fuel as an alternative or replacement to conventional fuels is supported however there are also other opportunities to improve overall environmental performance of the sector.

The Green Paper identifies that the Federal Government are seeking to explore opportunities to assess, improve and clarify the function of roles in environmental regulation at all airports to enable better stakeholder and environmental outcomes. It also highlights that activity is underway to make the Airports (Environment Protection) Regulations 1997, which are due to expire in April 2025. Council believes that airports can improve their planning to deliver greater environmental outcomes. In the case of the Melbourne Airport Master Plan 2022 (Master Plan) and the embedding of improved environmental performance and outcomes, Council acknowledged notable environmental performance progress over recent years, however, also identified many areas for improvement. Notably, the Master Plan only endeavoured to ameliorate some of the airport's negative impacts on the surrounding people and environment.

It is considered that all airports should make a net positive contribution in recognition of the environmental burden they impose beyond their site boundaries. Air travel results in significant environmental impacts and airports should seek to positively contribute to environmental outcomes to help offset the industries negative impacts as a whole, and have greater consideration for environmental matters including:

- natural landscape features and view lines
- rivers and creeks including impacts of stormwater
- noise and odour emissions
- biodiversity and habitats
- invasive weed species and pest management
- threatened ecological species
- contamination.

3.2 Council Position / Recommendations:

1. Council supports efforts to reduce carbon emissions and the decarbonisation of the aviation industry.
2. The environmental requirements should be strengthened in the Airports Act to address land conservation, land management, biodiversity and habitat matters.

3.3 *Airport development planning processes and consultation mechanisms*

3.3.1 Noise - Australian Noise Exposure Forecast (ANEF)

Aircraft noise is one of the most detrimental side effects of aviation. The effect of aircraft noise on affected communities is not just limited to annoyance and sleep disturbance, but includes impacts such as anxiety, depression, heart disease, and cognitive impairment as well as poorer educational outcomes in children.

The Green Paper proposes a complementary system alongside the Australian Noise Exposure Forecast (ANEF) to aid regulators and the public to gain an understanding of the nature and frequency of airplane noise that would be expected when living, or intending to live, within a particular ANEF contour.

Council submits that while a 'complementary system' is useful in explaining the way noise is measured, it will not address the underlying issue that the ANEF does not adequately capture and measure aircraft noise to ensure the safety and wellbeing of residents impacted by aircraft noise.

Council engaged the expert advice of Tonkin & Taylor, to undertake a Health Risk Assessment and air quality assessment (HRA) in relation to Melbourne Airport's 2022 Master Plan and MDP. The HRA is shown as an attachment to this submission, and was led by Dr Lyn Denison, a qualified scientist specialising in air quality and health risk assessment and included noise modelling undertaken by noise experts, Marshall Day.

Dr Denison identified in her findings that guidelines in the WHO Noise Guidance were exceeded across the areas within the ANEF 20 and ANEF 25 contours, indicating that there was an increased risk of adverse health effects within the exposed population.

Dr Denison identified that the metrics used in the Master Plan were those specified by AS2021:2015, which are based on amenity impacts, not health impacts, and that these do not take into account the more recent information on the health effects of noise by enHealth and WHO Noise Guidance. On this basis the values used by the Melbourne Airport 2022 Draft Master Plan were not consistent with the metrics recommended by the WHO Noise Guidance, which have been developed to protect against long-term exposure to aircraft noise.

In the case of Melbourne Airport, no genuine consideration was given to the health implications for Brimbank's residents or any effective ways to reduce and mitigate these impacts. Specifically, Melbourne Airport's 2022 Draft Master Plan forecast noise levels in the ANEF 20 and 25, exceeding WHO Noise Guidance threshold for annoyance, sleep disturbance, and cognitive development in children.

The Western Sydney International Environmental Airport – Airspace and Flight Path Design – Draft Environmental Impact Statement (Western Sydney Airport Draft EIS) was released on 24 October 2023 for public exhibition and examines the impact of the proposed flight paths on the environment and the community.

Importantly, it found that there is the potential for noise from the project to result in potentially significant increases in sleep disturbance, noise annoyance (and therefore complaints) and, to a lesser extent, cognitive impairment for children (as learning delays). These impacts were identified at a number of receptors located close to the runway as well as beneath the approaches and take off routes away from the runway. Most of the impacts on community health that are considered to be potentially significant are located within the existing or predicted ANEC 20 contours.

The Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) has developed a draft Noise Insulation and Property Acquisition (NIPA) policy in relation to aircraft overflight noise for buildings outside the Sydney Airport Site. The NIPA policy details the eligibility requirements for inclusion and is based on the aircraft noise results from this assessment and provides that this includes Treatments for Residential & Non-Residential buildings within ANEC 20 (Australian noise exposure concept), with an internal noise objective (i.e. bedrooms/living spaces/other of 50 dBA).

Council's 2022 Submission identified that Melbourne Airport's Master Plan and MDP would have an unreasonable and unacceptable impact on the health and wellbeing of community, mostly due to aircraft noise. The 2022 ANEF 25 contour outlined in the Master Plan and MDP impacts areas of Keilor, Keilor Park and Keilor North in Brimbank, while the ANEF 20 contour extends as far south as Sunshine North and covers the suburbs of Keilor, Keilor Park and Kealba. Importantly, many of these dwellings were constructed without noise attenuation as it was not a requirement in the planning scheme.

Council submits that the Federal Government must develop a noise compensation scheme for airport impacted communities, including Brimbank, to address the negative impacts of living near an airport. It appears that this approach is being undertaken for Western Sydney Airport, however, is not being instigated elsewhere suggesting there is an inconsistent regard to airport planning and community health and wellbeing.

Council submits that an independent expert review must be undertaken of the ANEF and Noise Contour system to assess the impact of aircraft noise on human health and wellbeing against the WHO Guidelines. The outcomes of this work should inform the establishment of appropriate noise metrics that accord with WHO Noise Guidance, and

is ultimately embedded in the legislative framework that directs airport planning to ensure that the impacts of airport planning, and specifically aircraft noise does not have an unacceptable impact on the health and wellbeing of the community. Importantly, this work should also inform best practice noise prevention and amelioration measures to address noise exceedances, including the establishment of a noise insulation program and compensation scheme.

Council also seeks a stronger focus on the ongoing measuring of aircraft noise to determine to ensure it is not exceeding noise forecasts to safeguard community health and wellbeing. Airservices Australia (Airservices) has indicated that there is a common misconception that current noise monitoring is undertaken to determine compliance with aircraft noise regulations, and have also indicated there are no Australian regulations which specify a maximum allowed level of aircraft noise. In addition to establishing aviation noise metrics to establish what is acceptable and unacceptable, Council also submits that this requires ongoing noise monitoring to support compliance with the system.

Once noise metrics standards have been established, Council submits that ensuring there is a complementary system of communication for current and future residents is important. Council concedes that aircraft noise cannot be eliminated and it is important that community understands how the Federal Government assesses and monitors noise to ensure it is not causing unacceptable harm. Any information and communications should cater for cultural and linguistically diverse (CALD) communities, and disadvantage, particularly where communities may not have direct access to the internet. Brimbank has a diverse community with 57.3% of residents who speaking another language other than English at home and 13.6% who do not to speak English well or at all (Brimbank Profile ID 2021). In 2016 over 16% of Brimbank households did not have internet connection, (which is more than 5% higher than the Greater Melbourne Average,) limiting access to information.

3.3.1 Council Position / Recommendations:

1. Undertake an independent and expert review of Australian Noise Exposure Forecast (ANEF) and Noise Contour systems to assess the impact of aircraft noise on human health and wellbeing against the WHO Noise Guidance and inform establishment of a noise metric system.
2. Establish a standardised noise metric system that incorporates health and safety considerations and is embedded in the regulatory framework for airport planning e.g. Airports Act, and is required to be used to protect community from aircraft noise impacts.
3. Introduce changes to legislation that require airports to prepare a well-founded and valid Health Impact Assessment (HIA) in relation to the off-site noise impacts associated with Master Plans and runway Major Development Plans, that are required to accord with the World Health Organisation's

Noise Guidance; mandating that the HIA undergoes an independent and expert peer review to ensure its veracity; and requiring that the HIA and peer review are made available for public review as part of the statutory consultation for Master Plans and runway Major Development Plans.

4. Establish guidance that requires airports and authorities that engage with the public to provide noise information and communications that responds to socio demographic characteristics of impacted communities, including multiple sources of information that can be accessed by community and translated information.
5. Support and fund an appropriate network of Environmental Monitoring Units for the purpose of measuring aircraft noise to ensure that forecast aircraft noise in Master Plans and runway MDPs are not exceeding what was originally reported and approved by the Federal government and comply with any noise metric system established to minimise harm to human health.

3.3.2 Noise – Land Use Planning

The Victorian Government introduced the MAEO in 2008 to identify properties impacted by noise due to flight paths. The MAEO requires construction to accord with Australian Standards relating to Aircraft Noise Intrusion and restricts dwelling density. Despite this provision, there are some flaws in the current system.

The MAEO is subject to change and can contract and expand, depending on the development plans of an airport. This means that areas have been developed without an MAEO in place. In the case of Melbourne Airport's proposed third runway, the expansion of the ANEF 20 will likely result in the future expansion of the MAEO and apply to dwellings that have already been constructed without noise attenuation, and without any compensation identified for property owners.

Previous work by Airservices and the Melbourne Airport Environs Safeguarding Standing Committee (MAESSAC) identified the need to embed the National Airport Safeguarding Framework (NASF) Guidelines in Victorian planning schemes. The Victorian Government has responded positively and has commenced a program to facilitate this outcome. This is consistent with the Green Paper which contends that awareness and implementation of matters outside of the Airport Act such as NASF should be led by the State and Territory governments. However a limitation is the resource and financial impost created by additional requirements for assessments by technical specialists that proponents must produce, and that planners must assess, often requiring referral due to the lack of internal expertise in most councils. Council submits that more detailed analysis should be undertaken by airports and reviewed by State and Territory governments to better inform land use and development directives in the NASF and embed in planning schemes. Similarly reports and guidance should be made available by government that inform and guide planning applications.

Given councils operate with finite resources and that many airports are significant businesses, it is considered they should be making a greater financial contribution to the communities they impact. While Melbourne Airport makes a financial contribution to the City of Hume, it doesn't make a contribution to the City of Brimbank, which is significantly impacted by its operation, and is required to fund the cost of additional planning assessment requirements as a result of its proximity to the airport. In 2022, Council received 59 planning applications within the MAEO that required additional airport related considerations. While Council is not required to refer planning applications to Melbourne Airport, it does notify them of applications within the MAEO providing them an opportunity to lodge a submission.

Council has previously submitted to the MAESSAC that it does not support Melbourne Airport in being a determining referral. Notwithstanding Council does to some extent rely on the technical expertise of Melbourne Airport in relation to airport safeguarding advice, however it is considered there should be greater independence and resourcing. Council submits that State and Territory governments should have their own panel of independent experts where these matters can be referred to ensure a consistent, independent and expert approach.

State and Territory governments could also develop an extra layer of information in the planning information systems which is publically available so is easily accessible when landowner or potential landowners are conducting due diligence. The Victorian Government has commenced a program of similar work, however it is only in the preliminary stages, with significant information still required.

Over many years Melbourne Airport has provided annual information sessions for planners on airport safeguarding. Council planners have regularly attended these sessions, which are seen as a valuable exercise that should continue for all airports, however, this doesn't replace the need for specialist knowledge and skills when assessing applications. Significant investment is required by government to provide greater training of planners, and or resourcing of independent specialist advisors to support the assessment of planning applications for complex aviation matters.

In some cases, it may be appropriate that applications are referred to government organisations that hold specific technical knowledge and skills like CASA, or Airservices Australia (Airservices) that should be determining authorities. Great information is required about the type of applications that should be referred, and consideration for changes to the legislative framework to facilitate these referrals.

3.3.2 Council Position / Recommendations:

1. Require Airports to prepare detailed analysis on the impacts and implications of the National Airport Safeguarding Framework on areas that surround airport, to be reviewed by State and Territory governments and embedded in planning schemes.

2. Provide localised information and guidance about the impacts of the National Airport Safeguarding Framework on areas surrounding airports and make reports available to local government and planning proponents that inform and guide planning applications.
3. Invest in specialised training of planners, and or resourcing of independent specialist advisors to support the assessment of planning applications for complex aviation matters.
4. Review and examine the appropriateness of facilitating determining referral authorities for statutory planning applications for aviation related government authorities e.g. CASA and Airservices.

3.3.3 Handling of Aircraft Noise Complaints

Council and the Brimbank community have held long term concerns about the aircraft noise complaints system. Key concerns include:

- The actual recording of aircraft noise complaints by Airservices is issues based which means that the volume of calls received about the same issue is not reported, even though they may relate to different incidents.
- If a resident rings multiple times about the same issue, despite the incident occurring at different times, the issue only gets recorded once, and they may then be treated as a 'serial' complainer and case managed, even though their issue may not be resolved.
- The complaints response system is heavily weighted toward supporting the aviation sector, and doesn't consider the health and wellbeing of residents impacted by aircraft noise.

As outlined in the White Paper TOR Submission, residents who make multiple complaints for different incidents that relate to an already reported issue may not have all their complaints registered. This means that the number of complaints being recorded is not reflective of the number being received and skews the data.

Further analysis and transparent criteria are required to establish:

- What constitutes a 'new' complaint, and how multiple complaints about the same issue but relating to separate issues are transparently recorded and appropriately shared with stakeholders
- The criteria for noise complaints to be considered resolved
- How the information is relayed back to the complainant, and opportunities for escalation
- Performance monitoring standards for the customer service provided by Airservices to complainants
- Appropriate standards of reporting to stakeholders.

Council also identifies the need for greater transparency about the consequences for airlines when a complaint results in compliance action. Currently very little information is known about the implications for airlines when they breach regulations and if penalties apply. This type of information is considered important in terms of Airservices providing a full response and closing the loop, not only with the customer, but also with other community stakeholders like councils and the CACG.

3.3.3 Council Position / Recommendations:

1. Commission an independent review of Airservices and the noise complaints and information service handling procedures and practices.
 - a. Assess the independence of current aviation noise management systems and processes, including the potential for the current system to be prejudiced toward outcomes that benefit the aviation sector over community impacts.

3.3.4 Amelioration Programs

Aircraft noise can have significant impacts on the health and wellbeing of impacted communities, particularly where suburbs have developed without attenuation. Greater regard is required for mitigation, and or compensation measures as part of airport planning. Ongoing noise monitoring is also required to determine if aircraft noise is in line with forecasted noise during the planning stage to inform further noise abatement and mitigation.

A good example of how airport planning can be mismanaged is the case of Brisbane Airport. Since the opening of a parallel runway in July 2020, complaints have soared from Brisbane residents about aircraft noise. As a result, Brisbane Airport has been the subject of multiple reviews which may result in changes to flight paths. This suggests that the original noise assessments undertaken for current flight paths underestimated the impact of aircraft noise, further emphasising the inadequacies of the current noise system and measures.

Mitigation measures can be separated into active and passive noise abatement measures, where active measures relate to internal changes of flight paths, flight times, and aircraft models, and passive measures are more community-focused measures.

Best practice international airports provide a range of noise mitigation measures to address noise including funded noise insulation schemes, compulsory acquisition, a curfew, and noise abatement procedures. European examples provide a framework for best practice measures to provide good passive noise abatement programs that assist pre-existing homes mitigate the impact of noise on the residents. Examples are available from Heathrow and Frankfurt regarding retro fitting sound insulation treatments.

A national compensation scheme is required to fund the installation of noise mitigation measures that reduce the impact of adverse aircraft noise on the affected communities by insulating dwellings and buildings accommodating sensitive land uses or by other forms of compensation, as necessary.

Council has demonstrated through its HRA that a noise insulation program is required in areas within the ANEF 20 and ANEF 25 contours for residential premises, schools, childcare and early learning centres, aged care facilities and public buildings such as libraries and community centres.

In addition to being a requirement under the Aircraft Noise Levy Act 1995, a compensation scheme will provide:

- fairness and equity – accounts for an unfair distribution of adverse aircraft noise on affected communities;
- responsibility – the airport accepts accountability for the adverse aircraft noise outcomes
- proportionality and reasonableness – the compensation scheme is structured in a balanced,
- reasonable and commensurate manner;
- consistency – rules and standards are fairly and consistently implemented;
- transparency – the mitigation of adverse aircraft noise is minimised in a simple, effective and user friendly way;
- accountability – decisions can be justified under public scrutiny; and
- agility – allows affected communities to anticipate and adapt to anticipated change.

In June 2023, the National General Assembly of the Australian Local Government Association (ALGA) endorsed a motion submitted by Brimbank City Council that ALGA advocate for the Australian Government to establish a compensation scheme for airport-impacted communities.

In the past, compensation schemes have been established to support households affected by new airport runways. These include a compensation scheme in 1994 when Sydney Airport's third runway was built, and more recently, a compensation scheme for a new airport in Sydney's Badgerys Creek, in recognition to the change in noise levels and lifestyle. A compensation scheme was also developed for residential and public buildings surrounding Adelaide Airport in the early 2000s.

Compensation should also be considered for properties within Public Safety Areas (PSA). PSA's are designated areas of land at the end of airport runways where planning restrictions may apply. The PSA comprises two areas, the 1:10,000 inner area where the risk of being killed by an aircraft is one in 10,000 per year and an outer area, where the risk decreases to one in 100,000 per year. The incompatible uses within nominated PSA's for both the inner and outer PSA include dwelling houses, multiple dwellings, tourist parks, hostels, residential care facilities and retirement villages.

Within the Brimbank context, many local residential buildings were not built to accommodate the acoustic demands of Melbourne Airport and its expansion. This is in part due to settlements in Keilor establishing as early as 1850s, including non-residential buildings like the Keilor Primary School, which was constructed before Melbourne Airport was commissioned. Another issue is that the ANEF can expand and retract depending on the operation of the airport. In the case of Melbourne Airport, it is currently proposed to apply to a much larger north south area to accommodate the development of the third runway but retract in the east south orientation due to less use. The change doesn't result in any compensation for those people that have already built homes and complied with the regulations that were current at the time they constructed.

As mentioned earlier in relation to the Western Sydney Airport Draft EIS, DITRDCA has developed a draft Noise Insulation and Property Acquisition (NIPA) policy in relation to aircraft overflight noise for buildings outside the Sydney Airport Site. The NIPA policy details the eligibility requirements for inclusion and is based on the aircraft noise results from this assessment and provides that this includes Treatments for Residential & Non-Residential buildings within ANEC 20 (Australian noise exposure concept), with an internal noise objective (i.e. bedrooms/living spaces/other of 50 dBA.

Council's 2022 Submission identified that Melbourne Airport's Master Plan and MDP would have an unreasonable and unacceptable impact on the health and wellbeing of community, mostly due to aircraft noise. The 2022 ANEF 25 contour outlined in the Master Plan and MDP impacts areas of Keilor, Keilor Park and Keilor North in Brimbank, while the ANEF 20 contour extends as far south as Sunshine North and covers the suburbs of Keilor, Keilor Park and Kealba. Importantly, many of these dwellings were constructed without noise attenuation as it was not a requirement in the planning scheme.

Council submits that the Federal Government must develop a noise compensation scheme for airport impacted communities, including Brimbank, to address the negative impacts of living near an airport. It appears that this approach is being undertaken for Western Sydney Airport, however, is not being instigated elsewhere suggesting there is an inconsistent regard to airport planning and community health and wellbeing.

The lack of appropriate regard for the health and wellbeing of communities that meets international and best practise standards means that more and more communities will be impacted by aircraft noise and other off site impacts as airports expand, which is likely to increase complaints, and heightens the need to address and improve airport planning now.

3.3.4 Council Position / Recommendations:

1. Establish a legislative framework that requires airports to implement noise mitigation measures based on international best practice including:
 - a. A noise insulation program in the areas within the ANEF 20 and ANEF 25 contours for residential premises, schools, childcare and early learning centres, aged care facilities and public buildings such as libraries and community centres.
 - b. Requirements for noise abatement procedures that appropriately share aircraft noise and provide reasonable respite to communities surrounding airports and imposes penalties when breached.
2. Require airports including individual leased Federal airports to identify noise mitigation measures to adequately address noise exceedances beyond WHO Noise Guidelines, including options for a Federal funded noise insulation program, a noise curfew, voluntary property acquisition or other compensation measures, especially for houses and other buildings within the vicinity of airports prior to their construction, expansion or commission.
3. Establish a policy framework that outlines a compensation scheme for airport-impacted communities. This should be provided either by means of a noise amelioration program to owners of dwellings and buildings accommodating sensitive land uses (i.e. schools, places of worship, childcare centres and hospitals) adversely affected by aircraft noise. Such a compensation scheme aligns with the legislated requirement under the Aircraft Noise Levy Act 1995 which aims to recover the costs incurred in providing noise amelioration programs to airport-impacted communities.
4. Require that a purchase scheme be implemented where properties within the Public Safety Area of runways can be voluntarily offered by owners, at current market value, for purchase by the Federal Government.

3.3.5 Community Engagement and Community Aviation Consultation Groups (CACGs)

The Green Paper questions how the existing consultation framework and CACGs can be improved and proposes a draft Community Engagement Standard (draft CES) as an important step in communicating a standard process to community.

While the draft CES is important, Council considers that many issues have not been considered which relate to the lack of transparency in the process about how feedback is considered, what informs this consideration and the absence of a feedback loop for public submissions that shows how the aviation sector responded to feedback. Most

importantly, there is no third party review option built into the process as explained further below.

Council's White Paper TOR Submission expressed concern over the lack of transparency in relation to changes as a result of Federal and State government referrals, or how airports assessed and responded to public submissions as a result of the public exhibition of an airport Master Plan or Major Development Plan.

Victorian planning amendment legislation may provide the Federal government with guidance on how consultation could be more transparent and better targeted. For major planning projects in Victoria, the Minister for Planning can appoint expert advisory committees to hold public hearings to consider significant proposals and allow stakeholders to present submissions to an independent panel of experts for consideration, who then make independent recommendations to the government, before a decision is made. The process also requires that all documentation about a proposal is made public, with the opportunity for peer review.

In Queensland, community forums are appointed to review documentation to allow for a peer review and advice. This approach not only assists in informing the community, it also delivers a more transparent review process.

While airports are required to establish a CACG, questions are sometimes raised about their level of effectiveness and independence when airports appoint the chair and can direct and determine the membership structure and ongoing operations. For example, Council has long been advocated that Councillors be included in the membership structure, however this has been declined by the Melbourne Airport CACG. Overtime the role and function has slowly diminished and anecdotally this is attributed to the inability of the CACG to progress matters of community importance like the way Airservices responds to and reports on noise complaints, the lack of information provided by Melbourne Airport in response to Master Plan submissions, the lack of public information about the CACG to name a few.

Council submits that CACGs can deliver an important function in engaging with community about aviation matters and should be maintained, however there should be a greater level of separation and independence of from airports. On this basis they should be reviewed and potentially appointed and run by State or Territory governments, with funding provided by the relevant airports. The ongoing membership and attendance of airports and aviation organisations remains paramount. Council also submits that community membership should be reviewed to consider strengthening to represent the broader interests of the community, including regard for Councillor Membership from each of the impact councils proximate to the airport.

Council also wishes to raise the possibility of having a local councillor position invited to CACG meetings, in addition to the community representative categories.

3.3.5 Council Position / Recommendations:

1. Establish an independent and expert advisory committee, or similar, to provide a transparent, independent and public review process that enables impacted stakeholders to present their submissions for independent consideration, and which can make recommendations to the Government about an airport master plan and major development plan.
2. Require Federal and State government referrals, assessments and decisions for airport master plans and major development plans to be made public, including any peer reviews commissioned.
3. Require airports to publically release their assessment of submissions received about Master Plans and Major Development Plans, and specify how these changes in response to submissions made. This should be made public when airports submit their final draft Master Plan or major development plan to the Government for approval.
4. Require airports to make public their final draft master plan or major development plan, when they submit it to the Government for approval to promote transparency about the process.
5. Require Federal and State government referrals, assessments and decisions for airport master plans and major development plans to be made public, including any peer reviews commissioned.
6. Retain the role and function of the CACGs to serve as a community consultative group that works collaboratively on airport planning, development and operations and the impacts on the community.
7. Increase the independence of CACG from airports to provide a more robust and transparent consultation process.

3.3.6 Preparation of Major Development Plans

Under the Airports Act, a Major Development Plan (MDP) must accompany all developments valued at \$25 million or more, however, a major development is also defined as going beyond just the monetary threshold and linked to the impact of a development proposal.

It is considered that the requirement for an MDP should not be limited to a specific development cost but commensurate to the impact that the proposed development has on surrounding land. This should consider the impact the proposed development has on both onsite and offsite land and include, but not be limited to, environmental, noise, health, roads/traffic and stormwater/drainage impacts.

Notwithstanding this, the minimum threshold to prepare a Major Development Plan should be retained and that any proposed increase should be subject to a robust public notification and review process and be strategically justified.

3.3.6 Council Position / Recommendations:

1. Retain the existing \$25 million threshold trigger to prepare an MDP subject to providing further justification for an increase.
2. Consider the potential for projects that may not meet a monetary threshold, but potentially have a significant impact that necessitates a Major Development Plan process.

3.4 *General Aviation*

The emergence of 'new' technologies, such as drones and electric batteries, can have significant benefits to the community. Council is generally supportive of new technologies and innovation particularly where they increase employment and economic output. Notwithstanding, sometimes the legislative framework is insufficient developed to respond to the pace of change. Council flags the need for the Federal Government to continue to manage and monitor the environmental impacts of new technologies and ensure appropriate manage the assessment process in terms of the impact they may have on the community in line with recommendations is provided at Section 3.3.

3.4 Council Position / Recommendations:

1. Council supports new technologies and innovation where it increases employment and economic output and doesn't have detrimental consequences for the health and wellbeing of community.

3.5 *Emerging aviation technologies: a leadership role for Australia*

The Green Paper highlights a leadership role a range of aviation technology matters, including the use of drones and Advanced Air Mobility (AAM) technology such as Unmanned Aerial Systems (UAS).

While Council is generally supportive of new technologies and innovation, sometimes the assessment of impacts and the legislative framework is insufficiently developed to manage unintended consequences.

Council has already raised concerns regarding insufficiencies in the aviation planning framework including inadequate protection of the community from unacceptable aircraft noise and the lack of transparency around aviation planning and decision

making. These and other concerns raised should inform how new technology is assessed in terms of its potential impacts on the community also. For example:

- How are noise levels of new technologies considered?
- Do Public Safety Areas apply for UAS?
- What is the regulatory framework and will penalties or restrictions apply
- How does new technologies contribute to Australia's commitment to net zero emissions after 2050?
- How does NASF apply to new technology?
- How is privacy protected?

While Council anticipates that advanced technology should contribute to greater sustainability and quieter aircraft, this may not always be the case. Council submits that a greater focus on the health and wellbeing should be a focus when facilitating and investing in new technology.

3.5 Council Position / Recommendations:

1. Council supports new technologies and innovation where it increases employment and economic output and doesn't have detrimental consequences for the health and wellbeing of community.

3.6 *Future industry workforce*

While the aviation sector provides a significant range of employment and business development opportunities, the Green Paper identifies a range of challenges and measures in terms of skills gaps, difficulties in attracting and retaining personnel across various sub sectors and changing needs as technology advances.

Council submits that there is a significant opportunity for airports and the aviation sector to build stronger partnerships with all levels of government, including councils, and educational institutions to address these gaps. This may be further strengthened by the aviation sector adopting a 'good' neighbour approach with the communities it impacts, and seeking to uplift communities through its investments to maximise the social and economic benefits.

Brimbank's labour force includes a broad mix of occupations due to the diverse education qualifications, skills and locational attributes (proximity to employment areas). There is a high representation of 'blue collar' workers, reflected by the proportion of technicians and trade workers, machinery operators and drivers, and labourers.

Brimbank also has a higher unemployment rate when compared with Greater Melbourne. This is a consistent long term trend, partly attributing to higher levels of socioeconomic disadvantage in some parts of the municipality. Council's Economic

Development Strategy 2022-2027 seeks to reduce the unemployment rate in Brimbank through improved employment pathways, upskilling and job readiness.

Council submits that airports should have greater regard for the communities surrounding them and seek to partner with councils to examine how they can target their investment to maximise the uplift and positive impact on communities. While the economic benefits are often alluded to in Master Plans, Council submits that airports should develop a stronger social agenda with employment targets that require meaningful partnerships with governments and institutions that and 'real' outcomes, particularly for those communities where they have a significant negative impact.

As an example, Melbourne Airport is now partnering with surrounding councils to deliver jobs fairs to try and attract local talent to fill their many vacancies. These partnerships however can be further strengthened and expanded to explore business development opportunities for local industry also and should be a continuing focus.

3.6 Council Position / Recommendations:

1. Airports and the aviation sector should work with more closely with local and state government to facilitate local employment and business development opportunities to meet the needs of the airports and deliver targeted social and economic uplift to the communities they impact.

4. Council Position / Recommendations

1. Council supports a competitive aviation sector, greater consumer protection and air travel that is accessible to people of all abilities.
2. Airports should contribute to the development of transport infrastructure that is required to support their growth and development.
3. Council supports efforts to reduce carbon emissions and the decarbonisation of the aviation industry.
4. The environmental requirements should be strengthened in the Airports Act to address land conservation, land management, biodiversity and habitat matters.
5. Undertake an independent and expert review of Australian Noise Exposure Forecast (ANEF) and Noise Contour systems to assess the impact of aircraft noise on human health and wellbeing against the WHO Noise Guidance and inform establishment of a noise metric system.
6. Establish a standardised noise metric system that incorporates health and safety considerations and is embedded in the regulatory framework for airport planning e.g. Airports Act, and is required to be used to protect community from aircraft noise impacts.

7. Introduce changes to legislation that require airports to prepare a well-founded and valid Health Impact Assessment (HIA) in relation to the off-site noise impacts associated with Master Plans and runway Major Development Plans, that are required to accord with the World Health Organisation's Noise Guidance; mandating that the HIA undergoes an independent and expert peer review to ensure its veracity; and requiring that the HIA and peer review are made available for public review as part of the statutory consultation for Master Plans and runway Major Development Plans.
8. Establish guidance that requires airports and authorities that engage with the public to provide noise information and communications that responds to socio demographic characteristics of impacted communities, including multiple sources of information that can be accessed by community and translated information.
9. Support and fund an appropriate network of Environmental Monitoring Units for the purpose of measuring aircraft noise to ensure that forecast aircraft noise in Master Plans and runway MDPs are not exceeding what was originally reported and approved by the Federal government and comply with any noise metric system established to minimise harm to human health.
10. Require Airports to prepare detailed analysis on the impacts and implications of the National Airport Safeguarding Framework on areas that surround airport, to be reviewed by State and Territory governments and embedded in planning schemes.
11. Provide localised information and guidance about the impacts of the National Airport Safeguarding Framework on areas surrounding airports and make reports available to local government and planning proponents that inform and guide planning applications.
12. Invest in specialised training of planners, and or resourcing of independent specialist advisors to support the assessment of planning applications for complex aviation matters.
13. Review and examine the appropriateness of facilitating determining referral authorities for statutory planning applications for aviation related government authorities e.g. CASA and Airservices.
14. Commission an independent review of Airservices and the noise complaints and information service handling procedures and practices.
 - a. Assess the independence of current aviation noise management systems and processes, including the potential for the current system to be prejudiced toward outcomes that benefit the aviation sector over community impacts.
15. Established a legislative framework that requires airports to implement noise mitigation measures based on international best practice including:

- a. A noise insulation program in the areas within the ANEF 20 and ANEF 25 contours for residential premises, schools, childcare and early learning centres, aged care facilities and public buildings such as libraries and community centres.
 - b. Requirements for noise abatement procedures that appropriately share aircraft noise and provide reasonable respite to communities surrounding airports and imposes penalties when breached.
16. Require airports including individual leased Federal airports to identify noise mitigation measures to adequately address noise exceedances beyond WHO Noise Guidelines, including options for a Federal funded noise insulation program, a noise curfew, voluntary property acquisition or other compensation measures, especially for houses and other buildings within the vicinity of airports prior to their construction, expansion or commission.
 17. Establish a policy framework that outlines a compensation scheme for airport-impacted communities. This should be provided either by means of a noise amelioration program to owners of dwellings and buildings accommodating sensitive land uses (i.e. schools, places of worship, childcare centres and hospitals) adversely affected by aircraft noise. Such a compensation scheme aligns with the legislated requirement under the Aircraft Noise Levy Act 1995 which aims to recover the costs incurred in providing noise amelioration programs to airport-impacted communities.
 18. Require that a purchase scheme be implemented where properties within the Public Safety Area of runways can be voluntarily offered by owners, at current market value, for purchase by the Federal Government.
 19. Establish an independent and expert advisory committee, or similar, to provide a transparent, independent and public review process that enables impacted stakeholders to present their submissions for independent consideration, and which can make recommendations to the Government about an airport master plan and major development plan.
 20. Require Federal and State government referrals, assessments and decisions for airport master plans and major development plans to be made public, including any peer reviews commissioned.
 21. Require airports to publically release their assessment of submissions received about Master Plans and Major Development Plans, and specify how these changes in response to submissions made. This should be made public when airports submit their final draft Master Plan or major development plan to the Government for approval.

22. Require airports to make public their final draft master plan or major development plan, when they submit it to the Government for approval to promote transparency about the process.
23. Require Federal and State government referrals, assessments and decisions for airport master plans and major development plans to be made public, including any peer reviews commissioned.
24. Retain the role and function of the CACGs to serve as a community consultative group that works collaboratively on airport planning, development and operations and the impacts on the community.
25. Increase the independence of CACG from airports to provide a more robust and transparent consultation process.
26. Retain the existing \$25 million threshold trigger to prepare an MDP subject to providing further justification for an increase.
27. Consider the potential for projects that may not meet a monetary threshold, but potentially have a significant impact that necessitates a Major Development Plan process.
28. Council supports new technologies and innovation where it increases employment and economic output and doesn't have detrimental consequences for the health and wellbeing of community.
29. Council supports new technologies and innovation where it increases employment and economic output and doesn't have detrimental consequences for the health and wellbeing of community.
30. Airports and the aviation sector should work with more closely with local and state government to facilitate local employment and business development opportunities to meet the needs of the airports and deliver targeted social and economic uplift to the communities they impact.

5. Attachment: Tonkin & Taylor Health Risk Assessment for Melbourne Airport Master Plan



Melbourne Airport Expansion Noise Health Risk Assessment

Prepared for
Brimbank City Council

Prepared by
Tonkin & Taylor Pty Ltd

Date
April 2022

Job Number
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Executive summary

Tonkin and Taylor Pty Ltd (T+T) has been engaged by Brimbank City Council to undertake a health risk assessment (HRA) for noise from the proposed expansion of the Melbourne Airport including a new North-South runway. The draft noise contours included as part of the 2022 Melbourne Airport Master Plan extend over large parts of the Brimbank Local Government area (LGA). In addition to undertaking the HRA, T+T were also engaged to undertake limited stakeholder engagement to gain an understanding of the current impacts of noise from the airport operations and concerns about the proposed expansion and to undertake a review of the air quality assessment that has been undertaken as part of the development of Master Plan and the predicted impacts on the Brimbank LGA.

The outcomes of the stakeholder engagement show that the residents in parts of Keilor, Keilor Park, Keilor Village and Kealba are adversely impacted by the current operations of the Melbourne Airport. Noise from aircraft take-offs and landings is causing sleep disturbance and increased levels of stress and anxiety in the impacted community. People are unable to enjoy their homes and cannot utilise their outdoor areas. This impact is predicted to worsen and affect more people in the Brimbank LGA with the proposed airport expansion. The community feel that their concerns have been dismissed by the Melbourne Airport Corporation and are feeling frustrated and helpless. This is having a significant impact on the health and wellbeing of the impacted community.

The results of the HRA have shown that the proposed airport expansion will lead to significant increases in the percentage of the population that are highly annoyed by aircraft noise. It has also shown that there will be a significant increase in sleep disturbance in the exposed community which may lead to increases in health effects such as cardiovascular disease and anxiety and depression. The WHO (2018) guidelines are exceeded across the areas within the ANEF 20 and ANEF 25 contours indicating that there is an increased risk of adverse health effects within the exposed population.

A review of the baseline health profile and socioeconomic indicators for the Brimbank LGA show that the suburbs within the ANEF 20 and ANEF 25 contours are a vulnerable population to the impacts of aircraft noise. They have a lower socioeconomic status than Australia and Victoria as a whole which is a known risk factor for the adverse effects of aircraft noise. The proportion of children assessed as being developmentally on track in the language and cognitive skills is notably lower in Brimbank (79.3%) than in Greater Melbourne (85.3%). Aircraft noise has been shown in epidemiological studies to impact on children's cognitive development particularly in reading and oral comprehension. There are also higher rates of deaths from ischaemic heart and cardiovascular disease in Brimbank compared to the rest of Victoria. All these health outcomes can be exacerbated by exposure to aircraft noise.

School children who live and go to school within the ANEF 20 and ANEF 25 contours are predicted to experience a delay in reading and oral comprehension of between 3 and 5 months compared to children in lower noise areas. These effects are due to direct impacts during the day as well as impacts due to sleep disturbance which may occur outside the normal night hours of 11pm to 6am. Exposure during critical periods of learning at school could potentially impair development and have a lifelong effect on educational attainment. This impact is predicted to occur within a population that is known to be delayed in their language and cognitive skills compared to the rest of Melbourne.

Given the potential adverse effects due to the increase in aircraft noise, mitigation measures should be implemented to minimise the risk to the exposed community.

1 Introduction

Tonkin and Taylor Pty Ltd (T+T) has been engaged by Brimbank City Council to undertake a health risk assessment (HRA) for noise from the proposed expansion of the Melbourne Airport including a new North-South runway. The draft noise contours included as part of the 2022 Melbourne Airport Master Plan extend over large parts of the Brimbank Local Government area (LGA). In addition to undertaking the HRA, T+T were also engaged to undertake limited stakeholder engagement to gain an understanding of the current impacts of noise from the airport operations and concerns about the proposed expansion and to undertake a review of the air quality assessment that has been undertaken as part of the development of Master Plan and the predicted impacts on the Brimbank LGA.

This report presents the outcomes of the stakeholder engagement as well as the results of the HRA for aircraft noise. The HRA has been conducted using the most recent WHO Noise Guidelines (2018). It also presents a review of national and international approaches to mitigating the impacts of noise from airport operations on local communities. The outcomes of the review of the air quality assessment against the requirements of the Environment Protection Act (2018) and the new environmental legislation in Victoria is also presented.

1.1 Environment Protection Act (2017) as amended (2018) and Subordinate Legislation in Victoria

The Environment Protection Act 2017 (the Act), and subordinate legislation came into effect on 1 July 2021 and is designed to drive environmental improvements by ensuring that individual industries take responsibility for the risks they pose to human health and the environment. At the centre of the Act is the General Environmental Duty (GED). This requires all duty holders (businesses, industries, community etc) to understand, abate and manage their emissions so that risks of harm to the environment and to human health are minimised. Complying with the GED means taking proactive steps as well as employing industry best practices to minimise risk to human health and the environment, so far as reasonably practicable.

The GED requires anyone engaging in any activities that may give rise to risks of harm to human health or the environment from pollution or waste to minimise those risks, so far as reasonably practicable. This requires such risks to either be eliminated, or if it is not reasonably practicable to eliminate such risks, to be reduced so far as reasonably practicable.

In determining whether it is reasonably practicable to minimise risks of harm to human health and the environment, the following matters are relevant:

- The likelihood of the risk eventuating.
- The degree of harm that would result if the risk eventuated.
- What the person knows, or ought reasonably to know about the harm or risks of harm and any ways of eliminating or reducing those risks.
- The availability and suitability of ways to eliminate or reduce the risk.
- The cost of eliminating or reducing the risk.

The GED requires the duty holder to reduce the risk of harm to human health and the environment from pollution and waste. Noise comes under the category of pollution, and it includes vibration. As far as reasonably practicable, if the duty holder's activity involves noise it's their duty to reduce the levels of risk. Businesses must not cause unreasonable noise or aggravated noise. They must make sure that any noise from their activities or premises doesn't unreasonably impact the local community.

To meet the obligations of the GED, a duty holder must show they have understood and assessed the concept of minimising risks of harm to human health and the environment, including, but not limited to:

- A duty imposed on a person to, so far as reasonably practicable, eliminate or reduce the risks of harm to human health and the environment.
- A duty to determine what is reasonably practicable when minimising risks of harm to human health and the environment, including:
 - The likelihood of the risk causing harm to human health and the environment.
 - The degree of harm to human health and the environment.
 - The knowledge of the duty holder regarding harm to human health and the environment.
 - The availability and suitability of measures to eliminate or reduce the risk of harm to human health and the environment.
 - The cost to eliminate or reduce the risk of harm to human health and the environment.

2 Structure of Report

The structure of this report is as follows

- Section 3 – Outcomes of Stakeholder Engagement
- Section 4 - Noise Health Risk Assessment
- Section 5 - Risk Mitigation Measures
 - Summary of measures implemented to protect health of communities at other Australian airports and overseas
- Section 6 – Conclusions and Recommendations
- Section 7 - Review of Air Quality Assessment
- Section 8 - References

3 Stakeholder Engagement

As part of the assessment of the health effects of aircraft noise on the community in Brimbank, targeted consultation sessions were conducted. The purpose of these sessions was to gain an understanding of the current operation of the airport on the local community and the community concerns around the planned airport expansion as described in the 2022 Airport Master Plan. Council officers made contact a range of impacted stakeholders including Brimbank residents, community and sporting facilities, education and early learning organisations and Brimbank members of the Melbourne Airport Community Aviation Consultation Group (CACG). The focus was on areas impacted by aircraft noise including including Keilor, Keilor Park, Keilor Village, Kealba, and Sunshine North.

3.1 Focus Groups

The consultation sessions were run as three separate focus groups:

- Stakeholders from Keilor, Keilor Park and Keilor Village who are identified as being under the current and proposed flight paths, including Brimbank members of CACG.
- Stakeholders from Kealba, Sunshine North and Sydenham
- Education related stakeholders including schools that are under the current and proposed flight paths.

In addition to the focus groups individual discussions were held with residents of Keilor, Keilor Village and Kealba who were unable to attend the focus groups. The age of people who participated in the focus groups and individual discussions ranged from 20's through to 70+ years of age.

3.2 Key Issues

Across both community session and in individual discussions there were common themes. Many participants commented that the current operation of the airport is impacting on their ability to sleep. People in Keilor, Keilor Park, Keilor Village and Kealba stated that they get a maximum of 3 to 4 hours sleep a night and that is highly disturbed. Some residents spend nights away from home just so they can get some sleep. All the people that participated in the engagement are concerned that the expansion of the airport will make the situation they are currently experiencing much worse. People in Keilor Park, Keilor Village and Kealba all stated that the current situation is intolerable and is having an impact on their health and quality of life and don't know how they will be able to live in their current homes with an increase in flights proposed with the current plan for the airport expansion.

One of the key issues for residents in these areas is that there is no respite from the noise from aircraft taking off. They commented that they can still hear planes in the distance after take-off when the next plane takes off over their properties. There isn't a period where they cannot hear the aircraft. With the number and frequency of flights to increase with the expansion they are concerned that this will only get worse. They also noted that there has been an increase in flights that seem to circle back over their suburbs after take-off which means that they are exposed to additional noise from these flights even though they are at a higher altitude.

Residents in Keilor Park, Keilor, Keilor Village and Kealba stated that they were unable to use the outdoor space at their homes due to aircraft noise which is predicted to increase with the airport expansion. They were unable to hold conversations when planes were taking off and in some cases the noise was quite painful. Some residents commented that it felt like there was increased pressure in their ears which was quite painful. They also commented that they were unable to open the windows in their homes due to the increase in noise when they were open.

Several residents commented that they are unable to use Brimbank Park for exercise and recreation due to the aircraft noise and that this is predicted to get worse with the Airport expansion. They said that they couldn't hold a conversation during take-offs due to the noise and that the quality of their time within the park was diminished due to the constant noise from aircraft take-offs and landings.

Some residents, mainly older residents, stated that they are depressed and are being treated by medical professional for anxiety and depression. They feel that they can no longer live in their homes as the noise is unbearable and will only get worse. They believe that the aircraft noise is impacting on their health and that this will only get worse. They are unable to enjoy their homes and feel they need to sell but don't think that anyone would purchase them. They feel trapped and don't know what to do.

Many of the people who attended the focus groups have attended many community consultation sessions run by the Melbourne Airport Corporation. Many felt that the concerns that they raised during the current consultation through the HRA process had been heard but feel very strongly that they haven't been heard by Melbourne Airport Corporation – that their concerns have been dismissed in all public sessions that have been held and any additional communication with the Corporation. This has left them feeling frustrated and helpless.

Some of the residents in Kealba and Keilor Village questioned the accuracy of the noise predictions developed by the Airport Corporation as part of their Master Plan. A number said that according to the interactive noise tool their houses are shown as not currently being impacted by the noise from aircraft, however they are unable to sleep due or enjoy their outside areas due to the aircraft noise. Some had conducted noise monitoring at their homes and had recorded noise levels between 70 and 80 dB which is not consistent with the information provided in the noise tool when their addresses were entered into the system. This has raised concerns about the accuracy of future predictions of noise when the current experience at their homes is that they are impacted more severely than the noise tool is predicting.

4 Health Risk Assessment Noise

4.1 Introduction

The health effects associated with exposure to noise from airports has been extensively studied. In 2018 the World Health Organization (WHO) reviewed their Community Noise Guidelines and in this process developed health- based guidelines specific to aircraft noise. The health risk assessment (HRA) for noise has been undertaken in accordance with the Australian Government *Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazard 2012*" (enHealth, 2012) and the World Health Organisation (WHO) Environmental Noise Guidelines (2018). The health effects that have been assessed include annoyance, sleep disturbance, increases in cardiovascular disease and cognitive impairment in children.

4.2 Methodology

The risk assessment process detailed in the enHealth HRA Guidelines comprises five components as outlined below:

1. **Issue Identification** – Identifies issues that can be assessed through a risk assessment and assists in establishing a context for the risk assessment.
2. **Hazard Assessment** – Identifies hazards and health endpoints associated with exposure to hazardous agents and provides a review of the current understanding of the toxicity and risk relationship of the exposure of humans to the hazards.
3. **Exposure Assessment** – Identifies the groups of people who may be exposed to hazardous agents and quantifies the exposure concentrations.
4. **Risk Characterisation** – Provides the qualitative evaluation of potential risks to human health. The characterisation of risk is based on the review of concentration response relationship and the assessment of the magnitude of exposure.
5. **Uncertainty Assessment** – Identifies potential sources of uncertainty and qualitative discussion of the magnitude of uncertainty and expected effects on risk estimates.

4.3 Population Profile

4.3.1 Population and Health Profile

The baseline health status and demographics of the potentially exposed community is important to understand as it can impact on the sensitivity of the population to the adverse effects of air pollution and noise. People in older age groups (>65 years of age), with existing diseases such as respiratory and cardiovascular disease, people with asthma, children (<15 years) and people in low socioeconomic groups all fall into groups that are more sensitive to the effects of environmental pollution.

The study area for this HRA is suburbs within the Brimbank Local Government Area (LGA) that are impacted by the ANEF 20 and 25 contours released as part of the proposed Airport expansion.¹ Population statistics and baseline health data is available at both the LGA and suburb level.

¹ The ANEF system is a measure of the aircraft noise exposure levels around aerodromes. It is based on average daily sound pressure levels, which are measured in decibels. Noise exposure levels are calculated in ANEF units.

4.3.2 Population Profile

4.3.2.1 Age Profile

The most recent published census data (Australian Bureau of Statistics [ABS], 2016) for Brimbank and the affected suburbs is summarized in the **Table 4-1**. The data is also included for Victoria for comparison with the State averages.

Table 4-1: Population profile of the Brimbank LGA and affected suburbs Census 2016

Data	Brimbank	Kealba	Keilor	Keilor Park	Sunshine North	Victoria
Total population	194,319	3,194	5,853	2,719	11,700	5,929,624
0 – 14 years	18.4%	17.7%	16.9%	17%	17.7%	18.3%
15 – 64 years	67.9%	69.8%	62%	57%	67.3%	66.2%
Over 65	13.6%	12.5%	21.1%	26%	15.2%	15.6%
Median age	35	36	44	43	35	37

Source: Australian Bureau of Statistics – 2016 Census.

As can be seen from **Table 4-1** the age of the populations of Keilor and Keilor Park are higher than the Victorian average. For both suburbs this is driven by a larger percentage of the population in the >65 year age group compared to the Victorian average, a cohort that is known to be more vulnerable to the effects of air pollution and noise. Children also fall into a vulnerable group to the effects of air pollution and noise.

4.3.2.2 Health Profile

The baseline health statistics for the Brimbank area were obtained from the Brimbank Atlas of Health and Education (2019) and the Report on Population Health Data (Health West Partnership, 2012). **Table 4-2 and 4-3** summarize the health indicators and socio-economic factors for the Brimbank LGA and Victorian state measures. The health indicators shown in Table 4-2 have been linked with adverse health outcomes arising from exposure to air pollution and noise.

Table 4-2: Health Indicators – Brimbank and Victoria

Health Indicators	Brimbank	Victoria
Heart Disease	8.2%	
Anxiety and Depression	27.8%	
Asthma	11.9%	10.7%
Deaths Ischaemic Heart Disease (IHD)	31/100,000	27.8/100,000
Deaths Cardiovascular Disease	44.5/100,000	39.8/100,000

The proportion of children assessed as being developmentally on track in the areas of language and cognitive skills is notably lower in Brimbank (79.3%) than in Greater Melbourne (85.3%) (Brimbank Atlas of Health and Education, 2019). Compared with other LGAs in Greater Melbourne, Brimbank had the third lowest proportion of children who were assessed as being on track in these areas of cognitive development. Aircraft noise has been shown in epidemiological studies to impact on children's cognitive development particularly in reading and oral comprehension. This means that the Brimbank population forms a sensitive population in regard to the impacts of aircraft noise from the Airport Expansion.

4.3.2.3 Socioeconomic Profile

People who are of low socioeconomic status (SES) have been identified as a vulnerable group for the effects of air and noise pollution. This is due to the fact that people within these groups usually have poorer health status than people within higher SES groups. They may also have poorer access to medical care. In addition, they usually live in areas that are more polluted (e.g., near major roads or near industry) as property is generally cheaper in these areas.

There are several indices of social deprivation used to assess SES status in Australia. One commonly use is the Socio-Economic Indexes for Areas (SEIFA) index. The SEIFA index is a measure of relative social advantage and disadvantage and considers 20 variables to assess relative social disadvantage. The lower the SEIFA index the greater the level of disadvantage. The index is relative to a score of 1000 which is considered as the Australian average.

The SEIFA Index of Relative Socio-Economic Advantage/Disadvantage is derived from attributes such as low income, low educational attainment, high unemployment, jobs in relatively unskilled occupations and variables that broadly reflect disadvantage rather than measuring specific aspects of disadvantage. At the advantage end of the scale, households with high incomes, high education levels, large dwellings, high numbers of motor vehicles, spare bedrooms and professional occupations contribute to a higher score.

The key indicator in Table 4-3 is the SEIFA index which is the relative indicator of socioeconomic advantage/disadvantage. The SEIFA index for Brimbank is lower than the Victorian average indicating that the population in this area may form a vulnerable group to the effects of air pollution and noise from the Airport expansion.

Table 4-3 summarises the socioeconomic status (SES) of the Brimbank LGA population.

Table 4-3: Socio-Economic Factors – Brimbank and Victoria

Socio-Economic Factors	Brimbank	VIC
Unemployment (%) – PHIDU – June 2020	9.4%	5.4%
SEIFA Index of Relative Socio-economic Disadvantage (Index score based on Australian score of 1000) – PHIDU – June 2016	921	1010
Proportion of low-income households – PHIDU – June 2016	48.9%	40.9%
People who left school at year 10 or below, or did not go to school (Age standardized rate per 100) - PHIDU - 2016	31.2	26.0
Estimated number of people aged 18 years and over who, in the past 12 months, felt that they had experienced discrimination or have been treated unfairly by others (ASR per 100) - PHIDU - 2014	18.7	17.4

Source: PHIDU.

4.4 Health Risk Assessment

4.4.1 Issues Identification

The current State of Knowledge on the adverse health effects of aircraft noise indicates that there are impacts of the current and proposed operations of the airport on the exposed community in Brimbank. The impact of the current operations on the local community as identified during the stakeholder engagement process includes sleep disturbance and anxiety and depression. These are occurring at current flight numbers which are going to increase with the proposed Airport expansion and third runway. Residents stated that they are unable to enjoy the outdoor areas of their homes and the open space in Brimbank, such as Brimbank Park, due to aircraft noise. This is predicted to be worse with the proposed Airport expansion and impact across a larger proportion of the Brimbank LGA. The HRA presented in the following sections, where possible, quantifies the potential impact on the Brimbank community from the aircraft noise predicted for the Airport expansion.

4.4.2 Hazard Assessment

In recent years, evidence has accumulated regarding the health effects of environmental noise. The main health effects associated with environmental noise are:

- Annoyance;
- Sleep disturbance;
- Increase in ischaemic heart disease;
- Cognitive impairment; and
- Psychological effects including anxiety and depression.

An increasing body of literature has shown traffic noise, including aircraft noise, to have adverse short- and long-term health effects (Babisch 2006; Berglund et al. 1999; Bluhm et al. 2007; Stansfeld et al. 2000, 2005). One of the suggested mechanisms by which noise affects non-auditory health is through indirect or direct activation of the sympathetic nervous system and endocrine systems (Ising and Kruppa 2004; Stansfeld and Matheson 2003), resulting in autonomic reactions, including increased blood pressure, heart rate, and arrhythmia (Berglund et al. 1999). Therefore, research has focused on the impact of transportation noise on cardiovascular health.

4.4.2.1 Annoyance

Annoyance is the most prevalent community response in a population exposed to environmental noise. It is not in itself considered to be a health effect (WHO, 2018, 2009; enHealth, 2018, 2004). The term annoyance is used to describe negative reactions to noise such as disturbance, irritation, dissatisfaction and nuisance (Guski, 1999). Annoyance can also be accompanied by stress-related symptoms, leading to changes in heart rate and blood pressure. Acoustic factors, such as the noise source and sound level, account for only a small to moderate amount of annoyance responses: other factors such as the fear associated with the noise source, interference with activities, ability to cope, noise sensitivity, expectations, anger, attitudes to the source – both positive or negative, and beliefs about whether noise could be reduced by those responsible, all influence annoyance responses (WHO, 2000).

The noise metrics associated with adverse health effects are Lden and Lnight. Lden is a weighted measure of day, evening and night noise levels while Lnight is the noise level experienced between 11pm and 6am. Both are annual averages. Exposure to aircraft noise at 60 dB Lden is estimated to be associated with 38% of the population reporting being “annoyed” and 17% being “highly annoyed” (EC, 2002). Exposure to aircraft noise at 65 dB Lden is estimated to be associated with 48% of the population reporting being “annoyed” and 26% being “highly annoyed” (EC, 2002). However,

several studies have suggested that aircraft noise annoyance around major airports in Europe has increased (Babisch et al., 2009; Janssen et al., 2011; Schreckenberg et al., 2010) indicating that the percentage of the population reporting being “annoyed” or “highly annoyed” at each noise exposure level may have increased since these figures were put forward by the European Commission in 2002 (EC, 2002).

Annoyance responses can also increase in relation to a change in airport operations. A study around Zurich airport found that residents who experienced a significant increase in aircraft noise exposure due to an increase in early morning and late evening flight operations had a pronounced over-reaction of annoyance i.e. the annoyance reaction was greater than that which would be predicted by the level of noise exposure (Brink et al., 2008).

Children also report annoyance responses, although it is not known at what age children begin to exhibit annoyance responses. The RANCH study found that children aged 9-11 years of age living near London Heathrow, Amsterdam Schiphol, and Madrid Barajas airports, reported annoyance for aircraft noise exposure at school and at home (van Kempen et al., 2009). For school exposure the percentage of “highly annoyed” children increased from about 5.1% at 50 dB LAeq 16 hour, to 12.1% at 60 dB LAeq 16 hour.

4.4.2.2 Sleep Disturbance

Possible effects of noise on sleep are generally grouped into three categories:

- The immediate effects of noise on sleep (sleep disturbance and physiological effects)
- The secondary effects of sleep disturbances (morning after effects)
- Long term health effects.

Sleep disturbance is defined as any deviation, measurable or subjectively perceived, from an individual’s habitual or desired sleep behaviour. This may include awakenings, sleep quality, medication use to control sleep, total sleep time, time spent in slow wave sleep, arousals and time spent in rapid eye movement sleep (WHO, 2009).

The WHO estimated sleep disturbance to be the most adverse non-auditory effect of environmental noise exposure (Basner et al., 2014; WHO, 2011). Undisturbed sleep of a sufficient number of hours is needed for alertness and performance during the day, for quality of life, and for health (Basner et al., 2014). Humans exposed to sound whilst asleep still have physiological reactions to the noise which do not adapt over time including changes in breathing, body movements, heart rate, as well as awakenings (Basner et al., 2014). The elderly, shift-workers, children and those with poor health are thought to be at risk for sleep disturbance by noise (Muzet, 2007).

The effect of night-time aircraft noise exposure has been explored for a range of sleep outcomes ranging from subjective self-reported sleep disturbance and perceived sleep quality, to more objective measures of interference with ability to fall asleep, shortened sleep duration, awakenings, and increased bodily movements as assessed by polysomnography (Michaud et al., 2007). Most evidence comes from studies of self-reported sleep disturbance. However, self-reported sleep disturbance outcomes are vulnerable to bias, as such measures are likely to be influenced by noise annoyance and other demographic factors (Clark and Stansfeld, 2011).

Reviews have concluded that there is evidence for an effect of night-time aircraft noise exposure on sleep disturbance from community based studies (Hume et al., 2012; Miedema & Vos, 2007). However, some reviews have concluded that the evidence is contradictory and inconclusive (Jones, 2009; Michaud et al., 2007), which might be explained by methodological differences between studies of noise effects on sleep disturbance. A meta-analysis of 24 studies, including nearly 23,000 individuals exposed to night-time noise levels ranging from 45-65 dBA, found that aircraft noise was associated with greater self-reported sleep disturbance than road traffic noise (Miedema and Vos,

2007). However, another study, whilst confirming that aircraft noise was associated with greater self-reported sleep disturbance than road traffic noise, found that when ²polysomnography measures of sleep disturbance were analysed, that road traffic noise was associated with greater disturbance than aircraft noise (Basner et al., 2011).

There is evidence that aircraft noise influences the time spent in different sleep stages, with aircraft noise reducing slow-wave sleep (NREM Stage 4) and REM sleep and increasing NREM Stages 1, 2 & 3 (Basner et al., 2008; Swift, 2010). This evidence, taken with the increase in REM sleep in the later stages of the night might have implications for early morning (04.00-06.30 hours) flight operations at airports.

A laboratory study compared the potential effects of changes in the night-time curfew at Frankfurt airport on sleep disruption (Basner and Siebert, 2010), using polysomnography on 128 subjects over 13 nights. Three different operational scenarios were compared: scenario 1 was based on 2005 air traffic at Frankfurt airport which included night flights; scenario 2 was as scenario 1 but cancelled flights between 23.00-05.00 hours; scenario 3 was as scenario 1 but with flights between 23.00-05.00 hours rescheduled to the day-time and evening periods. The study found that compared to the night without a curfew on night flights (scenario 1), small improvements were observed in sleep structure for the nights with curfew, even when the flights were rescheduled to periods before and after the curfew period. However, the change in the amount of time spent in the different sleep stages for the different scenarios was small, which might be explained by the small number of night-flights (on average 4 take-offs per hour) in the Frankfurt airport scenarios examined - larger effects may be observed for airports with a greater number of night-flights. The authors concluded that the benefits for sleep seen in the scenario involving rescheduling of flights rather than cancellation may be offset by the expected increase in air traffic during the late evening and early morning hours for those who go to bed before 22.30 or after 01.00 hours.

The WHO Europe Night Noise Guidelines (WHO, 2009) were based on expert-consensus that there was sufficient evidence that nocturnal environmental noise exposure was related to self-reported sleep disturbance and medication use, and that there was some evidence for effects of nocturnal noise exposure on high blood pressure (hypertension) and heart attacks. The WHO Noise Guidelines (2018) state that the target for night noise exposure from aircraft should be 40 dB Lnight, outside. The WHO note that meeting this guideline may not protect vulnerable groups such as the elderly, children, and the chronically ill from the effects of aircraft noise at night on health.

There have been fewer studies on aircraft noise exposure and sleep in children (Stansfeld and Clark, 2015), even though children are a group thought to be vulnerable to the effects of sleep disturbance (Pirrer et al., 2010). Children sleep outside the typical hours used to denote night-time noise exposure around airports (e.g. Lnight is typically 23.00 hours to 07.00 hours), so exposures during the hours of the evening and morning, which would fall within day-time exposure metrics may also be relevant when considering sleep disturbance effects for children.

4.4.2.3 Cardiovascular Disease

In recent years, evidence that aircraft noise exposure leads to increased risk for poorer cardiovascular health has increased considerably. A recent review, suggested that risk for cardiovascular outcomes such as high blood pressure (hypertension), heart attack, and stroke, increases by 7 to 17% for a 10 dB increase in aircraft or road traffic noise exposure (Basner et al., 2014). A review of the evidence for children concluded that there were associations between aircraft

² Polysomnography records biophysiological changes that occur during sleep, including brain waves using electroencephalography (EEG), eye movements using electroculography (EOG), muscle activity using electromyography (EMG), and heart rhythm using electrocardiography (ECG).

noise and high blood pressure (Paunović et al., 2011), which may have implications for adult health (Stansfeld and Clark, 2015).

The HYENA study (Hypertension and Exposure to Noise near Airports) examined noise effects on the blood pressure (hypertension) of 4,861 people, aged 45-70 years, who had lived for over five years near seven major European airports including London Heathrow; Amsterdam Schiphol; Stockholm Arlanda and Bromma; Berlin Tegel, Milan Malpensa; and Athens Eleftherios Venizelos (Jarup et al., 2008). High blood pressure was assessed via measurements and medication use. The HYENA study found that a 10 dB increase in aircraft noise at night (L_{night}) was associated with a 14% increase in risk for high blood pressure but day-time aircraft noise (L_{Aeq} 16 hour) did not increase the risk for high blood pressure (Jarup et al., 2008). The HYENA study did not find an association between day-time aircraft noise and high blood pressure which might be because many residents work away from home during the day-time, leading to potential mis-classification of their day-time aircraft noise exposure. The HYENA study also found that a 10 dB increase in night-time aircraft noise was associated with a 34% increase in the use of medication for high blood pressure in the UK (Floud et al., 2011). The HYENA study is a high quality large-scale study of aircraft noise exposure effects on blood pressure, which includes a population sample around London Heathrow airport.

A further study conducted as part of the HYENA project demonstrated an association between noise and cardiovascular disease risk factors (Floud et al., 2013). The results are consistent with the hypothesis that noise exposure provokes a stress response causing a release of stress hormones, which in turn affect factors such as blood pressure and heart rate and thus cardiovascular disease risk. Night-time aircraft noise was statistically significantly associated with self-reported heart disease and stroke but was reduced and became non-significant after adjustment for confounders. However, there was a significant association for those who had lived for 20 years or more at their current address and aircraft noise. A statistically significant association (25 % increase in risk) was found between exposure to night-time aircraft noise and heart disease and stroke in people who had lived in the same home for 20 years or more, and this association was robust to adjustment for exposure to NO_2 air pollution.

A study around London Heathrow airport examined risks for hospital admission and mortality for stroke, coronary heart disease and cardiovascular disease for around 3.6 million people living near the airport (Hansell et al., 2013). Both day-time (L_{Aeq} 16 hour) and night-time (L_{night}) aircraft noise exposure were related to increased risk for a cardiovascular hospital admission. Compared to those exposed to aircraft noise levels below 51 dB in the day-time L_{Aeq} 16 hour, those exposed to aircraft noise levels over 63 dB L_{Aeq} 16hour in the day-time had a 24% higher chance of a hospital admission for stroke; a 21% higher chance of a hospital admission for coronary heart disease; and a 14% higher chance of a hospital admission for cardiovascular disease. These estimates took into account age, sex, ethnicity, deprivation and lung cancer mortality as a proxy for smoking. These results were also not accounted for by air pollution, which was adjusted for in the analyses. Similar effects were also found between aircraft noise exposure and mortality for stroke, coronary heart disease, and cardiovascular disease. The study concluded that high levels of aircraft noise were associated with increased risks of stroke, coronary heart disease, and cardiovascular disease for both hospital admissions and mortality in areas near Heathrow airport.

Further longitudinal evidence for an association between aircraft noise exposure and mortality from heart attacks comes from a large-scale Swiss study of 4.6 million residents over 30 years of age (Huss et al., 2010). This study found that mortality from heart attacks increased with increasing level and duration of aircraft noise exposure (over 15 years), but there were no associations between aircraft noise exposure and other cardiovascular outcomes including stroke or circulatory disease. The lack of association between aircraft noise and stroke differs from the findings of the similar study conducted by Hansell et al., (2013) around Heathrow airport, which did find an association of aircraft noise on stroke mortality.

A multi-airport retrospective study of approximately 6 million older people residing near airports in the United States (Correia et al., 2013) found that averaged across all airports and using the 90th centile noise exposure metric, a zip code with 10 dB higher noise exposure had a 3.5% higher (95% confidence interval 0.2% to 7.0%) cardiovascular hospital admission rate, after controlling for covariates. Despite limitations related to potential misclassification of exposure, a statistically significant association between exposure to aircraft noise and risk of hospitalization for cardiovascular diseases among older people living near airports was observed. The most recent meta-analysis of the field (Babisch, 2014) concluded that aircraft noise exposure was associated with increased risk for cardiovascular outcomes such as high blood pressure, heart attack and stroke.

It is biologically plausible that long-term exposure to environmental noise might influence cardiovascular health (Babisch, 2014). The proposed pathways between environmental noise exposure and cardiovascular diseases (Babisch, 2014) include increased stress associated with noise exposure that might cause physiological stress reactions in an individual, which in turn can lead to increases in established cardiovascular disease risk factors such as blood pressure, blood glucose concentrations, and blood lipids (blood fats). These risk factors lead to increased risk of high blood pressure (hypertension) and arteriosclerosis (e.g. narrowing of arteries due to fat deposits) and are related to serious events such as heart attacks and strokes (Babisch, 2014; Basner et al., 2014). The stress that triggers this pathway can operate directly via sleep disturbance or indirectly via interference with activities and annoyance.

To date, few studies have examined whether aircraft noise exposure influences metabolic risk factors for cardiovascular health, such as Type II diabetes, body mass index, and waist circumference. Such factors would lie on the proposed pathway between aircraft noise exposure and cardiovascular diseases. A study of long-term exposure to aircraft noise in Sweden found that exposure was associated with a larger waist circumference but less clearly with Type II diabetes and body mass index (Eriksson et al., 2014). Further studies are required to investigate these associations.

4.4.2.4 Children's Learning and Cognitive Development

Children may be particularly vulnerable to the effects of noise because they may have less cognitive capacity to understand environmental issues and anticipate stressors and they may lack appropriate coping strategies to deal with noise. Additionally, noise may interfere with learning at a critical developmental stage.

The impact of environmental noise on children's learning and memory has been known for many years. Epidemiological studies show effects of chronic noise exposure on tasks involving central processing and language, such as reading, comprehension, memory and attention. Experimental studies investigating acute (short-term) exposures have found similar effects. Exposure during critical periods of learning at school could potentially impair development and have a lifelong effect on educational attainment.

There are several ways in which aircraft noise could influence children's cognition (Stansfeld and Clark, 2015):

- lost teaching time - as a teacher may have to stop teaching whilst noise events occur;
- teacher and pupil frustration;
- annoyance and stress responses;
- reduced morale;
- impaired attention;
- children might tune out the aircraft noise and over-generalise this response to other sounds in their environment missing out on information; and

- sleep disturbance from home exposure which might cause performance effects the next day.

Many studies have found effects of aircraft noise exposure at school or at home on children's reading comprehension or memory skills (Evans and Hygge, 2007). The RANCH study (Road traffic and Aircraft Noise and Children's Cognition and Health) of 2844 9-10 year old children from 89 schools around London Heathrow, Amsterdam Schiphol, and Madrid Barajas airports found that aircraft noise was associated with poorer reading comprehension and poorer recognition memory, after taking socioeconomic factors and road traffic noise into account (Stansfeld et al., 2005).

The exposure-response relationship between aircraft noise at school and reading comprehension from the RANCH study (Clark et al., 2006), showed that as aircraft noise exposure increased, performance on the reading test decreased. Reading began to fall below average at around 55 dB LAeq 16 hour at school. The development of cognitive skills such as reading and memory is important not only in terms of educational achievement but also for subsequent life chances and adult health (Kuh and Ben-Shlomo, 2004). In the UK, reading age was delayed by up to 2 months for a 5 dB increase in aircraft noise exposure (Clark et al., 2006). The UK primary schools in the RANCH study ranged in aircraft noise exposure from 34 dB LAeq 16 hour to 68 dB LAeq 16 hour. The study found that a 20 dB difference in aircraft noise exposure between schools would result in an 8-month difference in reading age.

In the RANCH study, for primary school children, aircraft noise exposure at school and at home were very highly correlated: in the RANCH UK sample, this correlation was $r=0.91$ (Clark et al., 2006). Such a high correlation makes estimating the impact of aircraft noise exposure in both environments difficult. The RANCH study found that night-time aircraft noise at the child's home was also associated with impaired reading comprehension and recognition memory, but night-noise was not having an additional effect to that of day-time noise exposure on reading comprehension or recognition memory (Clark et al., 2006; Stansfeld et al., 2010). These findings suggest that indices of aircraft noise exposure in the day-time in the school environment should be sufficient to capture effects. Further analyses of the UK RANCH sample found that these associations for aircraft noise exposure remained after controlling for air pollution effects (Clark et al., 2012).

A further study investigating the effects of aircraft noise around Heathrow Airport in the home environments on children's cognition found a significant dose-response relationship between aircraft noise at home and performance on memory tests of immediate and/or delayed recall (Matsui et al., 2004). The study found no associations with other cognitive outcomes.

Two studies of interventions to reduce or remove aircraft noise exposure at school have been conducted. The longitudinal Munich Airport study (Hygge et al., 2002) found that prior to the relocation of the airport in Munich, high noise exposure was associated with poorer long-term memory and reading comprehension in children aged 10 years. Two years after the airport closed these cognitive impairments were no longer present, suggesting that the effects of aircraft noise on cognitive performance may be reversible if the noise stops. In the cohort of children living near the newly opened Munich airport impairments in memory and reading developed over the following two years.

A study of 6,000 schools exposed between the years 2000-2009 at the top 46 United States airports, (exposed to Day-Night-Average Sound Level of 55 dB or higher) found significant associations between aircraft noise and standardised tests of mathematics and reading, after taking demographic and school factors into account (Sharp et al., 2014). In a sub-sample of 119 schools, they found that the effect of aircraft noise on children's learning disappeared once the school had sound insulation installed.

Schools located near airports often also experience high levels of road traffic noise but it is important to note that aircraft noise exposure still influences children's learning, even if road traffic

noise exposure is high. The results presented for the RANCH study are the association for aircraft noise exposure, after taking road traffic noise into account (Clark et al., 2006).

A study conducted by Haines et al. (2002) studied a sample of approximately 11,000 11 year old children from 123 schools surrounding Heathrow Airport. The results of the study showed that chronic exposure to aircraft noise was significantly related to poorer reading and mathematics performance. However, after control for socioeconomic factors these associations were no longer statistically significant.

Children spend a considerable amount of time at school in the playground. Play is thought to be important for children's social, cognitive, emotional and physical development, as well as enabling relaxation between more formal teaching activities. The WHO (1999) established a community noise guideline of 55 dB for school playgrounds, during play, to protect against these effects.

It has been suggested that long-term noise exposure might influence psychological health in children. However, overall, the evidence for aircraft noise exposure being linked to poorer well-being, lower quality of life, and psychological ill-health is not as strong or consistent as for other health outcomes, such as cardiovascular disease. A recent study of 2300 residents near Frankfurt Airport found that annoyance but not aircraft noise levels per se (LAeq16 hour, Lnight, Lden) was associated with self-reported lower quality of life (Schreckenberger et al., 2010).

Several studies of children around London Heathrow Airport have shown no effect of aircraft noise at school on children's psychological health or cortisol levels (Haines et al., 2001a; Haines et al., 2001b; Stansfeld et al., 2009) - cortisol levels are known to be raised in children with depression. However, there may be a small effect of aircraft noise on hyperactivity symptoms. The West London Schools Study of 451 children around Heathrow airport, aged 8-11 years found higher rates of hyperactivity symptoms for children attending schools exposed to aircraft noise levels >63 dB LAeq 16 hour compared with <57 dB LAeq 16 hour (Haines et al., 2001a). A similar effect was observed in the RANCH study where a 10 dB LAeq 16 hour increase in aircraft noise exposure at school was associated with 0.13% increase in hyperactivity symptoms (Stansfeld et al., 2009). However, these increases in hyperactivity symptoms, whilst statistically significant, are extremely small and most likely not of clinical relevance. Aircraft noise exposure does not appear to be causing children to develop hyperactivity problems.

4.4.2.5 Psychological Effects

The health effects linked to aircraft noise exposures have been well studied and reviewed by international researchers and institutions (Baudin et al., 2018; Clark et al., 2011, 2020; Hegewald et al., 2020; Lee et al., 2021; Li et al., 2020; Wright et al., 2018). Most information comes from population-based epidemiological studies that find increases in cognitive disorders, depression, and sleep deprivation, with a particular negative impact on recognition memory and conceptual recall memory in school-aged children.

Several studies conducted in Europe have examined the adverse effects of aircraft noise on annoyance due to aircraft noise and noise sensitivity (Baudin et al., 2018), and self-assessed mental ill health with even minor increases in decibels (Wright et al., 2018). A slight increase in decibels in the UK study indicated that a minor difference, from <54dB up to ≥57 dB, was impactful in mental ill health by approximately 3% (low noise 9.7% vs high noise 12.4%, respectively). Furthermore, associated to mental health, multiple studies attributed increases in population anxiety and depression to aircraft noise pollution, with a 12% increase in depression (and anxiety) per 10 dB in Lden from aircraft noise exposure (Hegewald et al., 2020) being reported.

These health effects from aircraft noise pollution have a significant impact on children, more so related to night-waking, and the cognitive developmental and sleep-related issues in children. Aircraft noise is more intermittent than road traffic, and studies found more intermittent disruptions

during sleep, even if at lower decibels, are more impactful on sleep in children. Chronic exposure to aircraft noise for children are associated with high levels of annoyance, perceived stress, poor reading comprehension, poor information and comprehension recall, and less sustained attention. Furthermore, an extended 18-month exposure to aircraft noise found a significant decline in the psychological health of children. Children with high levels of noise sensitivity are more likely to suffer from sleep anxiety and parasomnias when impacted by aircraft noise (Clark et al., 2012; Lee et al., 2021).

The HYENA study found that a 10 dB increase in day-time (LAeq 16 hour) noise exposure was associated with a 28% increase in anxiety medication use in adults. Similarly, a 10 dB increase in night-time (Lnight) aircraft noise was associated with a 27% increase in anxiety medication use. However, day-time and night-time aircraft noise exposure were not associated with sleep medication or anti-depressant medication use (Floud et al., 2011). Anxiety medication is prescribed for individuals experiencing levels of anxiety and worry that interfere with their ability to function effectively: they can also be prescribed for sleeping problems. A sub-study of the HYENA study found that salivary cortisol (a stress hormone which is higher in people with depression) was 34% higher for women exposed to aircraft noise > 60 dB LAeq 24 hour, compared to women exposed to less than 50 dB LAeq 24 hour (Selander et al., 2009). However, no association between aircraft noise and salivary cortisol was found for men.

A study by Beutel et al (2016) found that strong noise annoyance due to environmental noise was associated with a two-fold higher prevalence of anxiety and depression in a study of 15,100 adults in Germany living near Frankfurt Airport. When other compared to other sources of noise, such as road traffic noise, aircraft noise affected approximately 60% of the study population and was much more prominent in the study responses for annoyance as well as depression and anxiety. A further study in France found similar results (Baudin et al, 2018). Aircraft noise was associated with in annoyance in a study of 1244 adults. The increase in annoyance was associated with increases in psychological health such as anxiety and depression. Older members of the population may be more vulnerable to the impacts of aircraft noise on depression and anxiety as they have lower residential mobility, spend more time at home and may have higher sensitivity to environmental influences on sleep disturbance and annoyance (Li et al, 2020).

The link between green space in cities and their benefit for mental health is well documented. A study by Engemann et al (2019) covering >900,000 people found that that children who grew up with the lowest levels of green space had up to 55% higher risk of developing a psychiatric disorder independent from effects of other known risk factors. The association remained even after adjusting for urbanization, socioeconomic factors, parental history of mental illness, and parental age. Stronger association of cumulative green space presence during childhood compared with single-year green space presence suggests that presence throughout childhood is important.

The benefits of green space for health and wellbeing have long been recognised (Maas et al. 2006, Mitchell and Popham 2008, Groenewegen et al. 2006). The positive link between green space and health and wellbeing is most apparent among the elderly, people who spend most of their time at home, and those from lower socioeconomic groups (De Vries et al. 2003). However, people of all ages and socioeconomic status can benefit from exposure to green space and views of nature (Groenewegen et al. 2006). Residents of neighbourhoods with abundant green space tend to enjoy better general health (Maas et al. 2006). Neighbourhoods with comparatively more walkable green space have been correlated with a lower mortality risk (Takano et al. 2002). The percentage of green space in people's living environments, and its proximity to people's homes, are positively associated with self-perceived health (Maas et al. 2006). Contact with green space has been found to be 'restorative', both psychologically and physiologically, reducing blood pressure and stress levels (Hartig et al. 2003, Pretty et al. 2005) and potentially promoting faster healing from surgery (Ulrich 1984). Increased green space can also promote physical activity (Kaczynski and Henderson 2007).

Undertaking physical activity in the natural environment may have greater psychological and physiological benefit than physical activity in other settings (Pretty et al. 2005). The findings of these studies show the importance of green spaces such as Brimbank Park on community health and well-being.

4.4.3 Exposure Assessment

The predicted noise levels presented in the Master Plan are the ANEF contours. The metrics used in the Health Risk Assessment done as part of the Master Plan are the metrics specified by AS2021-2015 which are based on amenity impacts not health impacts. These do not take into account the most recent information on the health effects of noise that has been considered by enHealth and WHO in the update of their noise guidelines in 2018. The Master Plan refers to enHealth 2004 and the guidelines incorporated in that document but not to the updated values recommended by enHealth in 2018. The values used in the HRA conducted as part of the Master Plan are not consistent with the metrics recommended by the WHO (2018) to assess the potential health effects of noise. The WHO guidelines have been developed to protect against long-term exposure to aircraft noise and are expressed as an annual average.

To generate the relevant health metrics T+T engaged Marshall Day Associates to convert the ANEF values to Lden and Lnight values. Lden is a weighted measure of day, evening and night noise levels while Lnight is the noise level experienced between 11pm and 7am. Both are annual averages. The Marshall Day report is in Attachment 1.

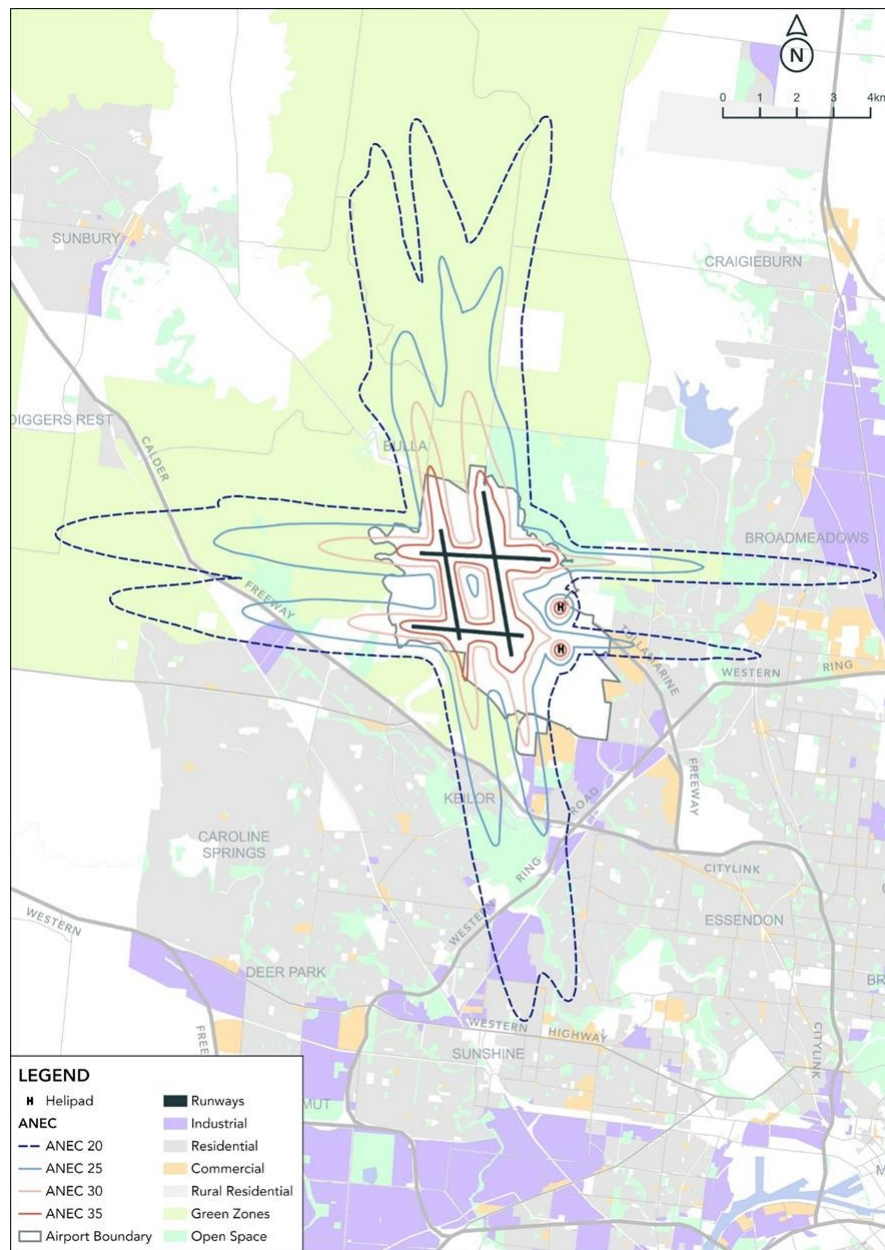
Marshall Day used data from various airports in Australia and New Zealand for which they had noise modelling data to derive the association between the ANEF contours and the Lden and Lnight metrics. The results of their analysis is shown in Table 4-4:

Table 4-4: Correlation between ANEF values and Lden and Lnight metrics

ANEF	Lden (dB)	Lnight (dB)
ANEF 20	61	53
ANEF 25	66	58
ANEF 30	71	67
ANEF 35	76	68

The draft ANEF contours for the 2022 Master Plan provided to Brimbank City Council by Melbourne Airport is shown in Figure 4-1.

Figure 4-1: Draft ANEF Contours 2022 Melbourne Airport Master Plan



As can be seen from Figure 4-1, the ANEF 20 contour extends as far south as Sunshine North and covers parts of the suburbs of Keilor, Keilor Park, and Kealba. Parts of Keilor and Keilor Park are also included in the ANEF 25 contour. According to the correlations shown in Table 4-4, the annual average noise levels in these areas as L_{den} and L_{night} range between 61 to 66 dB and 53 to 58 dB respectively. These predicted values due to the airport expansion are 16 to 21 dB and 13 to 18 dB above the WHO L_{den} and L_{night} guidelines respectively. The greater area covered by the ANEF 20 and ANEF 25 contours is due to the increased numbers of flights predicted with the airport expansion.

According to the Commonwealth Department of Infrastructure (DOI, 2016) at the 20 ANEF level, it is estimated that approximately 11 per cent of people will be seriously affected by aircraft noise and approximately 45 per cent of people moderately affected by aircraft noise. At the 15 ANEF level, approximately 8 per cent of people will be seriously affected by aircraft noise and approximately 34

per cent of people moderately affected. The DOI report also states that while the populations with the highest aircraft noise exposure often live within the 20 ANEF contour, experience shows the majority of noise complaints that are received come from residents living outside the 20 ANEF contour. Traditionally the residents of these areas have been given little information on aircraft noise through the ANEF system other than that the area is considered 'acceptable' for housing. Some people living outside the 20 ANEF contour have been given an expectation of receiving little or indeed no aircraft noise and as a consequence find the levels of noise actually experienced to be unacceptable. It also notes that there is a range of research pointing to the negative health impacts of sleep disturbance and the ANEF gives only limited recognition to the impact of night-time aircraft noise. The National Acoustics Laboratory (1982) study of aircraft noise which is the basis of the ANEF metric suggested that an ANEF value of 20 could be regarded as an 'excessive' amount of aircraft noise.

The population and predicted population growth in these suburbs between 2016 and 2046 are shown in Table 4-5:

Table 4-5: Population data and Predicted Population Growth 2016 – 2046 in Suburbs within the ANEF 20 and ANEF 25 contours Brimbank LGA.

Suburb	2016	2021	2026	2031	2036	2041	Total Change in Population	Annual Average % Increase in Population
Kealba	3,364	3,328	3,338	3,379	3,436	3,496	+132	+0.15
Keilor	6,157	6,366	6,653	6,827	7,009	7,189	+1,032	+0.62
Keilor Park and District	2,886	2,916	2,984	3,052	3,120	3,191	+305	+0.40
Sunshine North	12,123	13,242	15,439	17,533	19,437	21,266	+9,143	+2.27
TOTAL	24,530	25,852	28,414	30,791	33,002	35,142	11,629	+3.8

The data in Table 4-4 show that in 2016 there were 24,530 people living in the suburbs of Kealba, Keilor, Keilor Park and District and Sunshine North which is predicted to increase to 35,142 people by 2041. The ANEF 20 and 25 contours do not cover the entirety of these suburbs. Using the ANEF contours produced by Melbourne Airport Corporation the ANEF 20 contour covers approximately 20% Kealba, 65% Keilor, 60% Keilor Park, 40% Sunshine North. These percentages have been used to estimate the population within these suburbs within the ANEF 20 contour with the proposed expansion. In 2016 there was 11,256 people estimated to be living within the ANEF 20 contour predicted to grow to 15,745 in 2041.

According to the 2016 Census Data, shown in Table 4-1, between 12.5 and 26% of the population in these suburbs were 65 years of age or older and between 17 and 18% were children aged 1-14 years. Both these age groups are more sensitive to the effects of environmental noise including aircraft noise. Based on this data and the population data shown in Table 4-4, in 2016 there would up to 10,792 people in the affected suburbs in Brimbank that would fall into groups that are known to be sensitive to the effects of aircraft noise. This is predicted to increase to 15,463 people in 2041.

In these suburbs there are 8 schools and childcare/early learning centres as well as 4 aged care facilities/retirement villages.

It is generally acknowledged that the significance of the noise level change values are as follows:

- Differences in noise levels of less than approximately 2 dB are generally imperceptible in practice, an increase of 2 dB is hardly perceivable;
- Differences in noise levels of around 5 dB are considered to be clearly perceptible; and
- Increases in noise levels of around 10 dB are generally perceived to be a doubling of the perceived loudness of the noise. An increase of 10 dB is perceived as twice as loud. Therefore, an increase of 20 dB is four times as loud and an increase of 30 dB is eight times as loud etc.

4.4.4 Risk Characterisation

The purpose of the risk characterization is to estimate potential risks associated with exposure to noise from the proposed airport operations. For the assessment of health effects where there is a known threshold for effect, the predicted noise level for each averaging period is compared to the health based guideline values as set by WHO (2018). The ratio of the predicted noise level to the guideline is termed the hazard quotient (HQ):

$$HQ = \text{predicted noise level} / \text{health based guideline}$$

The hazard quotients are estimated for each of the averaging periods relevant to the guidelines for a given health outcome. The hazard quotient approach has been used to assess the potential impact on sleep disturbance and children's learning and cognitive development. It has also been used to assess the increase in risk for people highly annoyed by aircraft noise. The WHO guideline for Lden has been based on the number of people who are highly annoyed which occurs at lower noise levels than other health impacts such as increases in cardiovascular outcomes. Therefore, meeting the WHO guideline for annoyance means that other health outcomes will be protected.

It is accepted by health authorities, including enHealth and WHO, that a hazard quotient of 1 or below is an acceptable risk level. Hazard quotients greater than 1 indicate an increase in risk of adverse health effects and that risk management measures should be considered to minimize risk to acceptable levels.

4.4.4.1 Annoyance

The WHO (2018) reviewed the epidemiological literature relating to the impacts of aircraft noise and percentage of people in a population highly annoyed by noise. The association determined by WHO is shown in Table 4-6. Using the correlations determined by Marshall Day, the ANEF 20 contour corresponds to a Lden value of 61 dB which indicates that 36% of the population within the ANEF 20 contour would be highly annoyed by noise. Forty five percent of the population living within the ANEF 25 contour would be highly annoyed by noise.

WHO derived a guideline value of 45 dB to be protect the population from being highly annoyed by aircraft noise and other adverse health effects such as increases in cardiovascular disease. The WHO acknowledge that at this level there would still be 10% of the population highly annoyed by noise.

The ANEF 25 contour extends across the suburbs of Keilor, Keilor Park, Keilor Village and parts of Kealba. This means that 45% of the population within this contour would be highly annoyed by the aircraft noise. The hazard quotient is 1.5 which is a 50% increase in the population impacted compared with areas that would meet the WHO guideline. As the WHO Lden guideline is derived to protect against increases in annoyance, cognitive development and cardiovascular effects, this would indicate that there would be increases in cardiovascular disease within that population in

addition to annoyance and potentially impacts on cognitive development. As discussed in Section 4.4.2.5, increases in the number of people highly annoyed by aircraft noise has been associated with increases in depression and anxiety in adult populations. Based on the WHO data shown in Table 4-6, in the ANEF contour 45% of the population would be highly annoyed by aircraft noise arising from the proposed Airport expansion which indicates that a significant percentage of the adult population are potentially at risk for increases in depression and anxiety.

The ANEF 20 contour extends as far south as North Sunshine. Based on the Marshall Day analysis, the hazard quotient for the population living within this contour is 1.4 – a 40% increase in people highly annoyed compared with areas that would be compliant with the WHO guideline. As shown in Table 4-4 the total population in the ANEF 20 and 25 contours is predicted to be 15,745 by 2041. Based on the WHO data shown in Table 4-6, this would indicate that approximately 6,300 people would be highly annoyed by aircraft noise in 2041.

Table 4-6: Percentage of Population Highly Annoyed by Aircraft Noise (Source: WHO, 2018)

Lden (dB)	% Highly Annoyed
40	1.2
45	9.4
50	17.9
55	26.7
60	36.0
65	45.5
70	55.5

4.4.4.2 Highly sleep disturbed (HSD)

The WHO (2018) reviewed epidemiological studies linking aircraft noise and highly disturbed sleep. The WHO estimated sleep disturbance to be the most adverse non-auditory effect of environmental noise exposure (Basner et al., 2014; WHO, 2011). Undisturbed sleep of a sufficient number of hours is needed for alertness and performance during the day, for quality of life, and for health (Basner et al., 2014). Humans exposed to sound whilst asleep still have physiological reactions to the noise which do not adapt over time including changes in breathing, body movements, heart rate, as well as awakenings (Basner et al., 2014). The elderly, shift-workers, children and those with poor health are thought to be at risk for sleep disturbance by noise (Muzet, 2007). The WHO (2018) estimated that 11% of the population are highly sleep disturbed at Night levels of 40dB. The % of highly sleep disturbed at levels above 40 dB are shown in Table 4-7.

Table 4-7: Percentage of Population Highly Sleep Disturbed by Aircraft Noise (Source: WHO, 2018)

Lnight (dB)	% Highly Sleep Disturbed	95% Confidence Limit
40	11.3	4.72-17.81
45	15	6.95-23.08
50	19.7	9.87-29.60
55	25.5	13.57-37.41
60	32.3	18.15-46.36
65	40	23.65-56.06

The WHO has established a Lnight guideline of 40 dB to protect against highly disturbed sleep. They acknowledge that this guideline is not fully protective of health as it implies that approximately 11% of the population may be characterized as highly sleep disturbed at the Guideline level.

As shown in Table 4-5, the ANEF 25 contour corresponds to a Lnight value of 58 dB. Based on the information in Table 4-7, this would mean that approximately 32% of the population within the ANEF 25 contour would be highly sleep disturbed. For the ANEF 20 contour, approximately 25% of the population would be highly sleep disturbed.

The hazard quotients for the ANEF 25 and ANEF 20 contours are 1.5 and 1.3 respectively. This means that there is a 50% increase in people highly sleep disturbed in the ANEF 25 contour compared to areas that meet the WHO Lnight guideline. For people living in the ANEF 20 contour the increase is 30%.

As discussed in Section 4.4.2.2, possible effects of aircraft noise on sleep are generally grouped into three categories:

- The immediate effects of noise on sleep (sleep disturbance and physiological effects)
- The secondary effects of sleep disturbances (morning after effects)
- Long term health effects including increases in cardiovascular disease and psychological effects such as anxiety and depression.

People in older age groups, > 65 years of age, and children form vulnerable groups in relation to sleep disturbance. For people over 65 years of age exposure to high levels of environmental noise, including aircraft noise can increase the prevalence of cardiovascular disease, in particular ischaemic heart disease, as well as increases in anxiety and depression. The study by Hegewald et al (2020) reported a 12% increase in depression (and anxiety) per 10 dB in Lden from aircraft noise exposure. Based on the correlations between the ANEF contours and Lden metric, in the ANEF 25 contour there is a 21 dB increase in Lden above the WHO guideline. This would indicate that there is potentially a 24% increase in anxiety and depression in the population within the ANEF 25 contour. For the ANEF 20 contour the Lden equivalent is 16 dB above the WHO guideline indicating that there could be an increase of approximately 20% in anxiety and depression in that population. As shown in Table 4-2, 27.8% of the population in Brimbank currently suffer from anxiety and depression. Table 4-2 also shows that the deaths per 100,000 population for ischaemic heart disease and cardiovascular disease are higher in Brimbank compared to the rest of Victoria. This indicates that

the Brimbank community is more vulnerable to the impacts of aircraft noise due to higher rates of existing disease that are exacerbated by exposure to noise.

For children, sleep disturbance can lead to the inability to concentrate the following day which can impact on their cognitive development as discussed in Sections 4.4.2.4 and 4.4.4.3.

4.4.4.3 Cognitive Development in Children

As discussed in Section 4.4.2.3, aircraft noise has been associated with delays in cognitive development in children. WHO (2018) identified that at a Lden level of 55 dB there is a 1 month delay in reading and oral comprehension in children compared to children in lower noise areas. For every 5 dB increase above Lden of 55 dB there is additional 1-2 month delay. The WHO Lden guideline of 45 dB is considered to be protective of adverse effects of aircraft noise on cognitive development in children. Using the 45 dB the hazard quotient for cognitive development is 1.4 and 1.5 for the ANEF 20 and ANEF 25 contours respectively.

For the areas in Brimbank within the ANEF 25 contour, this could result in a delay in reading and oral comprehension of between 3 and 5 months compared to children in lower noise areas. For the population in the ANEF 20 contour the delay is similar. This means that for children in Brimbank living and going to school within the ANEF 20 and 25 contours, the increase in noise resulting from the expansion of the Melbourne Airport as proposed in the 2022 Master Plan would have their cognitive development delayed.

As discussed in Section 4.3.2.2, the proportion of children assessed as being developmentally on track in the language and cognitive skills is notably lower in Brimbank (79.3%) than in Greater Melbourne (85.3%). Compared with other LGAs in Greater Melbourne, Brimbank had the third lowest proportion of children who were assessed as being on track for language and cognitive skills. Aircraft noise has been shown in epidemiological studies to impact on children's cognitive development particularly in reading and oral comprehension. This means that the Brimbank population forms a sensitive population to the impacts of aircraft noise from the Airport Expansion.

As shown in Section 4.4.3, approximately 18% of the population in the suburbs within the ANEF 20 and ANEF 25 contours is between the ages of 1 and 14 years of age. This indicates that there is a significant number of pre-school and school aged children that may have their cognitive development impacted by the noise from the aircraft noise from the proposed Airport Expansion. These effects are due to direct impacts during the day as well as impacts due to sleep disturbance which may occur outside the normal night hours of 11pm to 6am. Exposure during critical periods of learning at school could potentially impair development and have a lifelong effect on educational attainment.

There are several ways in which aircraft noise could influence children's cognition (Stansfeld and Clark, 2015):

- lost teaching time - as a teacher may have to stop teaching whilst noise events occur;
- teacher and pupil frustration;
- annoyance and stress responses;
- reduced morale;
- impaired attention;
- children might tune out the aircraft noise and over-generalise this response to other sounds in their environment missing out on information; and
- sleep disturbance from home exposure which might cause performance effects the next day.

The Lden metric used by WHO (2018) takes into account exposures during the day, evening and night.

As discussed in Section 4.3 there are 8 schools and childcare/early learning centres within the ANEF 20 and ANEF 25 contours. These facilities are predicted to be exposed to noise levels above the WHO guideline meaning that there is an increased risk of delays in reading and oral comprehension attributable to aircraft noise. This is likely to be worse for children who also live in these areas as they will also be exposed to aircraft noise in their home environment.

5 Risk Mitigation

Multiple airports from Australia and abroad provide examples of aircraft noise mitigation measures for the surrounding population. These mitigation measures can be separated into active and passive noise abatement measures, where active measures relate to internal changes of flight paths, flight times, and aircraft models, and passive measures are more community-focused measures.

5.1 Passive noise abatement

When active noise abatement measures cannot be implemented effectively, or at all, passive noise abatement measures can be used as a replacement. These measures can also be utilised in conjunction with active measures to further reduce airport noise pollution for surrounding communities.

5.1.1 Best Practice

European examples provide a framework for best practice measures to provide good passive noise abatement programs that assist pre-existing homes mitigate the impact of noise on the residents. A Noise Insurance Policy has been implemented by Heathrow Airport in London to compensate residents most affected by any construction and operation of the expanded airport. Heathrow implement three schemes to address differing circumstances for nearby residents:

- Scheme 1 – for eligible properties affected by aircraft noise, a full package of sound insulation to habitable rooms
- Scheme 2 – for eligible properties to address noise from construction, road, or rail sources
- Scheme 3 – a £3000 contribution to a package of sound insulation treatment

With relation to scheme 3, Heathrow plan on seeking powers to be able to carry out noise insulation works compulsorily should that be necessary for properties at the end of the new runway.

Frankfurt Airport cover nearby residents with a similar scheme, labelled the Passive Noise Protection Program, by retrofitting affected homes and properties with noise insulation materials. A budget of €150 million was allocated to the program.

During the expansion of Perth Airport, recommendations were made with respect to manageable aircraft noise levels. Approximately 35dB for sleeping areas and 40dB for living areas were accepted as complying with the requirements of *Statement of Planning Policy No. 5.1 Land Use Planning* in the Vicinity of Perth Airport. Along with the Sydney Noise Amelioration Program, these policies were considered achievable at a reasonable cost with reasonable cost-effectiveness. Some of the key measures for residential developments included:

- Openings: Maximum size of openings (windows and doors) of 20% (of floor area) for sleeping areas and 50% (of floor area) for living areas
- Construction: Slab-on-ground
- Walls: Double brick cavity
- Roof: Pitched, minimum 25° slope, masonry tiles or metal sheet with acoustically sealed sarking (impervious membrane) over rafters
- Ceiling: Plasterboard 10mm minimum thickness, with ceiling joists separate from roof structure, i.e., not attached to rafters or roof trusses
- Insulation: Fibrous thermal insulation R2.5 or greater between ceiling joists
- Windows: Laminated glass 6.38mm or greater with acoustic or resilient flap weather seals to frames

- Doors: Solid core 40mm or greater with acoustic or resilient flap weather seals to frames. Doors with glass panels are to match the standard for windows above
- Note: Where air conditioning or mechanical systems are installed, sound-attenuated ducting will be necessary to limit noise intrusion

The specifications were to be reviewed after two (2) years of operation, with noise measurements to be undertaken to evaluate the efficacy in meeting the noise reduction targets listed above.

In addition, local government provided planning and building advice involving residential developments forecast to be affected by aircraft noise exposure above 20 Australian Noise Exposure Forecast (ANEF), including:

- Potential for noise nuisance and potential for noise nuisance and increases in noise exposure levels
- Noise reduction requirements under *Statement of Planning Policy No. 5.1*
- Limitations on the required noise control measures and the potential for residual indoor sound levels more than those recommended in *AS 2021*
- Need for closure of windows and doors to achieve the benefits of noise control measures, and the associated need for noise-attenuated ventilation and/or air conditioning
- Option to seek independent professional advice as to the building specifications required to achieve the minimum aircraft noise reduction standards identified in this report
- Recommendation in *Statement of Planning Policy No. 5.1* for noise control measures in areas between the 20 ANEF and 25 ANEF contours
- Desirability of supplementary noise control measures or in circumstances where the occupants of the housing are particularly sensitive to aircraft noise.

The Victorian Planning Provisions require noise attenuation that accords with the Section 3 AS2021 – 2015, where land is located in the Melbourne Airport Environs Overlay Schedule 1 and 2 (MAEO 1 & 2). The MAEO 1 & 2 applies to the ANEF 25 and 20 respectively. The VPP's don't extract any noise attenuation requirements from Section 3 AS2021 - 2015, as opposed to the Western Australian Statement of Planning Policy No. 5.1 Land Use Planning, which includes considerable information and detail about aircraft noise and noise attenuation measures. Planning provisions are outside the scope of this HRA, however it is understood that the Victorian Government has appointed a Melbourne Airport and Environs Safeguarding Standing Advisory Committee to provide advice on safeguarding matters.

5.1.2 Previous Australian examples of insulation programs

Such passive noise abatement measures have been implemented in Australia in the past, with two key examples being the Sydney Airport Noise Amelioration Program (NAP) and the Commonwealth Noise Insulation Scheme.

The NAP was introduced in November 1994 and was developed as a program to voluntarily acquire properties and provide financial assistance for noise insulation of residential and institutional buildings in areas most affected by aircraft noise. The total expenditure was estimated to be \$300 million over six financial years, and some funds were recouped using a levy on airlines and airline ticket sales. For example, between 1995 and 1997, the airlines recouped \$60.8 million from an additional charge on airline tickets. The system was overseen by the Department of Transport and Regional Development; however, the business unit was sold to a private sector buyer in 1997.

The Commonwealth Noise Insulation Scheme was introduced in 2000 as a tool to insulate buildings affected by aircraft noise and was used primarily by Adelaide and Sydney airports. The scheme

provided clear guidance on which affected buildings would be targeted for assistance by utilising the Australian Noise Exposure Index (ANEI) contours:

- Residential properties: 30 ANEI contour
- Public buildings (schools, churches, day care centres and hospitals): 25 ANEI contour

The scheme was funded by a Commonwealth levy on passengers; however, the levy was terminated in 2010, with the final works beginning in 2012, and concluding by 2013. The Commonwealth scheme funded noise amelioration programs for both Sydney and Adelaide airports.

Had the Noise Insulation Scheme been in place today, all affected areas in the Brimbank LGA would be able to apply for the scheme.

6 Conclusions and Recommendations

The outcomes of the stakeholder engagement show that the residents in parts of Keilor, Keilor Park, Keilor Village and Kealba are adversely impacted by the current operations of the Melbourne Airport. Noise from aircraft take-offs and landings is causing sleep disturbance and increased levels of stress and anxiety in the impacted community. People are unable to enjoy their homes and cannot utilise their outdoor areas. This impact is predicted to worsen and affect more people in the Brimbank LGA with the proposed airport expansion. The community feel that their concerns have been dismissed by the Melbourne Airport Corporation and are feeling frustrated and helpless. This is having a significant impact on the health and wellbeing of the impacted community.

The results of the HRA have shown that the proposed airport expansion will lead to significant increases in the percentage of the population that are highly annoyed by aircraft noise. This is due to a combination of issues – larger area covered by the ANEF 20 and 25 contours with the expansion and population growth. It has also shown that there will be a significant increase in sleep disturbance in the exposed community which may lead to increases in health effects such as cardiovascular disease and anxiety and depression. The WHO (2018) guidelines are exceeded across the areas within the ANEF 20 and ANEF 25 contours indicating that there is an increased risk of adverse health effects within the exposed population.

A review of the baseline health profile and socioeconomic indicators for the Brimbank LGA show that the suburbs within the ANEF 20 and ANEF 25 contours are a vulnerable population to the impacts of aircraft noise. They have a lower socioeconomic status than Australia and Victoria as a whole which is a known risk factor for the adverse effects of aircraft noise. The proportion of children assessed as being developmentally on track in the language and cognitive skills is notably lower in Brimbank (79.3%) than in Greater Melbourne (85.3%). Compared with other LGAs in Greater Melbourne, Brimbank had the third lowest proportion of children who were assessed as being on track for language and cognitive skills. Aircraft noise has been shown in epidemiological studies to impact on children's cognitive development particularly in reading and oral comprehension. There are also higher rates of deaths from ischaemic heart and cardiovascular disease in Brimbank compared to the rest of Victoria. All these health outcomes can be exacerbated by exposure to aircraft noise.

School children who live and go to school within the ANEF 20 and ANEF 25 contours are predicted to experience a delay in reading and oral comprehension of between 3 and 5 months compared to children in lower noise areas. These effects are due to direct impacts during the day as well as impacts due to sleep disturbance which may occur outside the normal night hours of 11pm to 6am. Exposure during critical periods of learning at school could potentially impair development and have a lifelong effect on educational attainment. This impact is predicted to occur within a population that is known to be delayed in their language and cognitive skills compared to the rest of Melbourne.

Given the potential adverse effects due to the increase in aircraft noise, mitigation measures should be implemented to minimise the risk to the exposed community. These measures should be based on national and international best practice including:

- Where possible limit the take-offs over the populated area within the Brimbank LGA
- Alternate the direction of take-offs to provide some respite to Brimbank residents from the aircraft noise
- Consideration of a curfew between 11pm and 6am to minimise sleep disturbance that can lead to other adverse health impacts
- If a curfew isn't possible then limit aircraft during these hours to more modern and quieter aircraft

- Implement noise insulation programs in the areas within the ANEF 20 and ANEF 25 contours similar to those previously funded by the Commonwealth Government and implemented in areas impacted by Sydney and Adelaide airports. These programs should be implemented in residential premises, schools, childcare and early learning centres, aged care facilities and public buildings such as libraries and community centres.

7 Review of Air Quality Report

The Air Quality Assessment for the proposed expansion of Melbourne Airport is presented in Chapter B10 of the Melbourne Airport M3R MDP. It appears that the assessment, including air dispersion modelling, was conducted by Melbourne Airport Corporation and reviewed by GHD Pty Ltd. Scenarios for construction as well as operations in 2026 and 2046 have been modelled and include airport operations and associated increases in traffic on the airport land. Off-site impacts have been modelled for these sources at a limited number of sensitive receptors.

The Environment Protection Act 2017 (the Act), and subordinate legislation came into effect on 1 July 2021 and is designed to drive environmental improvements by ensuring that individual industries take responsibility for the risks they pose to human health and the environment. At the centre of the Act is the General Environmental Duty (GED). This requires all duty holders (businesses, industries, community etc) to understand, abate and manage their emissions so that risks of harm to the environment and to human health are minimised. Complying with the GED means taking proactive steps as well as employing industry best practices to minimise risk to human health and the environment, so far as reasonably practicable.

At the time that the new Act came into force the Environmental Reference Standards (ERS) also came into force. The ERS provide reference standards against which the impact of a development or operating business can be assessed. The ERS for air quality adopted the air quality standards in the National Environment Protection (Ambient Air Quality) Measure. Although the ERS are not compliance standards they are used by Government Agencies in decision making processes around new developments and assessment of meeting the requirements of the GED.

Prior to 1 July 2021 the State Environment Protection Policies – Ambient Air Quality and Air Quality Management – provided the framework for assessing and managing emissions to air in Victoria. These were revoked on 1 July 2021 and according to the EPA Victoria website have no legal standing in Victoria post that date. The ERS have recently been updated (February 2022) to include the new NEPM NO₂ standards and more stringent standards for SO₂ and O₃.

The EPA has also released the Guideline for Assessing and Minimising Air Pollution in Victoria (2022). The draft guideline was released in 2021. The Guideline includes guidance on how to meet the requirements of the GED with respect to air quality assessments, assessing best practice and ‘as low as reasonably achievable’ emission controls and establishes air quality assessment criteria (AQAC) against which air dispersion modelling results can be compared. The AQAC replace the design criteria in the previous SEPPs.

Although the new EP Act and associated subordinate legislation was in force at the time that the Air Quality Assessment for the Airport Expansion was being prepared it has not been applied as part of the assessment. There is no discussion of the GED and how the emissions/operations are proposed to be managed to minimise the risk of harm to human health or the environment. The SEPP design criteria, which were revoked on 1 July 2021, have been used to assess compliance with air quality requirements in Victoria. This is not valid as the design criteria have had no legal standing in Victoria since 1 July 2021.

The design criteria were developed in 2001. The new AQAC and ERS are more stringent than the previous SEPP criteria. Therefore, the off-site air quality impacts have been assessed as being acceptable against less stringent criteria than those currently applicable in Victoria. If assessed against the ERS or AQAC the outcomes of the assessment may differ. T+T are unable to check this as there is not sufficient detail presented in the Air Quality Assessment conducted by Melbourne Airport Corporation to do a detailed review. It is T+Ts understanding that although the Airport operates on Commonwealth Land, the off-site impacts must be managed to comply with Victorian legislation. This hasn’t been done in the reports released by the Airport Corporation. An assessment

of meeting the GED to minimise risk to human health and the environment should have been undertaken and the ERS and AQAC should have been used to assess the outcomes of the air dispersion modelling. A list of potential emission control measures are listed in B10.8.2.3 however they have not been modelled to assess their effectiveness in minimising emissions.

Although the draft Guideline is mentioned in the Air Quality Assessment it is dismissed and has not been followed. Although only available in draft form at the time that the Air Quality Assessment was being undertaken it is the document that EPA Victoria has required to be followed since 1 July 2021. It should have been used to assess the air quality impacts from the proposed airport expansion as it is consistent with the new EP Act requirements.

The main sources of air pollution from airport operations are:

- Ground based operations at the airport including taxiing, take-offs and landings of aircraft, use of ground based vehicles, diesel generators etc
- Overflight emissions
- Increases in road traffic surrounding the airport due to the airport operations.

The Air Quality Assessment has only considered ground based operations within the airport boundary. It does not consider overflight emissions or road traffic surrounding the airport. Overflight emissions usually have minimal impact at ground level therefore excluding them from the modelling is unlikely to significantly change the outcomes of the assessment. However, increases in road traffic in areas surrounding the airport will increase local air pollution and should have been included in the assessment. It is an impact that is directly linked to the proposed airport expansion.

As discussed above, no modelling has been conducted for near road impacts off-site that would be due to increases in traffic on roads external to the airport solely attributable to the airport expansion. Therefore, T+T are unable to provide Council with any assessment of the potential impacts in the Brimbank LGA attributable to increased traffic directly related to the proposed expansion. However, there are significant increases in traffic predicted on Keilor Park Drive and on the Calder Highway west of Keilor Park Drive shown in Table 7-1. Increased traffic and associated congestion are known to increase near road pollution levels. Although not quantified in the air quality assessment, the predicted increases in traffic would result in increased air pollution levels near the affected roads – Keilor Park Drive and Calder Highway. There are no traffic predictions in the air quality report for other roads within the Brimbank LGA.

Table 7-1: Predicted Annual Increases in Traffic Keilor Park Drive and Calder Freeway west Keilor Park Drive No Build vs Build (Source: Tables 10:13 and 10:14 Melbourne Airport Corporation Air Quality Assessment)

Road Traffic Predictions	No Build	Build	Increase in Traffic due to Airport
Keilor Park Drive 2026	6,741,317	7,183,860	442,543
Keilor Park Drive 2046	8,972,253	10,274,506	1,302,253
Calder Fwy 2026	24,992,195	25,427,788	435,593
Calder Fwy 2046	31,602,969	33,199,029	1,596,060

To assess the potential impact on air quality the Airport Corporation has established Significance Criteria. According to Table 10.4 of the Air Quality Assessment an increase in an air pollutant level between 1% and 20% of the project standard is considered a minor impact. An increase of between 20% and 99% of the project standard is considered to be moderate impact. It is unclear how these

numbers were determined. They are not consistent with the current Victorian Guidance for Air Quality Assessments. According to the EPA Guideline for Assessing and Minimising Air Pollution in Victoria, an increase in air pollution levels less than 4% of the air quality assessment criteria is considered insignificant. Above 4% it is considered a significant impact and requires further assessment. This means that the impact of an incremental increase in pollutant level is being assessed by the Airport that is assessed as minor would be considered as significant by the EPA. Therefore, the impact would be considered greater if assessed by the current Victorian legislation than that used by the Airport Corporation for the same incremental increase.

The approach used by the Airport Corporation to determine the significance of the impact on increases in pollution levels highlights the importance of the selection of air quality assessment criteria used. For example, if a less stringent standard has been used, then 20% of that standard is higher than if a more stringent (lower) standard has been used. This is important as the Airport Corporation has used the old design criteria that were in the SEPPs which are less stringent than the current AQACs and ERS. This combined with the higher percentages of the AQAC used in determining Significance of the impact means that the conclusions drawn that an impact is minor or moderate are unreliable. If assessed using the current Victorian legislation and guidance it is likely that the Significance rating of the impact would be higher.

The Air Quality Assessment concludes that comparisons of model results for the No Build and Build scenarios indicated that Build leads to slightly worse air quality impacts overall – which is to be expected given the substantial increases in air and road traffic due to the Build. In all scenarios however, compliance with SEPP(AQM) criteria was achieved, except where background levels were already high (in the case of PM₁₀). The assessed risk levels for the operational case Build 2046 for all pollutants all ranged between negligible and medium. These conclusions would change if the current requirements for air quality assessments in Victoria were used rather than the SEPP (AQM) criteria which are less stringent and have been revoked.

The initial risk level for the M3R construction was assessed as high, but consideration of additional mitigation measures decreased this risk level to medium (Section B10.6). The Air Quality Assessment concludes that the potential for air quality impacts due to dust emissions from construction activities is anticipated to be mitigated to satisfactory levels through the application of dust suppression techniques implemented through the CEMP. The predicted concentration of nuisance dust as shown in Figure B10:13 extend beyond the airport boundary into the Brimbank LGA. The contour extends close to the residential receptor on Overnewton Road. Monitoring should be implemented at this location during the construction to ensure that the impacts are being managed so that any impacts are confined within the airport boundary and not impacting on sensitive receptors within Brimbank.

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9 Applicability

This report has been prepared for the exclusive use of our client Brimbank City Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

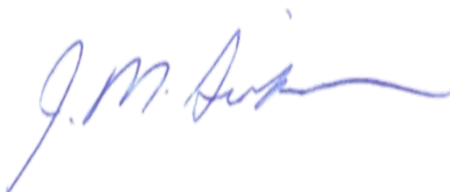
Tonkin & Taylor Pty Ltd

Report prepared by:

Authorised for Tonkin & Taylor Pty Ltd by:



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Dr Lyn Denison



Technical Lead Environmental – Human
Health Risk Assessment

Project Director

LSD

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Appendix A: Marshall Day Report

21 February 2022

Tonkin + Taylor
Kings Technology Park
Level 3, 99 Coventry Street
Southbank VIC 3006

Attention: Ms Suk-yi Lo

Dear Suk-yi

MELBOURNE AIRPORT EXPANSION - NOISE EXPOSURE REVIEW

Tonkin + Taylor, on behalf of the Brimbank City Council, is undertaking a health impact study for areas in the vicinity of Melbourne Airport. Specifically, the study is to assist Council with input to their submission on the Melbourne Airport Master Plan 2022.

Aircraft noise information is typically provided in range of formats, including exposure noise metrics (e.g. Australian Noise Exposure Forecast, ANEF) and single event metrics (e.g. maximum noise levels, $L_{A_{Smax}}$).

The ANEF is the most common published aircraft noise exposure metric in Australia. There is however limited data that correlates ANEF levels and health impacts; rather studies have been focussed on impacts such as annoyance arising from aircraft noise. Further details on community response to aircraft noise is provided in Appendix A.

The aircraft noise metrics adopted by Tonkin + Taylor to inform their health study/review are based on the World Health Organization (WHO) guidance, which reference the following noise metrics:

- L_{den} , the day-evening-night equivalent sound level over a 24 hour period with a:
 - 5 dB penalty applied to aircraft operations that occur during the evening period (6 pm – 10 pm)
 - 10 dB penalty applied to aircraft operations that occur during the night-time period (10 pm – 7 am)
- L_{night} , the equivalent sound level over the period of aircraft operations between 10 pm and 7 am

In the absence of publicly available information associated with Melbourne Airport operations in the form of the above metrics, Marshall Day Acoustics (MDA) has estimated a relationship between the ANEF and these metrics. The estimated conversion factors between the metrics are detailed in Table 1. Details on the method to establish these factors is described in Appendix B.

Table 1: Estimated relationships between ANEF and other aircraft noise metrics

Metric	Conversion factor from ANEF	Example for given ANEF value 20
ANEF	n/a	20 ANEF
L_{den}	+ 41	61 dB L_{den}
L_{night}	+ 33	53 dB L_{night}
$L_{Aeq,24hr}$	+ 37	57 dB $L_{Aeq,24hr}$

It is intended that this information can be used in combination with the published aircraft noise information for Melbourne Airport, and interpreted by Tonkin + Taylor to draw conclusions on potential health impacts.

An example of such analysis is the application of the conversion factors in Table 1 to noise contours contained within the Melbourne Airport Master Plan 2022. Specifically, review of the 2019 ANEI and the 2052 ANEF contours, provides an indication on the likely change in aircraft noise exposure from current airport operations and forecast long range future operations. Refer to Appendix C for an example of annotated figures.

We trust this information is satisfactory for your needs at this time. If you have any queries or comments, please do not hesitate to contact us to discuss.

Yours faithfully

MARSHALL DAY ACOUSTICS PTY LTD



Alex Morabito

Senior Associate

APPENDIX A COMMUNITY RESPONSE TO AIRCRAFT NOISE

A large number of overseas studies have been carried out to investigate community response to environmental noise. The general approach of these studies is to question residents (verbally or in writing) as to their level of annoyance due to a particular noise source. The noise level at the respondent's location is then determined by either measurements or by referencing noise modelling outputs, such as noise contours.

In many countries, aircraft noise levels are measured/calculated as L_{dn} – the Day/Night Level, which involves a summation of the noise energy over 24 hours with a 10 dB penalty for noise occurring at night. Land use planning around major Australian airports uses the Australian Noise Exposure Forecast (ANEF) metric for aircraft noise, which is based on a similar noise energy exposure concept to the L_{dn} metric. There is a generally accepted conversion factor between the two parameters of $L_{dn} \approx ANEF + 35$.

A graph of the percentage of people highly annoyed plotted versus the level of noise exposure, allows a 'dose-response curve' to be produced. In 1978, Schultz¹ provided the first synthesis of various studies into community response to transportation noise (including aircraft noise).

In 2001, Miedema and Oudshoorn² examined the aircraft specific studies into community response to noise. Their analysis was based on 20 studies from around the world which included over 40 airports (some studies looked at multiple airports) with 34,214 respondents. Over the past 20 years, the Miedema and Oudshoorn dose-response curve has been regarded as the 'current state of knowledge' into community response to aircraft noise.

In the last 5 years, a number of new comprehensive airport studies have been carried out. The two most significant of these are the FAA Neighbourhood Noise Study 2021³ and the Guski (WHO) Aircraft Noise Annoyance 2018⁴ studies. The dose-response curves from these studies are shown in Figure 1, together with the earlier Miedema 2001 and Schultz 1978 studies.

The findings from the recent FAA and Guski studies indicate that community annoyance to aircraft noise appears to have increased by approximately 10 dB; this is a significant increase in sensitivity.

Australian Standard AS 2021-2015 *Acoustics-Aircraft noise intrusion-Building siting and construction* (AS 2021) was updated prior to the FAA and Guski studies, however the Standard still referred to community response findings from a study in 1979.⁵ The findings of that study were broadly similar to the Miedema 2001 study.

Figure 1 shows that at 55 dB L_{dn} (approximately ANEF 20), 30 % of people are expected to be highly annoyed by aircraft noise. It also shows that noise effects occur in locations below 55 dB L_{dn} (ANEF 20), e.g., 20 % highly annoyed at 50 dB L_{dn} .

¹ Schultz, T. (1978). *Synthesis of social surveys on noise annoyance*. The Journal of the Acoustical Society of America 64 (2): 377-405.

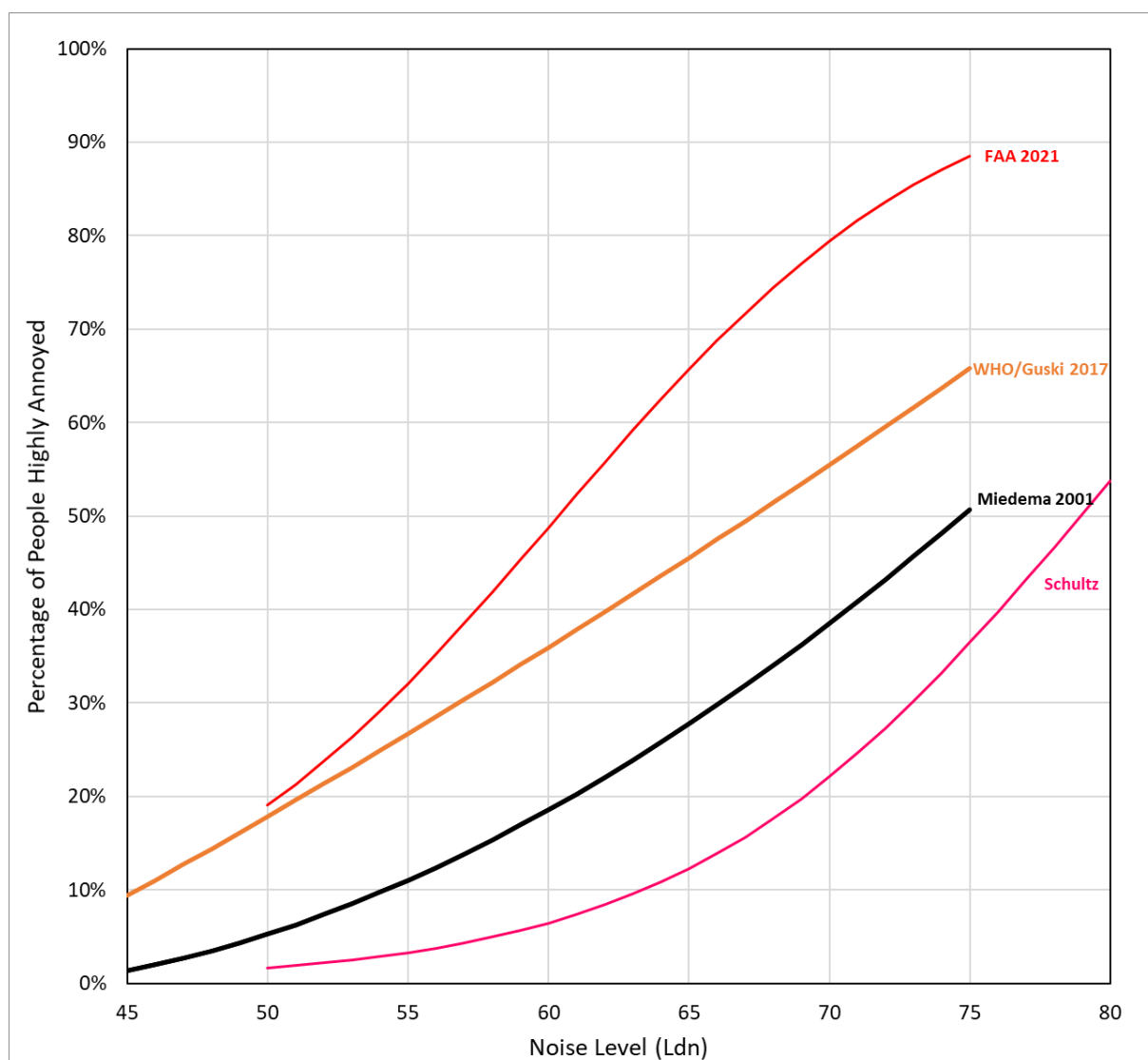
² Miedema, H, & Oudshoorn, C. (2001). *Annoyance from transportation noise: relationships with exposure metrics DNL and DENL and their confidence intervals*. Environmental Health Perspectives, 109(4).

³ U.S Department of Transportation (FAA). (2021). *Analysis of the Neighbourhood Environmental Survey*. National Technical Information Service.

⁴ Guski, R., Schuemer, R. and Schreckenber, D. (2018). *Aircraft noise annoyance - Present exposure-response relations*. Euronoise 2018. Crete: European Acoustics Association.

⁵ EDE, A.J. and BULLEN, R.B. (1982). *Aircraft Noise in Australia: A Survey of Community Reaction*, National Acoustic Laboratories Report No. 88. Australian Government Publishing Service, Canberra.

Figure 1: Summary of Dose-response curves



APPENDIX B CONVERSION FACTOR PROCESS

MDA has prepared aircraft noise contours for several airports throughout Australia and New Zealand, ranging in size and operations that occur.

To establish conversion factors between the various aircraft noise metrics, noise model data for airports which are currently similar in size and operation (number of annual movements) to Melbourne Airport has been used. Specifically, the forecast annual noise models prepared for Auckland Airport and Christchurch Airport were recalculated for each noise metric of interest. The noise levels were calculated for a 10 nautical mile (nmi) grid around each airport, at discrete points spaced at 0.2 nmi (370 m) apart.

For each discrete point, the difference between the calculated ANEF value and other respective metrics was determined. An analysis of the differences was undertaken, and an average value used as the estimated conversion factors presented in Table 1.

This process demonstrated good agreement and limited spread in the differences across the grid (± 1 -3 dB across the 10 nmi study area for the various metrics).

However, it is noted that, ideally, the equivalent process should be undertaken by those responsible for the preparation of the Melbourne Airport noise contours to recalculate and determine the airport-specific aircraft noise levels in the requisite noise metrics.

It is noted that the contours in Appendix C do not clearly indicate the extent of areas exposed to aircraft levels below 61 dB L_{den} , 53 dB L_{night} or 57 dB $L_{Aeq,24hr}$. Accordingly, in instances where impacts (health or other) occur at lower thresholds, then further information from Melbourne Airport is required.

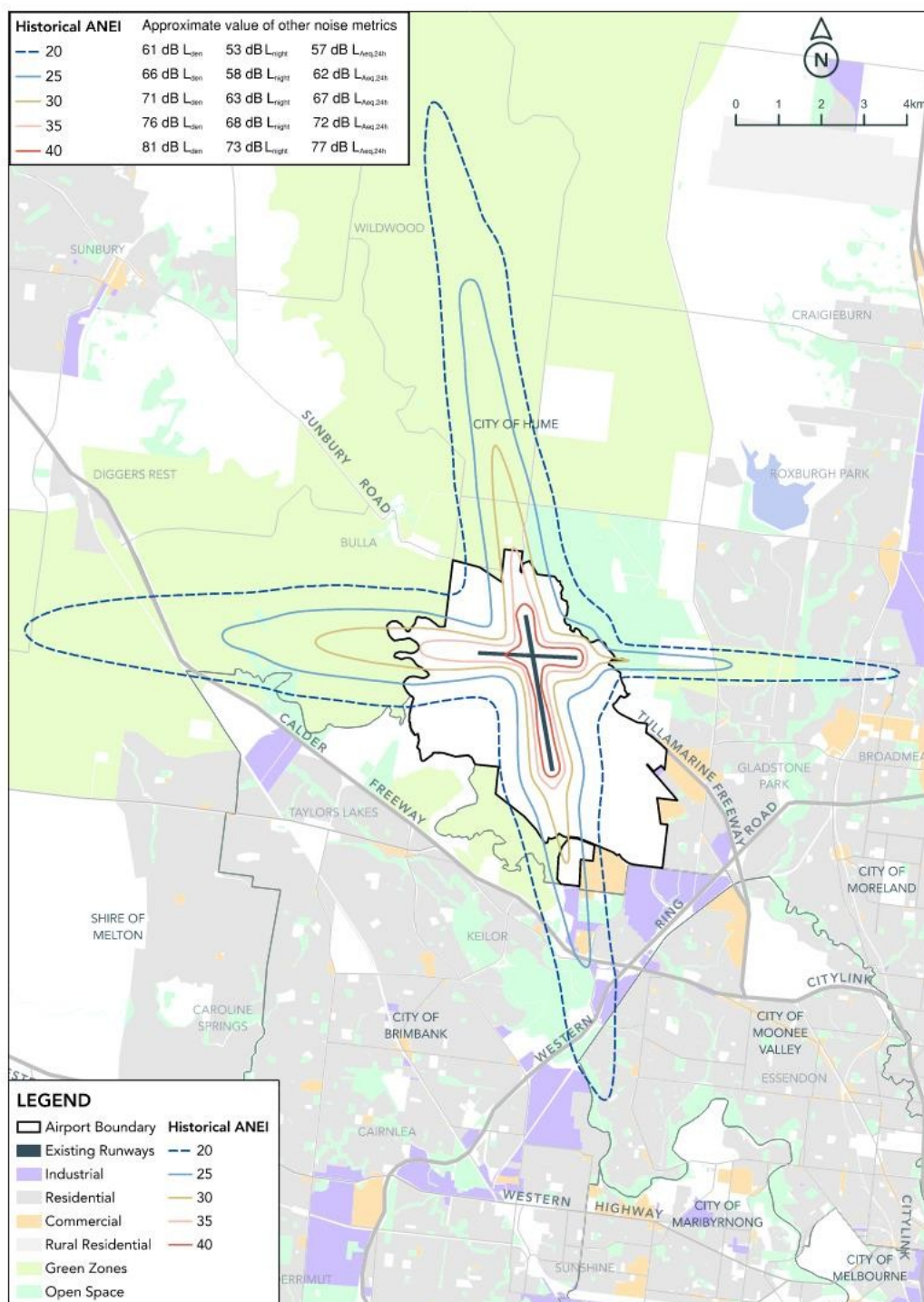
APPENDIX C MELBOURNE AIRPORT NOISE CONTOURS

Source: Melbourne Airport (2022), *Preliminary Draft Master Plan 2022*, Australia Pacific Airports (Melbourne) Pty Ltd

C1 2019 ANEI

Preliminary Draft Master Plan 2022

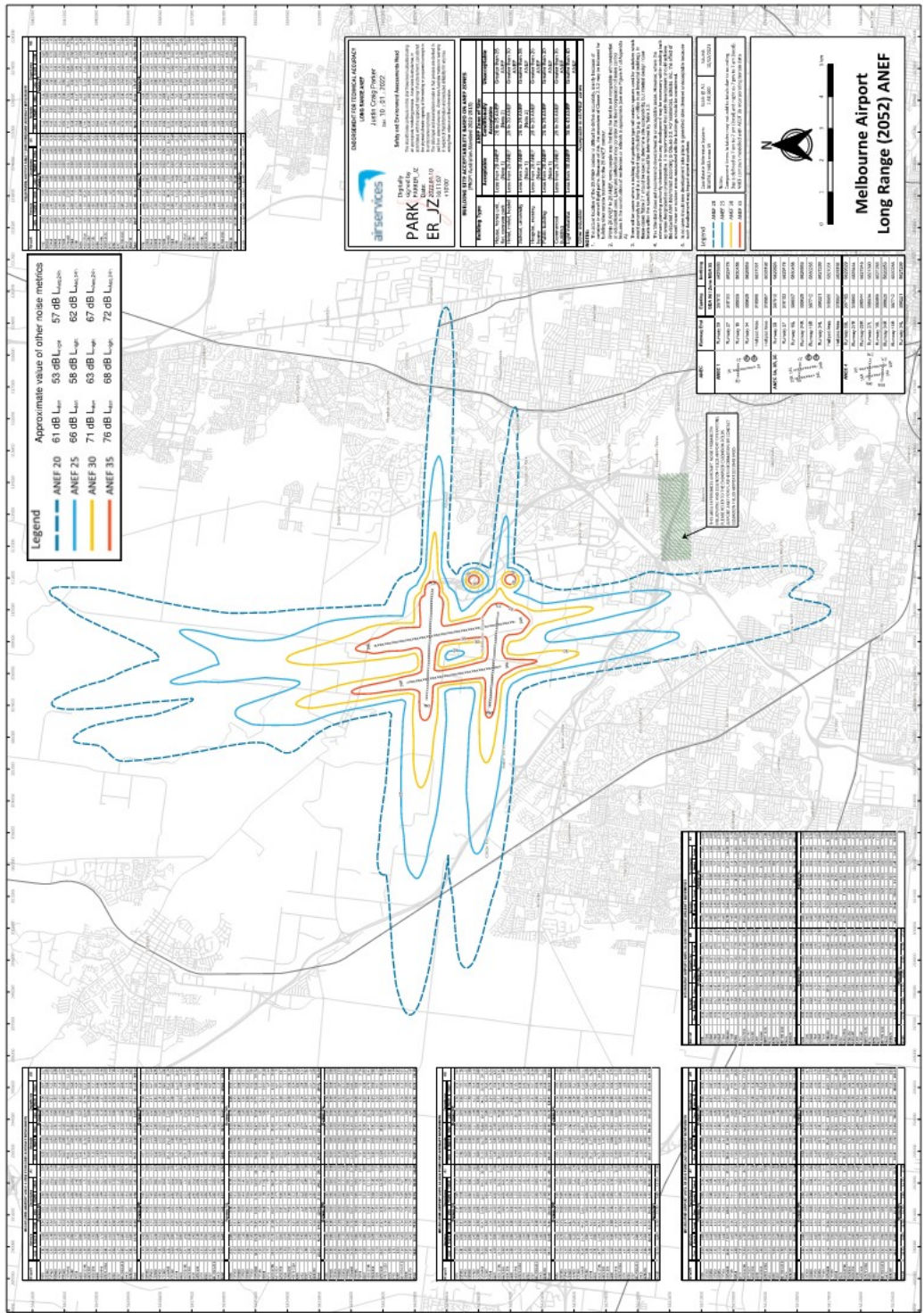
Figure 15-26
2019 ANEI for Melbourne Airport



C2 2052 LONG RANGE ANEF

Preliminary Draft Master Plan 2022

MELBOURNE AIRPORT LONG RANGE (2052) ANEF



Sustainability Policy

Overview

Our Purpose: Our people, through their leading expertise, create a legacy of outstanding value for our clients, our environment, and our communities.

This Sustainability Policy sets out our aspirations, commitments, and actions to respond to the global and local sustainability challenges facing our natural environment and society. It will support us in credibly delivering on **Our Pathway (Purpose and Values)** and demonstrating our contribution to the Sustainable Development Goals in our own operations and through the work we do with our clients. We will be updating the Policy as we develop and implement our strategic response in each of our three impact areas.

Our greatest impacts are in the following three areas:

- 1 Provision of targeted sustainability services for our clients
- 2 Our ability to deliver sustainable outcomes across all our projects
- 3 Our people communities, and the footprint of our operations

In this policy we consider how our collective actions can reduce negative impacts and maximise positive impacts in each of these areas.

Sustainability at Tonkin + Taylor

Sustainability as a service

Our expertise includes sustainability strategy and reporting, along with understanding and managing specific challenges within sustainability, including climate change adaption and resilience, environmental management systems, natural hazards and disaster risk reduction, biodiversity, and water quality. We are committed to ensuring that our people remain at the forefront of approaches to respond to these challenges, and provide strategic, long-term thinking for our clients and our communities.

Delivering sustainable outcomes on all our projects

Through our portfolio of projects, we can influence all aspects of sustainability.

T+T aspires to work with clients that have aligned values and sustainability objectives. We choose projects and clients where our advice will be taken on board, such that our involvement will leave the environment and communities better off.

In addition to providing our clients with the best technical advice and solutions, we care committed to building the ability of all our people to consider the wider context and potential impacts of each and every project. This includes considering the details of the project across its lifecycle, as well as the systematic view of how our contribution might positively influence other sustainability outcomes connected to the project.

Internal sustainability

T+T is committed to 'walking the talk' and integrating sustainability into how we operate.

We are implementing a wide range of sustainability initiatives to minimise our environmental footprint, support our people and communities, and enhance our natural environment.

Areas of our operations that we are targeting include:

- Reducing our carbon footprint
- Reducing consumption and practicing sustainable procurement
- Looking after the health, safety, and wellbeing of our people
- Creating an inclusive and diverse team
- Contributing to the next generation of technical specialists
- Playing an active role in developing our profession
- Contributing to our local communities

