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Reducing aircraft noise *in existing homes*

PerthAirport

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The products and suppliers included in this booklet are provided for information purposes only. Alternative manufacturers and suppliers also provide products that are similar and suitable for application to control aircraft noise.

Perth Airport does not endorse or recommend any specific product or supplier.

Note

If you are considering sound insulation for a home, it may be beneficial to contact an acoustic consultant to ensure the proposed changes will provide effective noise reduction. Visit the **Association of Australian Acoustical Consultants (AAAC)** website for more information: **aaac.org.au**
Before carrying out any of the works referred to in this booklet, advice should be obtained from a qualified tradesperson.

Disclaimer

1. Introduction

Perth Airport operates 24 hours a day, seven days a week, and is one of the most important public transport facilities in Western Australia. The airport plays an important role in Western Australia's economy, supporting employment opportunities, tourism and leisure – connecting people, places and services.

Noise from aircraft operating at Perth Airport is an unavoidable impact in the provision of air services. All areas of Perth will have aircraft from Perth Airport, Jandakot Airport or RAAF Base Pearce, flying overhead from time to time. Although aircraft and engine technological improvements continue to result in new aircraft being quieter, the growth in both the number of aircraft movements and the size of the Perth metropolitan region means many communities are exposed to aircraft noise at various levels.

This booklet provides assistance to existing home owners who wish to reduce aircraft noise intrusion into their homes. It includes information on simple and practical noise reduction measures that can be adopted for established homes. The noise mitigation measures outlined may reduce aircraft noise within the home, however the extent to which this is achieved is not quantified or guaranteed.

Although there are many construction and design features that can be built into new homes, this booklet concentrates on how to modify existing homes to reduce noise experienced inside.

Some of the noise mitigation measures outlined are relatively inexpensive and home owners may be able to make some of these alterations themselves. However, other items are more complex and may require the work to be carried out by a qualified professional or tradesperson.

Home owners need to decide if they are sufficiently annoyed by aircraft noise to warrant the cost of any of the noise reduction techniques outlined in this booklet. Where sleep disturbance is the primary concern, consideration could be given to insulating against noise in sleeping areas only.

It is worth bearing in mind that the measures described will generally lessen noise intrusion from other external sources as well, not only aircraft. In addition, many of these measures will have the added benefit of improving the thermal insulation of the home.

2. How we hear sound and noise

When assessing the impact of aircraft noise it helps to have a basic understanding of sound and the way the human ear perceives it.

Sound and noise are physically the same, the difference is that noise is defined as unwanted sound.

The loudness of a sound depends on its sound pressure level, which is expressed in units of decibels (dB). Most sounds heard in daily lives have sound pressure levels in the range of 30dB to 90dB.

The human ear is more sensitive to high-pitched sounds (like a human voice) than to low-pitched sounds (like a truck engine). A-weighted decibels, abbreviated dB(A), are an expression of the relative loudness of sounds as perceived by the human ear, taking into account the pitch of the sound. Community sound studies use A-weighted decibels (dBA) to assess the loudness of different sounds.

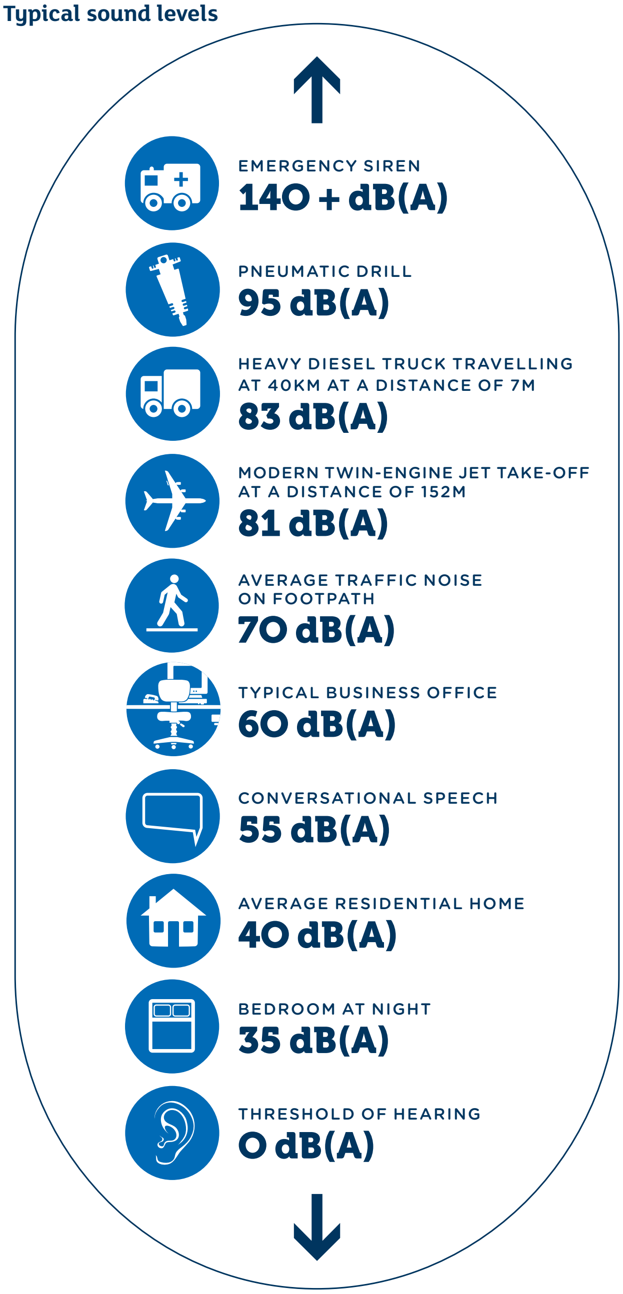
As examples, the sound level in the average residential home is about 40 dB(A), an average conversation is about 55 dB(A), typical home music listening levels are about 85 dB(A) and a loud rock band is about 100 dB(A). A modern twin-engine jet take-off at a distance of 152m is about 81 dB(A).

The following figure shows some typical noise levels that are experienced in everyday life.

The human ear also has different sensitivities to continuous, ongoing noise compared to short, sharp bursts of noise.

Further information about hearing mechanisms and noise levels can be found in Appendix B.

Typical sound levels



3. Australian Standard

Australian Standard 2021 (AS2021), ‘Acoustics – Aircraft noise intrusion: Building siting and construction,’ gives guidance on the design of new buildings to achieve acceptable internal noise levels in certain areas. These noise levels are often adopted as design goals when considering noise reduction measures for existing buildings.

A design to achieve this Standard requires professional advice tailored to the specific building under consideration.

The measures described in this booklet are designed to reduce aircraft noise inside most typical homes. However, they cannot be guaranteed to provide the noise levels specified in AS2021.

Further information on AS2021 is contained in Appendix A.

4. How noise enters a home

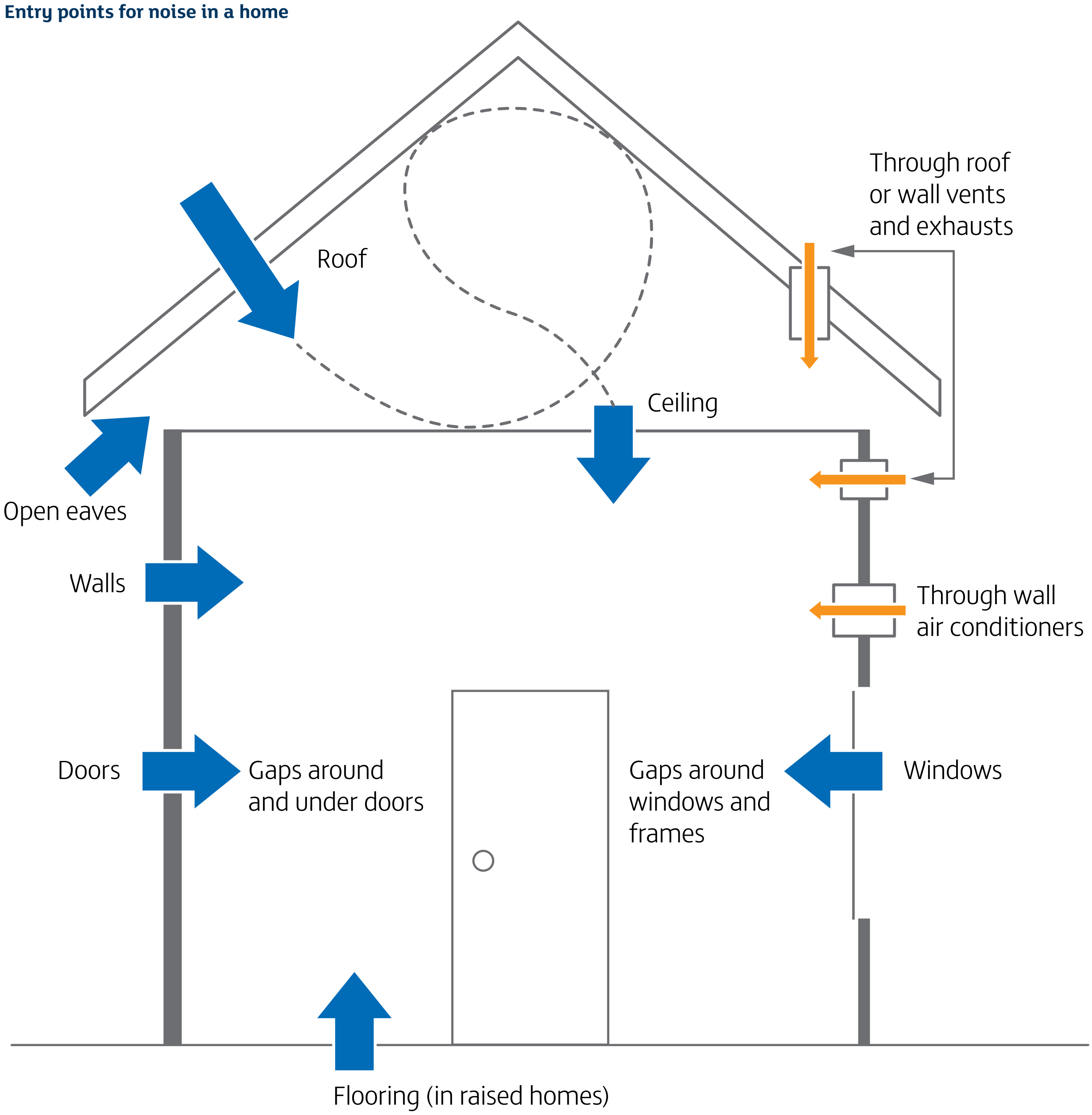
Generally, noise enters the home in the same way air enters – through cracks and openings in a home's exterior. The first step in insulating a home consists of sealing up the points of air (and sound) entry. These include gaps around and under doors, gaps around windows and frames, air vents, exhaust systems and open eaves.

Following this, there may also be a need to increase the density or other design features of building components through which noise must travel. These components include the roof and ceiling, doors, windows and frames and flooring in raised homes.

Each of these building components will allow noise into a home depending on its construction and ability to resist noise. It is the combination of all these components and their sound reducing characteristics that determine the ultimate level of aircraft noise in a residence.

In general, building components that have low density or a large area are likely to allow more noise into a building. Therefore, treatment of these 'weak links' represents the most cost effective approach to controlling noise from aircraft.

Entry points for noise in a home



5. *Practical ways of reducing noise levels in a home*

This section details a number of options home owners have to help reduce the amount of aircraft noise experienced inside a home.

A table at the end of this section outlines the scale of approximate cost for various options, in order of cost-effectiveness for a typical home, although this will vary for different types of construction.

Appendix C contains useful resources such as links to information on aircraft noise and websites for noise insulation products.

5.1 Gaps around doors and windows

Small gaps around doors and windows can permit noise intrusion.

Sliding windows and doors by their very nature have gaps and reduce the effectiveness of noise reduction measures.

Old and loose fitting windows can be the greatest source of noise transmission into the home as windows generally take up a large proportion of a wall in most rooms of a home. Sealing gaps can make a significant improvement in the internal noise level from sources outside.

Gaps around doors, and especially under the door, can also be significant noise paths and sealing these gaps will help.

The table below indicates how filling gaps can lower noise. A reduction in noise level of about 10 dB(A) will halve the noise in a room.

Typical reduction in noise transmission due to sealing various size gaps

Width of gap (millimetres)	Reduction in noise level when gap is sealed dB(A)
5	1
12	3
25	7
50	12

Methods of sealing gaps include:

- caulking gaps around window frames with a mastic sealant,
- installing compressible seals to window and door frames, and
- installing seals to door thresholds.

When using caulking it is worth the extra cost to use the most flexible sealant available, particularly if filling gaps against timber. Using lower cost, less flexible fillers will result in seasonal cracking in the caulking, reducing its effectiveness as a sound attenuator.

Large gaps (15 millimetres and more) may initially be filled with a foam gap expander or backing rod. The expander or backing rod can then be covered with the appropriate mastic sealer. If the expanding foam has extruded beyond the cavity it can easily be cut back with a knife to allow room for covering with mastic. It must be totally covered with sealant at least 10 millimetres deep to improve the acoustic rating.

When applying sealant to doors and windows it is worth checking the exterior of the home for any other fillable gaps. For instance, drainage pipes often have gaps around them in timber construction homes, and the same treatment as described for sealing around doors and windows can be used here.

Various types of door and window frame weather strips are also available. These strips are self-adhesive rubber and are placed into the corners of the door stop or window frame providing a compressible seal. A properly sealed door will have to be pushed or pulled to close and open it, due to the sealing.

To verify if a door has been fully sealed, it is a good idea to shut it at night against a backlit room. If no light shows through any cracks around the door, it is fully sealed. Otherwise, add additional sealing and/or a weather strip.

5.2 External doors

The thickness of external doors is another common source for noise to enter a home.

Hollow core doors reduce noise from aircraft by about 18 dB(A), but a solid core door with correct seals can improve this to around 30 dB(A). Most homes will have solid core doors that are at least 35 millimetres thick. Additional noise isolation can be achieved by replacing these doors with solid core doors up to 50 millimetres thick. However, any door should be effectively sealed before the need to replace the door is determined.

Hinged doors that shut against seals are more effective at insulating against noise than sliding doors. However, for existing sliding doors, seals can be added to help reduce noise. Serious consideration of the cost versus benefits should be made before replacing sliding doors.

There are many variations to these seals, depending on the type of door to be sealed.

The following are some examples of seals for doors:

Raven RP60 Automatic Door Seal

Raven RP48 Perimeter Seal

5.3 Vents in walls and ceilings

In older houses air vents are often built into the base of the building and are generally located in the walls.

Wall vents provide a direct path from outside to inside. An air vent in a brick wall can permit noise intrusion associated with aircraft within rooms. When combined with other openings the overall intrusion of noise can be significant.

Sometimes vents are in ceilings, which are open to the roof space. This is generally less critical than wall vents, but where a home also has open eaves noise intrusion can increase.

The easiest methods to seal or remove wall and ceiling vents are:

- grouting up wall vents or covering with a layer of fibre cement sheeting,
- fixing a piece of plasterboard over the ceiling vent or cutting out the ceiling vent and repairing the opening with plasterboard, and
- removing vents in walls of old houses that are not currently used for ventilation or covering them using sheet metal plate or fibre cement, either behind or over the vent.

Examples of wall and ceiling vents are shown in the following figures:

External wall vent

Internal wall or ceiling vent

5.4 Required openings

Some openings, such as vents required for gas heaters, cannot be sealed. However, noise transmission can be minimised with the installation of sound attenuators (also known as silencers). If attenuators are used, the vent may need to be increased in size to satisfy existing ventilation requirements.

> *Unflued gas heaters must not be used in homes that have been insulated against aircraft noise as these require a degree of natural ventilation via open doors or windows. Local councils should be contacted to discuss health regulations for the use of unflued gas heaters.*

5.5 Ventilation

The effectiveness of noise control measures requires windows and doors to be closed, which means there is no ventilation provided to occupied areas when closed. This can be addressed by providing new mechanical ventilation or treating existing ventilation.

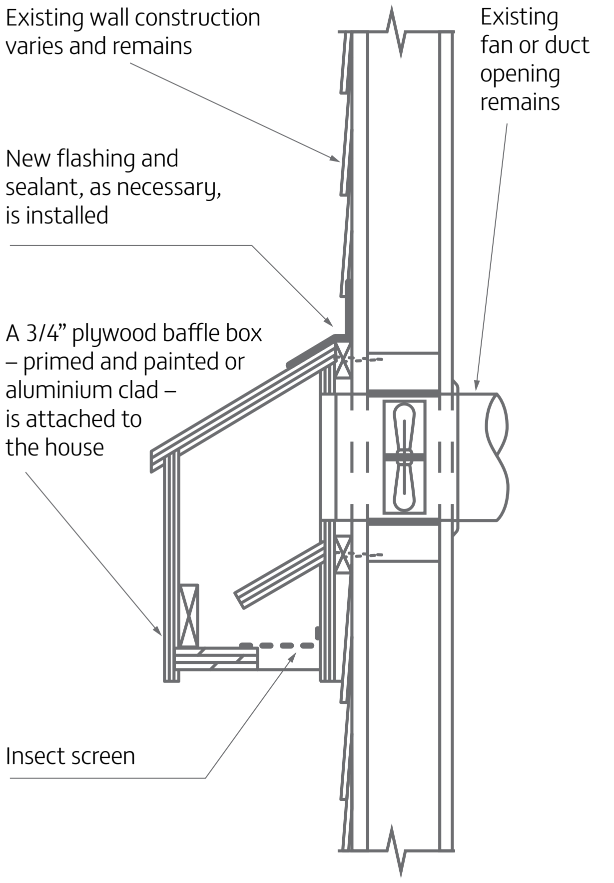
Fresh air can be provided to habitable rooms by:

- installing small fans in the roof with flexible acoustic ductwork drawing air from grilles in the eaves to occupied rooms. Consultation with a mechanical contractor is recommended, and
- installing acoustic ventilators such as the one below:

Aeropac acoustic ventilator

Where an existing vent is needed for ventilation and must be kept open, an acoustic cover can be fitted as illustrated:

Acoustic vent cover

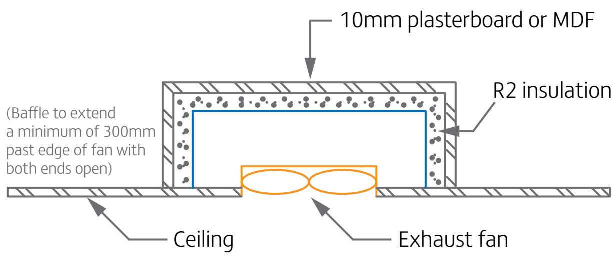


**The above diagram has been reproduced from the publication ‘Sound Insulating Your Home’ produced by the O’Hare Noise Compatibility Commission and the City of Chicago’s Department of Aviation.*

Other openings in ceilings include exhaust fans, typically those in toilets, kitchens and bathrooms.

An alternative option to removing vents or exhaust fans in ceilings is to install baffles over the top. Baffles can be made using 10 millimetre plasterboard lined with 50 millimetre acoustic insulation.

Baffle over ceiling exhaust fan



One of the simplest ways to reduce noise from vents in other rooms is to simply close the door to these rooms.

5.6 Air conditioning

Through-wall or window air conditioning units allow air and noise to enter rooms. Therefore these units should be removed and replaced. The most practical alternative is to replace the unit with a split or ducted system.

Home owners need to carefully consider the benefits of noise reduction versus the cost of replacing wall units with acoustically effective systems. Appropriate air conditioning will provide the additional noise reduction benefit of enabling residents to keep windows and doors closed which, particularly at night, affords the best noise reduction measure.

Through-wall (*not recommended)

Split system

Ducted

5.7 Roofs and ceilings

The roof area is normally the largest single element of a home that is exposed to aircraft noise. Therefore, increasing the noise reduction capability of the roof and ceiling can significantly reduce noise in the home. Where a solid wall would normally attenuate noise by up to 50 dB(A), ceilings and roofs of standard construction will on average only effect a 33 dB(A) reduction. As aircraft noise is an overhead source, improving the acoustic rating of this area of a home can be an effective way to reduce aircraft noise intrusion.

Some ways to achieve this are to:

- add thermal insulation above the ceiling between ceiling joists and the roof,

Thermal insulation

- use surface mounted or drop light fittings instead of recessed types,
- lay 10 millimetre plasterboard over joists and add additional insulation above plasterboard, and
- install a loaded vinyl noise blanket over the insulation and joists.

Alternatively, acoustic insulation can be used in the ceiling. This insulation has greater density than thermal insulation. A product with a thickness of 50 millimetres and density of $32kg/m^3$ is suitable. Acoustic insulation is available from many companies, but some examples of suppliers are provided in Appendix C.

Depending on the circumstances, it may only be necessary to install plasterboard or a loaded vinyl noise blanket and additional insulation over bedroom areas.

**You must ensure the roof structure can support the additional weight of plasterboard or loaded vinyl and insulation. Insulation batts must be at least R2.5 to be acoustically efficient. R2.5 or even R3.0 batts can generally be purchased from a hardware store.*

Wavebar loaded vinyl noise blanket above ceiling

Downlights and their transformers should not be covered as they need space for heat to escape. Covering downlights can be a fire hazard. It is recommended that lights with gaps, such as gimbal lights, be replaced with either surface mounted lights or non-gimbal LED downlights.

Gimbal light

5.8 Windows

Due to their relatively lightweight construction, aircraft noise travels easily through windows.

In addition to sealing around windows (refer to section 5.1), other options for insulating windows include:

Glazing

Increasing the glazing (glass) thickness can significantly decrease noise transmission through a window. Residential windows are generally constructed from three or four millimetre glass, which provides a noise reduction of around 20 dB(A). Changing the glass to a 6.38 – 10.38 millimetre laminated glass improves the noise reduction through the window by about 5 – 8 dB(A).

Double glazing

Using double glazed windows (two panes of glass) with a 50 millimetre gap between them can reduce noise penetration from 20 dB(A) to around 30 dB(A). There are two ways to double glaze – using two separate frames of glass, or a double glazed unit in a single frame. Either option is suitable for weatherboard or single brick homes.

In double brick homes, windows are normally positioned over the cavity, leaving space to install a secondary window. This is the most effective option, as typical sealed double glazed single units have small cavities of less than 50 millimetres, which is the minimum required in double brick residences. Single units are also an expensive option and not necessarily recommended due to cost.

If the existing window is an awning, sliding or casement type, a sliding window could be installed on the inside. This option allows for the windows to be opened during the day, but closed during the night, as opposed to having a fixed secondary pane of glass.

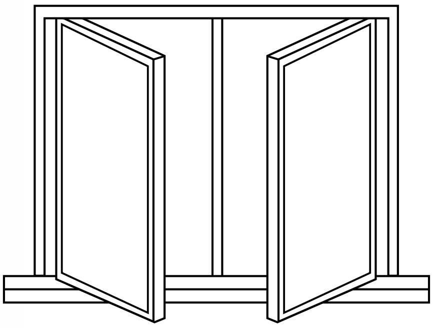
Another option is to install a magnetically-attached acrylic (as opposed to glass) panel behind the existing window.

Due to their construction, sliding windows let in more noise than casement or awning windows which can be fully closed against acoustic seals. Good window manufacturers and installers can provide information on window types, such as sliding windows that seal when closed, double glazing and laminated glass.

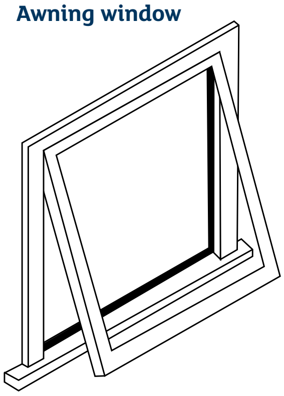
**Note: When considering an increase in glazing thickness or replacing existing glass, care needs to be taken to ensure the existing frame can accommodate thicker glass.*

Magnetite double glazing system

Casement window



Awning window



The Magnetite magnetically-attached acrylic panel system

5.9 Skylights

A skylight is a type of window through the roof covered by a sheet of glass or perspex. Some improvement can be made by adding a sheet of thicker laminated glass in a timber frame at the bottom of the skylight. However, the best option is to remove the skylight and patch the ceiling and roof.

Replacing windows altogether can be costly, so serious consideration should be taken in comparing benefits to cost.

5.10 Eaves

Open eaves allow a direct path into the roof space and effectively bypass noise reduction methods in the roof construction. Noise then enters rooms via the ceiling.

Enclosing eaves decreases the overall noise in the roof space and hence the rooms.

Eaves can be closed as shown in the photo below, by using timber between the roof joists, or other materials such as MDF and compressed cement sheeting.

Open eaves

Closed eaves

5.11 Walls

Double brick walls provide adequate noise reduction and do not require improvement.

Weatherboard walls can be upgraded by installing insulation inside the cavity. The most cost effective and practical way to install insulation in the cavity is to use a blow-in type material.

Alternatives are to remove existing cladding, install insulation in the cavity, attach a layer of fibre cement to the outside wall and then return the existing cladding to the wall. This solution is expensive and should be a last treatment option. It should not be undertaken without specialist acoustic advice.

5.12 Fireplaces

Fireplaces provide a direct path for noise to enter a residence via the flue or chimney. There is very little that can be done to reduce noise through this path and removal may be the only alternative, in which case the remaining chimney can be acoustically sealed.

If the fireplace is located in a living space then the benefit of the fireplace could outweigh the noise reduction achieved. For bedrooms, doors can be closed to reduce noise from this path.

5.13 Summary of options

Generally, additional noise reduction will be most needed in bedrooms where lower noise levels mean a better night's sleep. Therefore, some of the options outlined in this document can be limited to bedrooms.

If a home that is affected by aircraft noise has recently been occupied, an assessment period of around three months is recommended before considering any noise reduction measures. This will allow time to adjust to the new environment and make a proper assessment of the impact of aircraft noise on day to day lives.

The following table provides a summary of noise control options. **The scale of costs apply to a typical four bedroom/two bathroom brick home** and are provided as a guide only. They are approximate costs and should not be relied on. **The options are listed in order of preference, with those options most likely to be of benefit at a reasonable cost listed first.** Similar costs would apply to a weatherboard home of comparable size.

When considering the remedial options provided in this booklet it is worth remembering that their effectiveness as noise attenuators applies also to their insulating properties. Any of these actions will not only reduce noise from any source, they will also help keep a home cooler in summer and warmer in winter.

Option	Scale of cost	Comment
1. Seal gaps	\$4.50/lm = \$300	Seal gaps around window frames and doors, requires silicone sealant. Available from hardware stores.
2. Add seals to doors/ upgrade door type	\$275	Compressible seals to frame and drop seal to threshold. Range available from hardware stores or other suppliers.
3. Seal eaves	Should already be sealed to comply. 80lm house \$3,800	Seal eaves using timber, MDF or compressed fibre cement sheeting.
4. Replace hollow doors	\$150/door	Replace any existing hollow core external doors with solid core door with acoustic seals. Requires specialist supplier.
5. Add seals to windows	\$900	Install compressible seals. Range available from hardware stores.
6. Replace air conditioning	Ducted \$15,750 Split \$6,300	Remove any through-wall air conditioning units and replace with a split or ducted unit.
7. Upgrade glazing to windows*	\$2,500	Most domestic glazing (glass) is 3 – 4 millimetres thick. Replace with 6.38 – 10.38 millimetre thick laminated glass. Only recommended for bedrooms due to cost. Professional installation recommended.
8. Treat or remove skylight	\$300	Add a layer of 10 millimetre laminated glass at the bottom of the skylight.
9. Insulate ceiling	250m^2 ceiling \$8.50m^2 \$2,125 Soundcheck \$12.50/m^2 \$3,125	Insulation needs to cover entire ceiling. Insulation to be a minimum of R2.5 or 50 millimetre acoustic insulation. Available from hardware stores.
10. Add plasterboard or loaded vinyl noise blanket above ceiling	\$6,825	Requires good access to ceiling and a structure capable of supporting additional weight. Insulation is required to be laid over plasterboard. Recommended above bedrooms only due to cost. Available from hardware stores. Downlights not to be covered, can be replaced with fixed LED lighting.
11. Replace windows*	\$4,725 – \$5,250	Replace window frames with awning or casement types with correct seals and 6.38 – 10.38 millimetre laminated glass (glazing). Not recommended due to cost. Requires professional installation.
12. Double glazing*	\$26,250	Separate frames recommended over single units due to cost.

**Occupant needs to decide between the option of upgrading the glazing (glass) in windows or replacing the entire window frames, or if either should be undertaken.*

Appendix A – Australian Standard

AS2021 recommends indoor design sound levels for various spaces within a building, due to aircraft noise. These recommendations apply to new buildings constructed in certain specified areas, but are often also adopted as design goals when considering noise reduction measures for existing buildings. The recommended maximum indoor design sound levels within a residence are listed in the following table.

In March 2015 Standards Australia released the revised Standard AS2021-2015. This revision includes updated aircraft tables and advice about the development and endorsement processes for Australian Noise Exposure Forecasts (ANEF). A copy is available for purchase from SAI Global at **saiglobal.com**

Indoor design sound levels for determination of aircraft noise reduction

Location	Indoor design sound level, dB(A)*
Sleeping areas, dedicated lounges	50
Other habitable spaces	55
Bathrooms, toilets, laundries	60

**Decibels*

Appendix B – Hearing mechanisms and noise levels

In understanding the impact of aircraft noise it is helpful to have a basic understanding of sound, its propagation and the way the human ear perceives it as sound or noise.

Sound and noise are physically the same, the difference being that noise is defined as unwanted sound.

The ear is sensitive to air pressure variations from sound waves. Sound occurs due to oscillations of pressure in the air, just above and just below atmospheric pressure. This can be graphically represented as a wave pattern. These pressure oscillations reach the ear and are heard as sound.

Sound pressure can be measured directly, however the audible range of sound covers an enormous range of pressures. As shown in the following table, the sound pressure level of a jet engine is nearly a million times more than the sound pressure of a whisper. In order to manage such a large range of pressure variation, a logarithmic scale is utilised.

Fortunately, one of the peculiarities of the hearing mechanism is that the response of the ear to changes in sound level is well represented by a logarithmic scale.

Sound pressure levels are expressed as a ratio relative to a constant reference pressure. This pressure is 2 x 10 – 5 N/m^2, which corresponds to the lowest sound level the ear can normally detect. This ratio is expressed as 10 times the log of the ratio and the units are decibels (dB).

We also hear over a range of frequencies, with the human ear detection range generally being between 20 Hz and 20 000 Hz.

However, we do not respond to the loudness of noise equally over the entire frequency range – the ear is more sensitive to mid to high frequencies and less sensitive to low frequency noise. Due to this variation in sensitivity, a weighting scale has been adopted, which is known as the 'A' scale. Noise measured in the 'A' scale is written as dB(A).

The logarithmic scale is extremely useful in describing noise levels, however, it is non-linear so it can be confusing when considering the additive effect of two or more noise levels. For instance, the increase in overall noise level due to two identical noise sources is 3 dB(A). Eg: 35 dB(A) plus 35 dB(A) equals 38 dB(A).

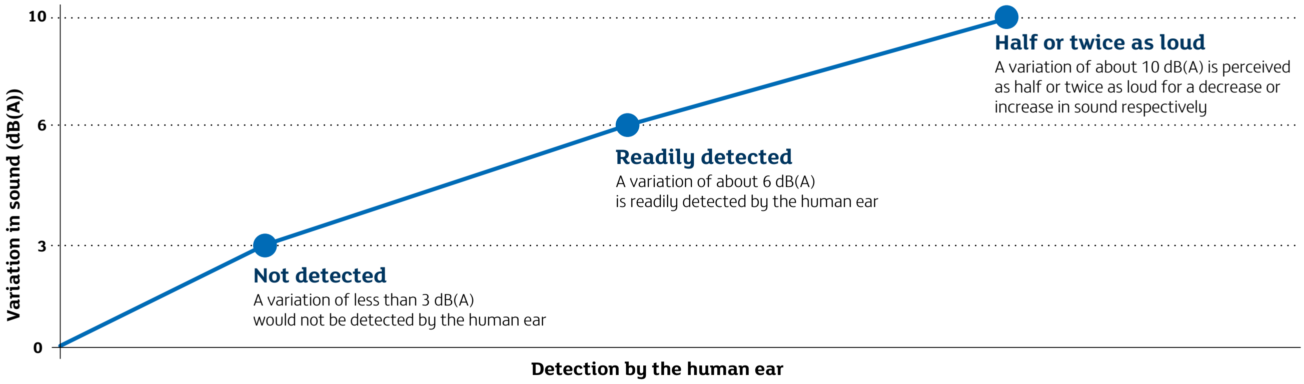
Typical sound pressure levels (logarithmic scale)

Pressure level (N/m^2)	Noise level (dB(A))	Typical level
200	140	Emergency siren
20	120	Threshold of pain
6.3	110	Angle grinder
2	100	Rock band at 5m from speakers
2.8 x 10-1	83	Heavy diesel truck travelling at 40km at a distance of 7m
2.2 x 10-1	81	Modern twin-engine jet take-off at a distance of 152m
6.3 x 10-1	70	Average traffic noise on footpath
2 x 10-2	60	Typical business office
6 x 10-3	55	Conversational speech
2 x 10-3	40	Average residential home
1 x 10-3	35	Bedroom at night
2 x 10-4	20	Whisper
2 x 10-5	0	Threshold of hearing

N/m^2 - Newtons/metre^2 which is pressure of Pascals (Pa)

The perception of variation of sound levels is shown in general terms in the below graph:

The perception of variation in sound levels (logarithmic scale)



Appendix C – Useful resources

Aircraft noise information

Aircraft Noise Information Portal

A range of organisations have different roles and responsibilities in relation to aircraft noise management. Perth Airport only has direct control over the management of ground-based aircraft noise. CASA is responsible for the administration and regulation of Australian-administered airspace under the *Airspace Act 2007,* while Airservices is the agency responsible for managing the airspace around Perth Airport. This includes the design of flight paths as well as the management of noise generated from aircraft approaching or departing Perth Airport.

Perth Airport is committed to working with Airservices, airlines, Commonwealth, State and Local governments to manage adverse impacts of aircraft noise on the community and as part of Perth Airport's commitment to ensuring the community has access to as much information as possible, Perth Airport has developed an Aircraft Noise Information Portal.

The purpose of the Portal is to help in understanding the flight paths and associated noise impacts that apply to individual properties.

The Portal includes information on:

- aircraft noise,
- flight paths around homes,
- land planning restrictions relating to aircraft noise,
- noise events and impacts related to homes,
- how to manage aircraft noise in homes, and
- information on runway closures and flight path trials.

A report summarising aircraft noise impacts for a particular address can be produced and the Portal also contains information on how to make an enquiry or complaint about aircraft noise. The Aircraft Noise Information Portal can be viewed at **perthairport.com.au/noise_faq**

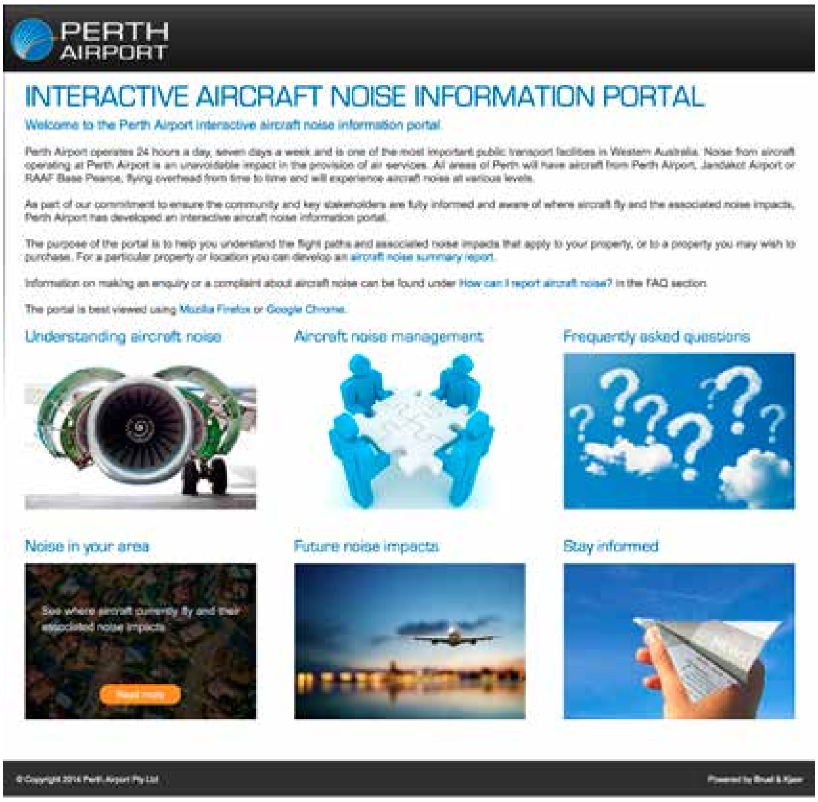
Airservices Australia

Airservices Australia manages the handling of enquiries and complaints regarding aircraft noise through the Noise Complaints and Information Service (NCIS). Airservices Australia's 'Reducing impact of aircraft noise at home' fact sheet is available from **airservicesaustralia.com** (aircraft noise/factsheets).

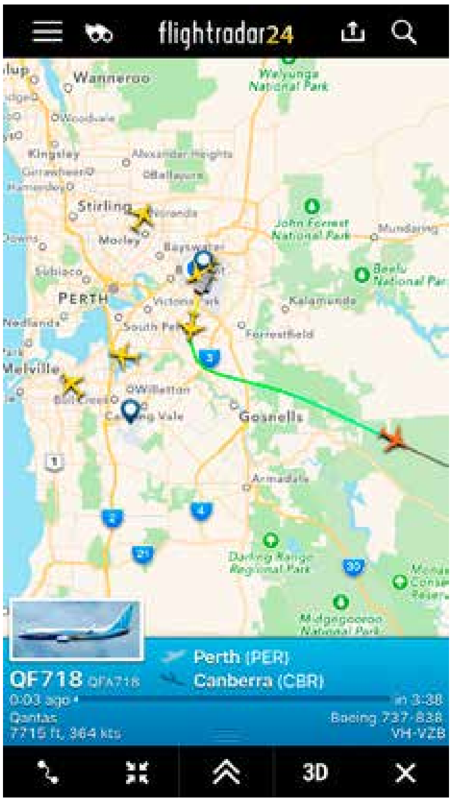
Flightradar24

Flightradar24 is an online tool that displays aircraft flight information on a map in real-time. Flightradar24 is available at **flightradar24.com** or for download as an app.

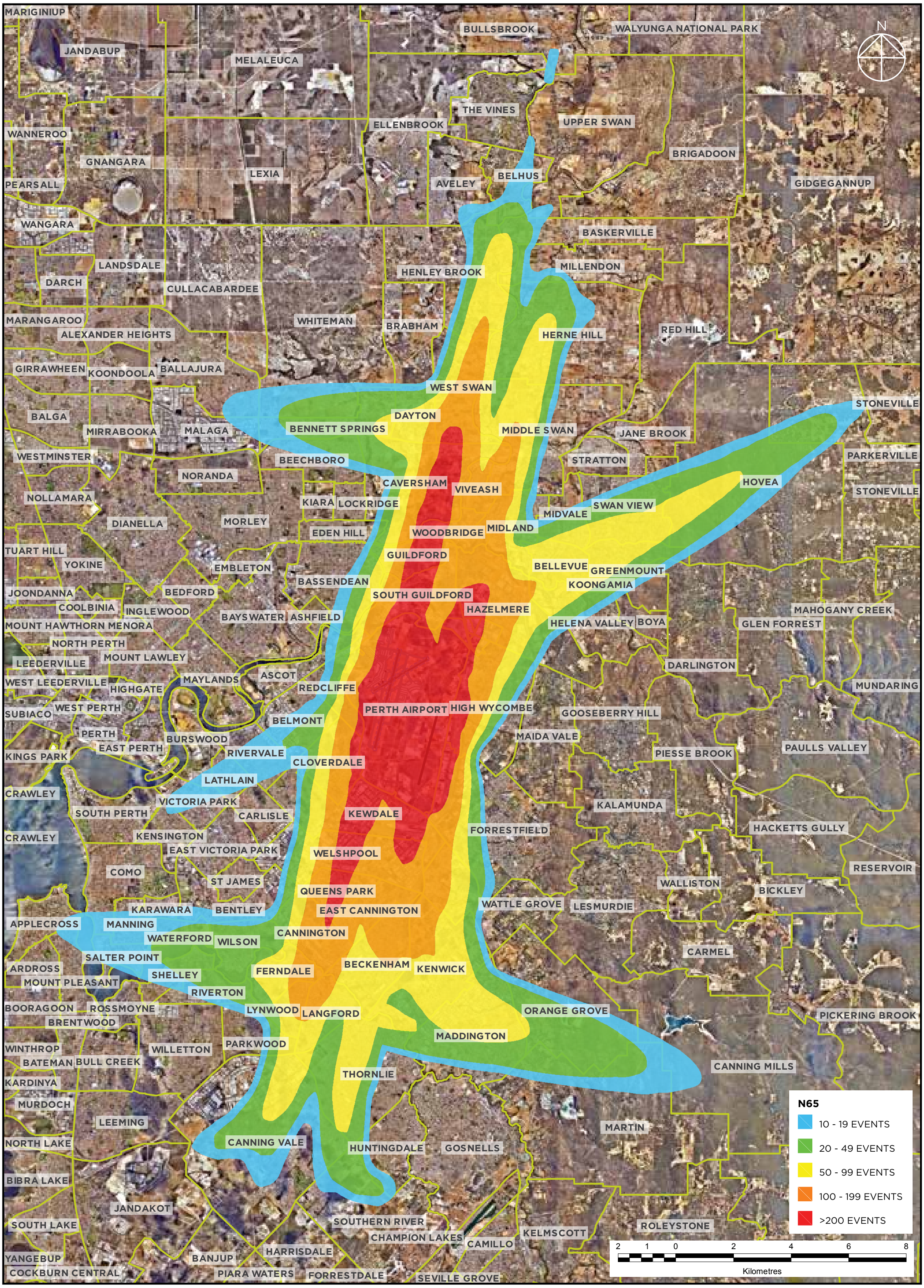
Aircraft Noise Information Portal



Flightradar24



Perth Airport Ultimate N65 Contour map: shows how many times on an average day that 65 dB(A) is exceeded at locations



N65 Contours

To improve how aircraft noise is communicated to the public, 'Number Above' (or 'N') noise contours were developed by the then Commonwealth Department of Infrastructure and Transport. 'Number Above' noise contours illustrate the average number of events per day that exceed a certain sound level, based on how a person typically perceives noise. The 'Number Above' or 'N65 contour maps' combine information on single event noise levels with aircraft movement numbers.

The N65 contour map for Perth Airport illustrates the average number of events per day over 65 decibels [65 dB(A)] for a particular area. This corresponds to an outdoor sound level of 65 decibels [65 dB(A)] and an indoor noise level of approximately 55 decibels [55 dB(A)]. This is considered the sound level at which conversation is disturbed.

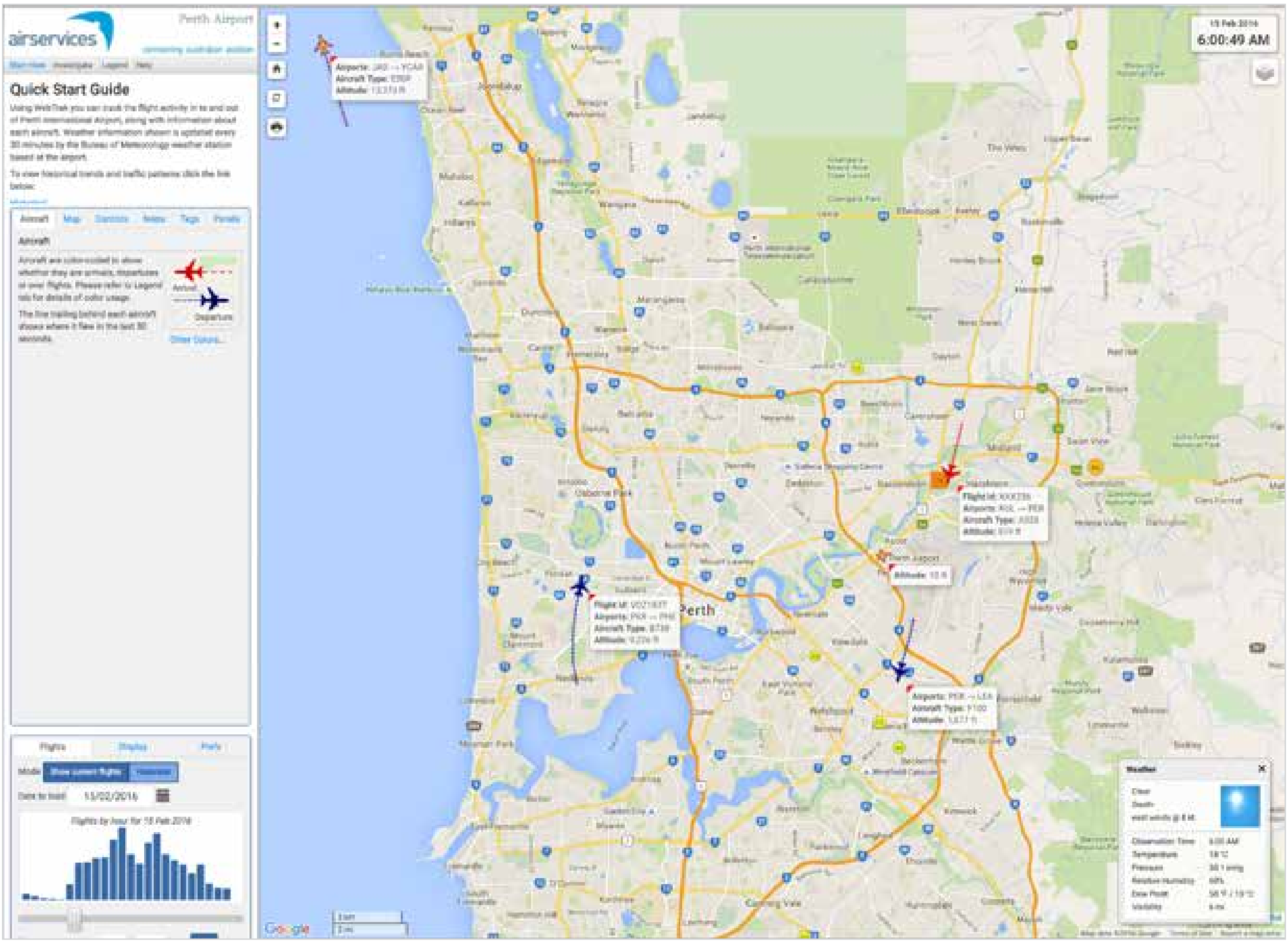
It should be noted, that the N65 contour map represents an average day and not a typical day. On a typical day more events may be experienced than the N65 contours suggest. This is because the traffic at Perth Airport varies significantly from season to season, day to night, weekdays to weekends and even from Monday to Wednesday.

While the National Airports Safeguarding Framework identifies the N70 mapping as a standard, Perth Airport has chosen to use the lower threshold of N65 noting that people in Perth tend to have their windows open and spend more time outdoors more commonly than those in other cities.

WebTrak

Another useful online tool for tracking aircraft movements is WebTrak. WebTrak displays surrounding suburbs within 55 kilometres of Perth Airport and allows the viewing of historical information about noise levels and arriving and departing aircraft, from as recent as 40 minutes to three months ago. WebTrak can be accessed at **airservicesaustralia.com** (aircraft noise/launch webtrak/ Perth) or via Perth Airport's Aircraft Noise Information Portal: **perthairport.com.au/noise_faq**

WebTrak online tracking tool



Common questions about aircraft noise

Will aircraft noise affect my health?

A number of research studies have been undertaken to investigate the effect of noise on human health and wellbeing. These studies need to be considered collectively, and in context, if drawing any conclusions about the potential impact of aircraft noise on areas surrounding Perth Airport.

To help people understand the true impact of aircraft noise on human health and wellbeing, the Department of Environment has produced a leaflet, 'Aircraft Noise and Its Effects'. A copy of the leaflet is available at **perthairport.com.au/noise_health**

There are planning measures in place around Perth Airport aimed at protecting residents from being adversely affected by aircraft noise.

Does living near the airport affect development on my land?

For land use planning purposes in Australia, aircraft noise impact is illustrated using the ANEF system.

The ANEF plans indicate the anticipated noise contours for the most likely or preferred development and forecasts for an airport. The ANEF is a central component of the AS2021 regarding land use planning in the vicinity of airports.

At Perth Airport an ANEF plan for the long-term airport capacity of 350,000 aircraft movements a year has been produced. It is expected that 350,000 movements will be achieved in approximately 50 years. The contours show the average daily aircraft noise exposure associated with the long-term airport development, including extensions to, and construction of new runways.

Perth Airport currently has approximately 145,000 aircraft movements per year and this is expected to grow to 222,000 by 2034.

The implications for development of land are summarised within the Western Australian Planning Commission's (WAPC) 'State Planning Policy No. 5.1 – Land Use Planning in the Vicinity of Perth Airport'. If a property is located within the ANEF 20 contour and above, then there can be zoning and development restrictions placed on land. This protects against inappropriate or low structural quality development being built in areas most likely to be affected by aircraft noise. The extent to which a property can be subdivided may also be affected. In some cases there may be a notification on land title, which is intended to forewarn future purchasers about the likely presence of aircraft noise.

Conditions such as noise insulation may also be a requirement of planning approval. Advice on noise insulation is given in the WAPC's publication 'Aircraft Noise Insulation for Residential Development in the Vicinity of Perth Airport' leaflet.

For information about land use planning policy in the vicinity of Perth Airport, please contact the Planning Department of the relevant local council or contact the WAPC on 6551 9000. A copy of the 'State Planning Policy No. 5.1 – Land Use Planning in the Vicinity of Perth Airport' and the 'Aircraft Noise Insulation for Residential Development in the Vicinity of Perth Airport' publication can be viewed by visiting **planning.wa.gov.au** (publications).

To find out more about the ANEF plan, view the Perth Airport Master Plan 2014 at **perthairport.com.au/masterplan** A hard copy of the ANEF plan is also available from Perth Airport by calling 9478 8888.

How can I report concerns about aircraft noise?

Airservices manages enquiries and complaints regarding aircraft noise through the Noise Complaints and Information Service (NCIS). To make a complaint, contact Airservices by:

- using WebTrak – which includes an option to lodge a complaint. For further information visit: **webtrak.bksv.com**
- completing the online form available at **airservicesaustralia.com** (aircraft noise/making a complaint),
- contacting the Airservices NCIS hotline on 1800 802 584, 9am – 5pm EST
- emailing ncis@airservicesaustralia.com, or
- writing to Noise Complaints and Information Service GPO Box 367, Canberra ACT 2601.

For more information visit: **airservicesaustralia.com**

If an issue has not been effectively addressed, or adequate information provided, a complaint may be lodged with the Aircraft Noise Ombudsman (ANO) by:

- emailing ano@ano.gov.au,
- completing the online form available at **ano.gov.au** (making a complaint/online complaint form),
- contacting the ANO on 1800 266 040, or
- writing to the ANO, GPO Box 1985, Canberra ACT 2601.

For more information visit: **ano.gov.au**

Where can I find more information regarding aircraft noise and its management?

Resource	Web address
Aircraftnoise.com.au	**aircraftnoise.com.au**
Airports Act 1996	**comlaw.gov.au**
Airservices Australia	**airservicesaustralia.com**
Aircraft Noise Ombudsman	**ano.gov.au**
Air Services Act 1995	**comlaw.gov.au**
Commonwealth Aircraft Noise Regulations	**infrastructure.gov.au**
Commonwealth Government Department of Infrastructure and Regional Development	**infrastructure.gov.au**
International Civil Aviation Organisation	**icao.int**
National Airport Safeguarding Framework	**infrastructure.gov.au**
Noise and Flight Path Monitoring Reports	**airservicesaustralia.com**
Perth Airport	**perthairport.com.au/noise**
Perth Airport Master Plan 2014	**perthairport.com.au/masterplan**

Useful contacts

Noise reduction information

Web address	Description
oharenoise.org	A booklet on sound insulating existing homes in Chicago can be downloaded from this website (under Resources/ Publications). It contains some useful information and illustrations but is written for American conditions.
wapc.wa.gov.au	The publication 'Aircraft Noise Insulation for Residential Development in the Vicinity of Perth Airport' can be downloaded from the Western Australian Planning Commission's website (under Publications/Search for title). This publication relates to residential construction around the airport and is relevant if an extension is being planned for a home, or sections are to be demolished or rebuilt.

Noise reduction products

The following suppliers of acoustic products are provided for information purposes only. Alternative manufacturers and suppliers also provide products that are similar and suitable for application to control aircraft noise. Perth Airport does not endorse or recommend any specific product or supplier.

Web address	Description
acoustica.com.au	Suppliers of Aeropac sound ventilators and loaded vinyl noise barriers
architectureanddesign.com.au	Australian architectural website that lists information and manufacturers of building materials and services. The InfoLink search system can be used to search for keywords such as 'acoustic' and locate information on insulation, doors, windows etc.
autex.com.au	Suppliers of acoustic insulation
csrmartini.com.au	Suppliers of acoustic insulation
lorient.com.au	Suppliers of acoustic seals
magnetite.com.au	Suppliers of soundproofing and thermal insulation for existing windows
pyroteknc.com	Suppliers of loaded vinyl noise barrier (Wavebar)
raven.com.au	Suppliers of acoustic seals
soundblock.com.au	Double glazing, noise reduction and soundproofing products
thermotec.com.au	Suppliers of loaded vinyl noise barrier

If you are considering sound insulation for a home, it may be beneficial to contact an acoustic consultant to ensure the proposed changes will provide effective noise reduction. Visit the **Association of Australian Acoustical Consultants (AAAC)** website for more information: **aaac.org.au**

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