

Williamtown Special Activation Precinct

Planning Considerations for Noise

13 December 2022

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13 December 2022

Williamtown Special Activation Precinct

Planning Considerations for Noise

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EXECUTIVE SUMMARY

This Noise Impact Assessment was conducted for the Department of Planning and Environment (DPE) to investigate the noise impact of the Williamtown Special Activation Precinct (SAP).

The structure plan for the Williamtown SAP comprises over 258 ha of developable land and incorporates a holistic flooding and drainage solution comprising a system of wetlands and linear channels. This report investigates and describes the applicable noise performance criteria of the structure plan for the Williamtown SAP.

This report summarises planning consideration and presents an analysis of the future land uses across the SAP. This report investigates the potential noise impact of the future land uses across the SAP at existing industries and sensitive areas. The report also presents an analysis of the potential noise constraints for the future proposed land uses.

One of the major noise sources which will impact the land use compatibility is aircraft noise from the Royal Australian Air Force (RAAF) Base Williamtown and Newcastle Airport. Aircraft noise impact was noted as being a limiting factor to determine compatibility of certain proposed industries, typically to land close to Newcastle airport and the RAAF base.

Land compatibility due to aircraft noise impact may slightly change beyond Year 2025. The Aircraft Noise Reduction (ANR) for building envelopes is calculated based on the maximum aircraft noise based on the aircraft type and the flight path. New or upgrades to airport runways will result into changes to flight paths and consequently maximum aircraft noise may be expected to change at sensitive receptors. This will typically result into additional upgrades to building envelopes to maintain an appropriate level of indoor acoustic amenity. The ANR is a design parameter used to determine appropriate building components. In general, specialist acoustic advice is recommended to be sought to ensure that the sound transmission loss of all individual building components is appropriate to achieve the required ANR values. This is the most cost effective method to ensure aircraft noise is adequately mitigated.

Existing residential dwellings which may also be impacted by future development, were identified. Potential noise mitigation strategies are discussed in this report while considering the existing land uses and sensitive areas to achieve a favourable acoustic outcome for the Williamtown SAP. Provision of buffer distances should be the first cause of action in terms of noise mitigation between high noise activities and highly sensitive areas. Buffer distances may not always be sufficient and additional noise mitigation strategies may be required to be implemented to achieve the noise goals of the development.

A Noise Management Precinct (NMP) is a form of economic instrument which should be considered when managing noise amenity. Economic instruments enable environmental requirements to be achieved at a lower cost than strict controls alone. In the case of a noise management precinct, the options for mitigating or managing noise are increased compared to traditional approaches. The ability to relocate a noise source, or trade or purchase noise mitigation at another site once standard mitigation measures have been applied, can reduce the cost of development when compared to traditional approaches.

The NMP approach allows noise from multiple sites to be managed as a single site by giving the operator of an activity or proposed activity the flexibility to take action to reduce noise in another nearby location, or work with others to take action to reduce noise on their behalf. While a new noise source always adds to existing noise levels, the NMP approach ensures any nominal increase from a single development is not significant and not detectable by the community. By maintaining the requirement to implement the usual suite of reasonable and feasible mitigation options, there is also potential for noise levels to be reduced over time.

In situations where high noise generating industries or activities are close to sensitive areas, a localised noise assessment will allow for a more concrete investigation to ensure the acoustic amenity of the local community is not adversely impacted. This localised assessment will provide a method to investigate cost effective solutions. The NMP should also be used as a tool to ensure cumulative impact are considered to meet noise goals.

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Acronyms and Abbreviations

Name	Description
ADF	Australian Defence Force
ANEC	Australian Noise Exposure Concept
ANEF	Aircraft Noise Exposure Forecast
ANL	Acceptable Noise Levels
EPA	Environment Protection Authority
ERM	Environmental Resources Management Australia Pty Ltd
NMP	Noise Management Plan
NPI	The EPA NSW Noise Policy for Industry (2017)
PNTL	Project Noise Trigger Level
RAAF	Royal Australian Air Force
RNP	Road Noise Policy
SAP	Special Activation Precinct

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) has been engaged by the Department of Planning and Environment (DPE) to undertake a program of environmental and heritage studies to support the development of the Williamtown Special Activation Precinct (SAP).

The structure plan for the SAP provides a flexible framework to accommodate a range of proposed land uses and allows development to proceed with a staged approach that reflect the challenging nature of the SAP and need for a consultative design approach.

This report investigates the noise constraints and establishes noise performance criteria for the structure plan by considering the proposed land uses across the SAP and their impact on existing and future sensitive land uses. This report identifies land use conflict between proposed industries and sensitive uses, and presents noise mitigation and management strategies to achieve a favourable outcome across the SAP.

1.1 SAP Background

Funded by the Snowy Hydro Legacy Fund, a Special Activation Precinct is a dedicated area in regional NSW identified by the NSW Government as places where business will thrive. They will create jobs, attract investors and fuel development. The precincts will support industries in line with the competitive advantages and economic strengths of each area.

The Williamtown SAP will help to create a defence and aerospace hub, boost the local economy and generate thousands of new jobs for the region. It will build on the Hunter region's history of supporting Australia's defence industry and emerging aerospace industry around the Royal Australian Air Force (RAAF) base as well as its proximity to air, road, rail and sea transport.

It aims to build on the NSW Government's existing investment into the Astra Aerolab and create highly-skilled, long-term job opportunities that will attract investors, and strengthen the region's economy. The SAP planning process will deliver coordinated and precinct-wide approach to addressing historical land constraints including flooding and drainage, which have acted as a barrier to development in the past.

The State Environmental Planning Policy – Activation Precincts SEPP and the master plan will replace existing planning instruments. It will provide for environmental protection and performance, land uses and planning pathways. The goal is to undertake upfront assessment at a strategic level so industry and the community have certainty and clarity about what types of land uses and where development can occur.

1.2 Structure Plan

The original Investigation of the SAP was defined by the proponent and included 11,408 ha of land within the Port Stephens LGA. This broad SAP Investigation Area was centred on the Williamtown Aerospace Precinct and included:

- RAAF Base Williamtown and Newcastle Airport;
- The DAREZ (Defence and Aerospace Related Employment Zone);
- Small residential clusters (Salt Ash, Williamtown and Fullerton Cove);
- Commercial and light industrial clusters; and
- The Tilligerry State Conservation Area.

The structure plan comprised over 258 ha of developable land and incorporated a holistic flooding and drainage solution comprising a system of wetlands and linear channels. The structure plan is presented in **Figure 1-1**, and is considered within this assessment.

Locality and Project Area

F1-1

Drawing No:	0574306s_WSAP3_HER_G001_R6.mxd		Williamtown SAP
Date:	30/11/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 1 2km

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1.3 Objectives of this Report

The purpose of this analysis is to investigate the noise constraints and establish noise performance criteria for the structure plan of the Williamtown SAP.

The aim is to identify and describe key noise generating and noise sensitive areas within each of the future land uses and investigate approaches to mitigating and managing noise impacts.

The impact of aircraft noise, being a major source of noise intrusion to sensitive land uses within the SAP, will be investigated. Land constraints and compatibility will be established based on potential aircraft noise.

This report establishes noise performance criteria specifically for the structure plan while considering existing and future sensitive land uses, and investigates and develops noise control strategies.

We note that baseline noise monitoring used to establish the existing noise environment in the Investigation Area was carried out during the COVID-19 pandemic. The data is expected to be reflective of reduced human and industrial activity, such as reduced number of aircraft movements and reduced road traffic. The monitoring data may not accurately reflect the noise environment pre or post COVID-19.

The Report includes:

- Identification of key noise generating activities and noise sensitive areas with each land use of the structure plan;
- Establishing the aircraft noise impact over the structure plan and investigate land use compatibility;
- Establishing noise performance criteria for the proposed land uses, and existing and future sensitive uses surrounding the SAP; and
- Development of potential noise mitigation and management strategies across the SAP on the existing noise environment and proposed future land uses.

This assessment provides a comprehensive noise analysis of structure plan to be included in the Masterplan.

2. MAIN NOISE POLICIES, GUIDELINES AND STANDARDS

This section provides an overview of the main assessment criteria applicable to the proposed land uses of the Williamtown SAP. The assessment criteria are generally based on the type of noise source and the impacted receiver. Each proposed land use will typically introduce a specific type of noise source to which an assessment criteria may be allocated. The assessment criteria will inform the SAP in terms of achieving the noise goals for each land use, development and activity.

The main assessment criteria relevant to the SAP have been established in accordance with the following policies, guidelines and standards:

- Aircraft Noise:
  - Australian Standard AS 2021:2015. *Acoustics - Aircraft noise intrusion - Building siting and construction*.
- Operational Noise:
  - NSW Environment Protection Authority (EPA), *Noise Policy for Industry* (NPI) (2017).
- Road Traffic Noise:
  - NSW Department of Environment and Climate Change (DECC), *Road Noise Policy* (RNP) (2011).
- Construction Noise:
  - NSW Department of Environment and Climate Change (DECC), *Interim Construction Noise Guideline* (ICNG) (2009).
- Construction and Operational Vibration:
  - NSW Department of Environment and Conservation (DEC*), Assessing Vibration: A Technical Guideline* (AVTG) (2006); and
  - British Standard BS 7385-2:1993, *Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration* (1993).

Other noise policies, guidelines and standards will most likely be applicable to the SAP, based on the type of noise source introduced as part of a new development, and based on the recommended mitigation and management measures.

2.1 Aircraft Noise

AS2021[1] provides guidance on the siting and construction of buildings in the vicinity of airports to minimise aircraft noise intrusion. The assessment of potential aircraft noise exposure at a site is based on the Australian Noise Exposure Forecast (ANEF) system.

As presented in **Appendix A**, ANEF Contours 2025 drawn for on maps of the airport environment define land areas around the airport affected by increasing aircraft noise (increasing ANEF values). Land-use planning for new developments should be in accordance with **Table 2-1** to minimise the noise intrusion for developments in the vicinity of airports.

The resulting land use compatibility based on ANEF zones is presented in **Table 2-1.**

[1] Acoustics-Aircraft Noise Intrusion-Building Siting and Construction

Table 2-1: Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable	Conditionally Acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

2.1.1 ANEF Zone Considerations

In the areas outside the 20 ANEF noise contour, the standard assumes that noise exposure is not of significant concern. However, noise does not drop off at this contour. It should be recognised that the actual location of the 20 ANEF contour is difficult to define accurately, because of variations in aircraft flight paths, pilot operating techniques and the effect of meteorological and terrain conditions on noise propagation. For that reason, the 20 ANEF contour is shown as a broken line on ANEF plans.

Within 20 ANEF to 25 ANEF, the land is generally not compatible with residential or educational uses. However, land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate.

There will be cases where a building of a particular type will contain spaces used for activities which would generally be found in a different type of building (e.g. an office in an industrial building). In these cases, **Table 2-1** should be used to determine site acceptability, but internal design noise levels within the specific spaces should be determined in accordance with the indoor design levels for the determination of aircraft noise reduction as recommended in AS2021.

AS2021 does not recommend development in unacceptable areas. However, where the relevant planning authority determines that any development may be necessary within existing built-up areas designated as unacceptable, it is recommended that such development should achieve the required Aircraft Noise Reduction (ANR) in accordance with the Standard. For residences, schools, etc., the effect of aircraft noise on outdoor areas associated with the buildings should be considered.

AS2021 notes that new development should be restricted on greenfield airport sites, as noise level requirements for such development may impact airport operations. ERM has considered the operational requirements of the airport when developing the mitigation and management measures for the SAP.

2.1.2 Conditionally Acceptable ANEF Zone

Buildings on sites determined to be ‘conditionally acceptable’ should be designed such that the ANR values determined are achieved for all internal spaces in accordance with the procedures outlined in AS2021. In general, this will require that external windows and doors be kept closed, since if these are opened for ventilation purposes the aircraft noise reduction of the building envelope will be significantly reduced. If it is necessary to close windows and doors to comply with this Standard, building ventilation should be in accordance with the National Construction Code on the assumption that windows and doors are not openable. Mechanical ventilation or air conditioning systems complying with AS 1668.2 should be installed.

Various rooms in a building may require different indoor design sound levels and consequently different ANR values. In addition, the areas of external building components may differ between rooms. For this reason, determination of appropriate building components should be performed separately for each room within a building. In some cases, an external perimeter approach to design may be appropriate.

If internal doors within a building need to be opened for functional reasons, then noise transmission from other internal spaces should also be taken into account in determining the overall ANR for each room.

In general, specialist acoustic advice will need to be sought to ensure that the sound transmission loss of all individual building components is appropriate to achieve the required ANR values. Possible sound transmission through vents and other openings should also be considered in the design.

2.2 Operational Noise

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the NSW Environment Protection Authority (EPA). The Noise Policy for Industry (NPI) and relevant application notes provide a framework and methodology for deriving limit conditions for project consent and environment protection licence conditions.

The NPI is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

The assessment procedure for industrial noise sources has three components:

1. controlling intrusive noise impacts in the short-term for residential receivers;
2. maintaining an appropriate amenity noise level for all land uses; and
3. assessment of sleep disturbance at residential receivers.

In assessing the noise impact of industrial sources, all three components must be taken into account for residential receivers. Assessment of on-site noise sources is guided by NPI, which is applicable to industrial noise sources from activities listed in Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act). In general, the types of premises (noise sources) dealt with in NPI include:

- industrial premises;
- extractive industry premises;
- commercial premises (generally limited to noise from heating, ventilation, air conditioning and refrigeration, and energy generation equipment);
- warehousing premises;
- maintenance and repair facility premises;
- intensive agricultural and livestock premises, for example, cattle feedlots and poultry farms; and
- utility generation/reticulation service premises, for example, energy generation from sources other than wind.

It is also noted that NPI does not apply to the following noise sources:

- vehicles associated with an industrial premise that are on a public road;
- transportation corridors (roadways, railways, waterways and air corridors);
- noise from sporting facilities, including motor sport facilities;
- construction activities;
- noise sources covered by regulations (domestic/neighbourhood noise);

- Blasting activities;
- shooting ranges;
- internal or occupational noise within any workplace regulated by SafeWork NSW;
- wind farms; and
- amplified music/patron noise from premises including those licensed by Liquor and Gaming NSW.

2.2.2 Project Intrusiveness Noise Levels

The project intrusiveness noise levels were established for identified residential receivers across the entire Investigation Area during the baseline noise analysis for Stage 1 of the Masterplan. The structure plan has narrowed down the residential receivers which may potentially be impacted.

2.2.3 Amenity Noise Levels

To limit continuing increases in ambient noise levels (i.e. background noise level creep), the maximum amenity noise level within an area from industrial noise sources should not normally exceed the amenity noise levels prescribed in the NSW NPI. For the SAP, each land use may be considered as one large development catchment comprising of separate parcels or noise characteristics. For each land use, consideration of the existing industrial noise-generating establishments within each land use and adjacent land use must be considered to achieve its amenity noise level. The project amenity noise level nominated here is therefore applicable each land use precinct rather than individual parcels.

To account for other industrial establishments outside of the SAP that could potentially be impacting on existing receivers in the assessment area, the amenity noise level applicable for the SAP has been determined based on the following per NPI:

> *Project amenity noise level = Recommended amenity noise level (as per **Table 2.2** of NSW NPI) minus 5 dB(A)*

The established amenity criteria applicable to the SAP are presented in **Table 2-2**.

Table 2-2: Established Project Amenity Noise Level for the SAP

Type of Receiver	Recommended Amenity Noise Level, in dBA $L_{eq,period}$	Project Amenity Noise Level, in dBA $L_{eq,period}$
Residential Rural	Day – 50 Evening – 45 Night – 40	Day – 45 Evening – 40 Night – 35
Hotels, motels, holiday accommodation (Assumed noise amenity area is considered as rural)	Day – 55 Evening – 50 Night – 45	Day – 50 Evening – 45 Night – 40
School classroom (Noisiest 1-hour period when in use)	35 (Internal) or 45 (External)	30 (Internal) or 40 (External)
Place of worship – internal	40	35
Area specifically reserved for passive recreation (e.g. national park) (When in use)	50	45
Active recreation area (e.g. school playground, golf course) (When in use)	55	50
Commercial premises (When in use)	65	60
Industrial premises (When in use)	70	65

2.2.4 Maximum Noise Level Assessment – Sleep Disturbance

New noise sources from industries specifically operating at night have the potential to disturb people's sleep patterns. Sleep disturbance is considered for operation and construction activities based on the guidelines as follows.

The potential for sleep disturbance from maximum noise level events during the night-time period is detailed in the NPI. The operational sleep disturbance criteria at the nearest residential locations are the following:

- $L_{eq,15min}$ 40 dBA or the rating background level plus 5 dB, whichever is the greater, and/or
- L_{Fmax} 52 dBA or the rating background level plus 15 dB, whichever is the greater.

Where the development night-time noise levels at a residential location exceed the following, a detailed maximum noise level event assessment should be undertaken.

New proposed industries which are expected to operate in the night-time period are recommended to be located from residential noise receivers to prevent sleep disturbance.

2.2.5 Management of Annoying Noise Characteristics

Certain noise sources may exhibit characteristics with a higher potential to cause annoyance and are required to be addressed. Tonality, low frequency emphasis and intermittency are generally considered to be attention-drawing and can cause greater annoyance. In contrast, short-term single noise events are less likely to be disturbing and may warrant some relaxation in the applicable noise criteria.

Specific modifying factors in the assessment of the noise source emissions are given in the NPI and should be addressed for each noise source introduced within the SAP.

2.3 Road Traffic Noise

New development within the SAP will generate additional vehicle movements on the surrounding road network. The increase in traffic volume have the potential to impact sensitive receivers.

The application notes from the Road Noise Policy (RNP) detail the requirements for operation-generated traffic noise as follows:

- For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies where the noise level without the development is within 2 dB of, or exceeds the relevant day or night noise assessment criterion.

The consideration of mitigation is required where additional traffic on existing roads creates an increase of more than 2 dB at existing sensitive receivers. Arterial and sub-arterial roads are assessed over the day (7 am to 10 pm) and night (10 pm to 7 am) periods and local roads are assessed over a one hour period (typically the peak hour) within the respective day and night periods.

Table 2-3 presents a summary of noise level criteria for the arterial, sub-arterial and local roads affected by additional traffic from land use developments and construction activities.

Table 2-3: Summary of Noise Level Criteria for Roads affected by Additional Traffic

Road Type	External Road Traffic Noise Criteria	
	Day 7 am – 10 pm	Night 10 pm – 7 am
Freeway/arterial/sub-arterial roads	60 dB $L_{Aeq\ 15hr}$	55 dB $L_{Aeq\ 9hr}$
Local roads	55 dB $L_{Aeq\ 1hr}$	50 dB $L_{Aeq\ 1hr}$

2.4 Construction Noise

New development proposed within the SAP will give rise to construction noise which may impact the existing industries and residential receivers. The ICNG provides guidance on management and mitigation of construction noise and vibration for general construction activities. The ICNG recommends noise management levels (NML) to determine the noise level at which reasonable and feasible noise management and mitigation should be considered for construction activities.

The noise management levels are derived and applied for residential receivers and other land uses. For residential receivers, they are based on existing RBLs at the receiver plus an additional allowance of 10 dB during the recommended standard hours for construction work and 5 dB outside these hours. Residents are deemed likely to be affected by noise where the NML are exceeded and typically requires noise management measures. Where the predicted noise levels exceed 75 dBA, residents are deemed to be 'highly affected' and require additional considerations to mitigate potential impacts, such as physical noise mitigation measures.

The NML within and surrounding the SAP must be derived in accordance with the ICNG when the extent of the construction sites and potential receivers are identified.

2.5 Vibration

Operational and construction vibration can lead to cosmetic building damage (and structural damage in extreme cases), loss of amenity due to perceptible vibration, termed human comfort, and impacts on the condition and structural integrity of key infrastructure.

Cosmetic damage is regarded as a minor in nature; it is readily repairable and does not affect a building's structural integrity. It is described as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks, and separation of partitions or intermediate walls from load bearing walls. If there is no significant risk of cosmetic building damage, then structural damage is not considered a significant risk and is not assessed.

2.5.1 Cosmetic Damage

In the absence of a specific Australian Standard or guidelines to address cosmetic damage due to vibration, it is recommended to refer to known international standards and guidelines. The evaluation of vibration in relation to cosmetic damage to buildings form vibrational energy is proposed to be conducted in accordance with British Standard BS 7385-2:1993 – Evaluation and measurement for vibration in buildings – Guide to damage levels from ground borne vibration. **Table 2-4** presents the guideline limits for cosmetic damage for short-term vibration.

Table 2-4: Transient Vibration Guide Values for Cosmetic Damage (BS 7385)

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 – 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Note: values referred to are at the base of the building		

The guide values in **Table 2-4** relate predominantly to transient vibration, which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in **Table 2-4** may need to be reduced by up to 50%.

2.5.2 Human Comfort

Table 2-5 presents the limits (vibration dose values) above which it is considered there is a risk that the amenity and comfort of people occupying buildings would be affected by vibration from construction works. These limits are taken from the NSW Assessing vibration: a technical guideline.

Table 2-5: Vibration Limits (Human Exposure) for Intermittent Vibration

Location	Day 7 am – 10 pm		Night 10 pm – 7 am	
	Preferred	Maximum	Preferred	Maximum
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Schools, educational institution	0.40	0.80	0.40	0.80
Places of worship	0.40	0.80	0.40	0.80

3. STRUCTURE PLAN

The structure plan was refined and developed to ensure that the visions and principles of the Williamtown SAP are realised without impeding the existing approved development associated with the Newcastle Airport Master Plan.

The structure plan provides a flexible framework to accommodate a range of proposed land uses and allows development to proceed with a staged approach focussed on meeting short term market demand for aerospace and defence related industries, with airside access. The structure plan has incorporated a number of key changes that reflect the challenging nature of the SAP and need for a consultative design approach.

The Structure Plan includes a combined 285 ha of developable area, encompassing new land use zones including Infrastructure / Newcastle Airport / Drainage Channels, Flood Mitigation & Wetlands / Classified Road (SP2), and Regional Enterprise Zone (REZ). These areas are adjacent to an Environmental Conservation Zone (C2) in the western section of the Project Area.

The following section summarises noise considerations and outlines the applicable operational assessment criteria and potential limitations within the land use zoning areas. **Figure 3-1** presents the structure plan.

PROPOSED UNAPPROVED TAXIWAY G

NEWCASTLE AIRPORT

MEDOWIE ROAD

NELSON BAY ROAD

WILLIAMTOWN

"THE KEEPING PLACE"

ENVIRONMENTAL PROTECTION AREA

CABBAGE TREE ROAD

FLOOD MITIGATION

Legend

- Structure Plan Boundary
- Existing Newcastle
- Approved Astra Aerolab
- Proposed Unapproved Taxiway
- Bund Location
- Extent of fill/ Public Open Space Oppotunity
- Environmental Protection Area
- Drainage Channels, Wetlands and Flood Mitigation
- Developable Blocks
- Heritage Significant
- Indicative Road Layout
- Main Road
- Minor Road

Source:
Port Stephens LGA DCBD, DTBD 2020
Imagery - Nearmap Oct 2022
ESRI World Street Map

Structure Plan

F3-1

Drawing No:	0574306s_WSAP3_NA_G005_R4.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.2 0.4km

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3.1 Noise Considerations

Potential industries and noise considerations are summarised in **Table 3-1**. The proposed industries have been developed as a guide and encompasses various uses.

Table 3-1: Noise Considerations

Land Use Zone	Area (ha)	Description	Potential Industries	Noise Considerations
Infrastructure / Airport / Drainage/Classified Road (SP2)	62.7	This zone will develop the region with additional defence facilities, to add to the existing DAREZ (Defence and Aerospace Related Employment Zone), Astra Aerolab Business and Technology Park (Astra Aerolab) and the Williamtown Aerospace Centre including 1 Technology Place and Precinct 52.	Air Transport Facility Food and Drink Premises Freight Transport Facility High Technology Industry Light Industry Retail Premises Warehouse or Distribution Centre	The zone includes a mix of high and low noise generating land uses. Industrial noise sources will be required to be assessed against the Noise Policy for Industry. Potential new sensitive receivers, such as the training accommodation and education training facilities, should be considered in the assessment. Spatial planning should be carefully considered to ensure the high noise generating areas are separated from low noise generating areas and sensitive areas. Noise sources should be carefully positioned and selected to allow for effective and efficient design of mitigation measures. Aircraft noise impacts will also be required to assessed to ensure the suitability of the industry.
Environmental Conservation (C2)	152.8	The zone includes the general green biodiversity corridor and aims at connecting conservation lands.	Water Storage/Drainage Environmental Facilities	Noise sensitive receptors and noise emitting sources are expected to be limited in this area. Should noise sensitive uses be promoted in this area, spatial planning should be carefully considered to ensure the high noise generating areas from the other developable areas do not impact this zone. The impact of aircraft noise should also be considered to maintain the recommended level of amenity for any proposed noise sensitive use.

Land Use Zone	Area (ha)	Description	Potential Industries	Noise Considerations
Regional Enterprise Zone (REZ)	152.8	The zone aims to attract industries that would contribute and benefit from being close to Newcastle Airport and accomodates a wide range of industry and employment uses, including research and development.	Training Facilities Depots Freight Transport Facility High Technology Industry Light Industry Retail Premises Warehouses or Distribution Centres Commercial Premises Function Centers Office Premises Research Stations Community Facilities Food and Drink Premises Function Center Places of Worship Public Administration Buildings Research Stations Service Stations Hotels	It is anticipated that the zone will introduce amix of high, medium and low noise generating sources. Noise emissions from light and high technology industry may exhibit tonal and impulsive characteristics which will cause additional annoyance to adjacent sensitive receivers. The primary form of noise mitigation for high noise sources would be to provide a noise buffer between noise generating activities and sensitive uses. High noise emitting sources should be located as far as possible from sensitive uses or located in a shielded area by surrounding structures. Where high noise generating activities are located in proximity of sensitive receivers and the provision of a noise buffer is not an option, a noise model is recommended to be established to understand potential impact and to develop appropriate mitigation measures to ensure the acoustic amenity of sensitive receivers are preserved. Noise modelling should be considered on a case-by-case basis and would be dependent on the proximity of adjacent sensitive receivers, with the objective of developing cost-effective solutions. A spatial planning exercise may be needed where high noise generating activities are to be separated from noise sensitive receivers. The intended level of amenity for sensitive uses such as restaurants and cafes should be carefully considered to ensure appropriate mitigation measures are investigated and incorporated. Live music and entertainment will be required to be assessed in accordance with the NSW Liquor and Gaming Entertainment Noise Policy. Specific attention should be given to low frequency noise sources from loudspeakers. The locations of sensitive uses such as offices should be carefully considered to promote adequate acoustic privacy. A vibration impact assessment may also be considered in research and development industries. This ensures that vibration sensitive equipment within medical facilities or laboratories, for example, can operate shielded from external vibration sources.

4. EXISTING NOISE ENVIRONMENT AND MANAGEMENT LEVELS

The structure plan, being directly west of the existing RAAF Base Williamtown and Newcastle Airport, will be impacted by existing and future aircraft noise. Land uses within the SAP may impact upon existing surrounding sensitive uses, typically residential premises.

This chapter discusses the potential aircraft noise impact on the SAP, and the impact of the SAP on existing and new sensitive receptors within and outside of the SAP.

4.1 Aircraft Noise Impact

Areas within the Williamtown SAP are impacted by existing aircraft noise generated by the Royal Australian Air Force (RAAF) Base Williamtown and the Newcastle Airport. The impact is represented by the Aircraft Noise Exposure Forecast (ANEF) for those airports which provides a means of planning effective noise abatement measures and determining land use compatibility. The most up to date ANEF contour map is for the Year 2025, based on forecast aircraft movement at the RAAF Base and Newcastle Airport for that year.

Australian Noise Exposure Forecast (ANEF) maps are planning tools used at each airfield in Australia, to help Councils determine appropriate developments, and whether noise attenuation such as insulation and double glazing is required by homeowners for new developments.

In order to provide an authoritative basis for suitable land use planning in the vicinity of the Australian Defence Force (ADF) establishments, the Department of Defence (Defence) produces noise exposure contour maps covering the operations at Defence airfields and some air weapons or bombing ranges. Noise contour maps for Defence are produced in consideration of Australian Standard AS2021-2000 *Acoustics—Aircraft noise intrusion—Building siting and construction*. The ANEFs are generally reviewed every five years or when there is a change in the operating aircraft or when there is a significant change in the number of movements or operational characteristics

The ANEF and ANEC contours were produced by the Integrated Noise Model (INM), a sophisticated computer modelling tool developed by the FAA. Preparation of the input data for the INM requires detailed information regarding aircraft flight tracks, aircraft operational profiles, aircraft noise signatures, aircraft movement numbers on specific flight tracks and time of day of the operations.

The Integrated Noise Model software used to model the impact of aircraft noise was developed by the US Federal Aviation Administration in response to an increasing requirement to be able to scientifically measure and forecast noise impacts around airports. The first version of the model was released in 1978. Version 6.2a, was endorsed by Airservices Australia for the preparation of ANEF contours. INM version 6.2a was used for the preparation of the ANEF contours for RAAF Base Williamtown and SAAWR. The specific US based noise exposure system parameters are varied within the model to reflect the Australian parameters for the Australian Noise Exposure Forecast System as endorsed by the House of Representatives Standing Committee on Aircraft Noise. The INM software has since been superseded by the Aviation Environmental Design Tool (AEDT) which will be used for future development of ANEF mapping tools.

The forecast annual aircraft movement numbers in **Table 4-1** are used in Williamtown and SAAWR 2025 ANEF. The F-35A forecast annual aircraft movement numbers models the planned number of aircraft movements from two operational squadrons and one training squadron of F-35A (approximately 70 F-35A aircraft) that will replace the current Squadrons of F/A-18 Hornet aircraft.

Table 4-1: Forecast Annual Aircraft Movements for Year 2025

Aircraft	Arrivals	Departures	Circuit Movements	SAAWR Movements	Total
F-35A (JSF)	6964	6964	3118	1200	18246
HAWK LIF	1971	1971	2728	10716	17386
JPATS (PC-9)	1188	1188	1640	708	4724
Military Transport	190	190	0	0	380
KC-30A (MRTT)	95	95	0	0	190
AEW&C	384	384	192	0	960
Civil Heavy Jet (A330)	260	260	0	0	520
Civil Medium Jet (737400)	5460	5460	0	0	10920
Civil Commuter (DHC8)	5512	5512	500	0	11524
Civil Light (CNA441)	2002	2002	540	0	4544
Business Jet (CL601)	2002	2002	100	0	4104
Helicopter (IROQA)	374	374	164	0	912
Total	26402	26402	8982	12624	74410

The RAAF Base Williamtown and SAAWR draft 2025 ANEF are illustrated in **Appendix A.**

4.2 Existing Land Zoning and Sensitive Areas

Development within the Williamtown SAP may potentially cause an adverse noise impact on existing sensitive receivers outside of the SAP. The sensitive receivers have been identified based on the existing land uses and development types within the Investigation Area.

The zoning identified in the *Port Stephens Local Environmental Plan 2013* (PSLEP) will determine the existing permissibility of any development type within the specified zone. Should the development type be 'prohibited' for a given zone, a planning proposal would be required to rezone land to formally amend the zoning of the PSLEP. It is however as part of the SAP Masterplan, the land zoning will be amended to suit the vision and principles for Williamtown SAP.

SP1
SP2
C1
MEDOWIE ROAD
RU2
SP2
SP2
SP2
B7
RU2
RU2
WILLIAMTOWN
SP2
SP2
RU2
CABBAGE TREE ROAD
SP2
RU2
SP2
RU2
C1
RU2
BAY ROAD
C1

Legend

- Structure Plan Boundary
- Williamtown_SAP_layout_RevO -outline
- Main Road
- Minor Road
- B7 Business Park
- C1 National Parks and Nature Reserves
- RU2 Rural Landscape
- SP1 Special Activities
- SP2 Infrastructure

Source:
Port Stephens LGA DCBD, DTBD 2020
Imagery - Nearmap November 2021

Land Zoning in the Investigation Area

F4-1

Drawing No:	0574306s_WSAP3_NA_G003_R4.mxd		Williamtown SAP
Date:	07/12/2022	Drawing Size: A3	
Drawn By:	VN	Reviewed By: JW	Client: Department of Planning, Industry and

Coordinate System: GDA 1994 MGA Zone 56

0 0.2 0.4km

N

ERM

4.2.1 Project Noise Trigger Levels at Receivers

The potential project specific trigger levels and criteria for residential receptors were derived from noise monitoring data collected in November 2020. The criteria provide an understanding of the potential impact and constraints to existing industries and sensitive areas.

The criteria for residential receptors are derived in accordance with the Noise Policy for Industry 2017 (NPI), where the "Project Noise Trigger Level" (PNTL) were established for all identified residential (dwelling). The PNTL for other sensitive receptors are based on the recommended amenity noise levels.These criteria represent the operational noise criteria used to assess potential impacts at the receivers. PNTL for all times of day and associated assessment periods are provided based on the assumption that operational activities may occur during the daytime, evening and night-time. The PNTLs for each receptor type are summarised in **Table 4-2** below.

The applicable noise performance criteria are discussed in the following chapter based on the closest identified sensitive receivers.

Table 4-2: Project Noise Trigger Levels

Receiver Type	Project Noise Trigger Levels, L_{eq},in dBA		
	Day (7 am to 6 pm)	**Evening (6 pm to 10 pm)**	**Night (10 pm to 7 am)**
Residential	42	40	35
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	60	50	45
School classroom	35 (Internal) 45 (External)	-	-
Active Recreation	55[1]	55[1]	55[1]
Passive Recreation	50[1]	50[1]	50[1]
Industrial	65[1]	65[1]	65[1]
Place of worship (internal)	35[2]	35[2]	35[2]

Note 1: Limit applies when facility is in use.
Note 2: The NPI recommends that industrial noise levels do not exceed 40 dB ($L_{Aeq,\ 15minute}$) internally within places of worship when in use.
Note 3: $L_{Aeq\ 15minute}$ Amenity criteria are equivalent to the period level +3 dB.

5. NOISE PERFORMANCE CRITERIA

This chapter summarises the noise performance criteria for potential developments in the SAP, including land compatibility with the ANEF zones and applicable Noise Management Levels. The Project Noise Trigger Levels (PNTLs) applicable to new and existing sensitive uses within and surrounding the SAP are also summarised in this chapter.

5.1 Noise Performance Criteria for the SAP

The noise performance criteria for the SAP is summarised in **Table 5-1**, and includes:

1. Aircraft noise impact on potential developments; and
2. Project Noise Trigger Levels (PNTLs) for potential developments

Table 5-1: Noise Performance Criteria for the SAP

Potential Land Use	Potential Development	ANEF Zone	Assumed Building Type	ANEF Zone of Site	PNTL Day	PNTL Evening	PNTL Night
Defence and Aerospace/ Airside	Air Transport Facility	25-45	Other Industrial	Acceptable	65	65	65
	Food and Drink Premises		Other Industrial	Acceptable	65	65	65
	Freight Transport Facility		Other Industrial	Acceptable	65	65	65
	High Technology Industry		Other Industrial	Acceptable	65	65	65
	Industrial Activity		Other Industrial	Acceptable	65	65	65
	Light Industry		Light Industry	Conditionally Acceptable	65	65	65
	Restaurant or Cafe		Commercial Building	Conditionally Acceptable	60	60	60
	Retail Premises Signage		Other Industrial	Acceptable	65	65	65
	Warehouse or Distribution Centre		Other Industrial	Acceptable	65	65	65
Environmental Conservation Area	Water Storage/Drainage	25-45	Other Industrial	Acceptable	65	65	65
	Environmental Facilities		Public Building	Conditionally Acceptable	45	45	45
Freight & Logistics	Warehousing	25-45	Other Industrial	Acceptable	65	65	65
	Industry		Other Industrial	Acceptable	65	65	65
	Freight		Other Industrial	Acceptable	65	65	65
	Industrial Training Facility		Other Industrial	Acceptable	65	65	65
	Facilities		Other Industrial	Acceptable	65	65	65
	Depots		Other Industrial	Acceptable	65	65	65
Light Industrial	Food and Drink Premises	25-45	Other Industrial	Acceptable	65	65	65
	Freight Transport Facility		Other Industrial	Acceptable	65	65	65
	General Industry		Other Industrial	Acceptable	65	65	65
	High Technology Industry		Other Industrial	Acceptable	65	65	65
	Industrial Activity		Other Industrial	Acceptable	65	65	65
	Light Industry		Light Industry	Acceptable	65	65	65
	Restaurant or Café		Commercial Building	Acceptable	60	60	60
	Retail premises		Other Industrial	Acceptable	65	65	65
	Warehouse or Distribution Centre		Other Industrial	Acceptable	65	65	65
	Childcare Centre		Educational	Conditionally Acceptable	45	45	45
Advanced Manufacturing	Food and Drink Premises	25-45	Other Industrial	Acceptable	65	65	65
	High Technology Industry		Other Industrial	Acceptable	65	65	65

Potential Land Use	Potential Development	ANEF Zone	Assumed Building Type	ANEF Zone of Site	PNTL Day	PNTL Evening	PNTL Night
	Light Industry		Light Industry	Acceptable	65	65	65
Research and Development	Business Premises	25-45	Commercial building	Conditionally Acceptable	60	60	60
	Commercial Premises		Commercial building	Conditionally Acceptable	65	65	65
	Function Centre		Commercial Building	Acceptable	60	60	60
	High Technology Industry		Other Industrial	Acceptable	70	70	70
	Information and Education Facility		Other Industrial	Acceptable	70	70	70
	Office Premises		Commercial Building	Conditionally Acceptable	65	65	65
	Research Station		Commercial Building	Conditionally Acceptable	65	65	65
Commercial Center	Business Premises	25-45	Commercial Building	Conditionally Acceptable	65	65	65
	Commercial Premises		Commercial Building	Conditionally Acceptable	65	65	65
	Community Facility		Public Building	Conditionally Acceptable	65	65	65
	Food and Drink Premises		Commercial Building	Conditionally Acceptable	65	65	65
	Function Center		Public Building	Conditionally Acceptable	65	65	65
	High Technology Industry		Commercial Building	Conditionally Acceptable	65	65	65
	Information and Education Facility		Commercial Building	Conditionally Acceptable	65	65	65
	Office Premises		Commercial Building	Conditionally Acceptable	65	65	65
	Place of Public Worship		Public Building	Conditionally Acceptable	65	65	65
	Pub		Commercial Building	Conditionally Acceptable	65	65	65
	Public Administration Building		Public Building	Conditionally Acceptable	65	65	65
	Research Station		Commercial Building	Conditionally Acceptable	65	65	65
	Restaurant or Café		Commercial Building	Conditionally Acceptable	65	65	65
	Retail Premises		Commercial Building	Conditionally Acceptable	65	65	65
	Service Station		Commercial Building	Conditionally Acceptable	65	65	65
	Shop		Commercial Building	Conditionally Acceptable	65	65	65
	Childcare Centre		Educational	Conditionally Acceptable	45	45	45
Tourism	Space Camp	25-45	House, home unit, flat, caravan park	Conditionally Acceptable	50	45	40
	Hotels		Hotel, motel, hostel	Conditionally Acceptable	50	45	40
	Tourism Activity Operators		Commercial building	Conditionally Acceptable	65	65	65
	Entertainment		Commercial building	Conditionally Acceptable	65	65	65
	Leisure Centre		Commercial building	Conditionally Acceptable	65	65	65

Where the building site is classified as 'conditionally acceptable', the maximum aircraft noise levels and the required noise reduction should be determined in accordance with the procedures set in AS2021. The required aircraft noise attenuation (ANR) should be achieved from the proposed construction of the building. The ANR is based on the sensitivity of internal spaces.

In general, a 'conditionally acceptable' building will require that external windows and doors be kept closed, since if these are opened for ventilation purposes the aircraft noise reduction of the building envelope will be significantly reduced. If it is necessary to close windows and doors to meet the internal design noise levels, building ventilation should be in accordance with the National Construction Code on the assumption that windows and doors are not openable. Mechanical ventilation or air conditioning systems complying with AS 1668.2 should be installed.

Various rooms in a building may require different indoor design sound levels and consequently different ANR values. In addition, the areas of external building components may differ between rooms. For this reason, determination of appropriate building components should be performed separately for each room within a building. In some cases, an external perimeter approach to design may be appropriate. If internal doors within a building need to be opened for functional reasons, then noise transmission from other internal spaces should also be taken into account in determining the overall ANR for each room.

In general, specialist acoustic advice will need to be sought to ensure that the sound transmission loss of all individual building components is appropriate to achieve the required ANR values. Possible sound transmission through vents and other openings should also be considered in the design. This is the most cost effective method to ensure aircraft noise is adequately mitigated.

5.1.2 Sensitive Land Uses

Sensitive land uses, including long term accommodation facilities, schools, childcare centres, hospitals, nursing homes and other similar sensitive uses, would preferably located with the light industrial and commercial areas without the requirement of onerous architectural design.

Sensitive land uses would be located ideally in the 20-25 ANEF zone. However, subject to detailed design and review, such development may be developed in the 25-30 ANEF zone.

Sensitive development will be analysed and developed further in the SSD stages.

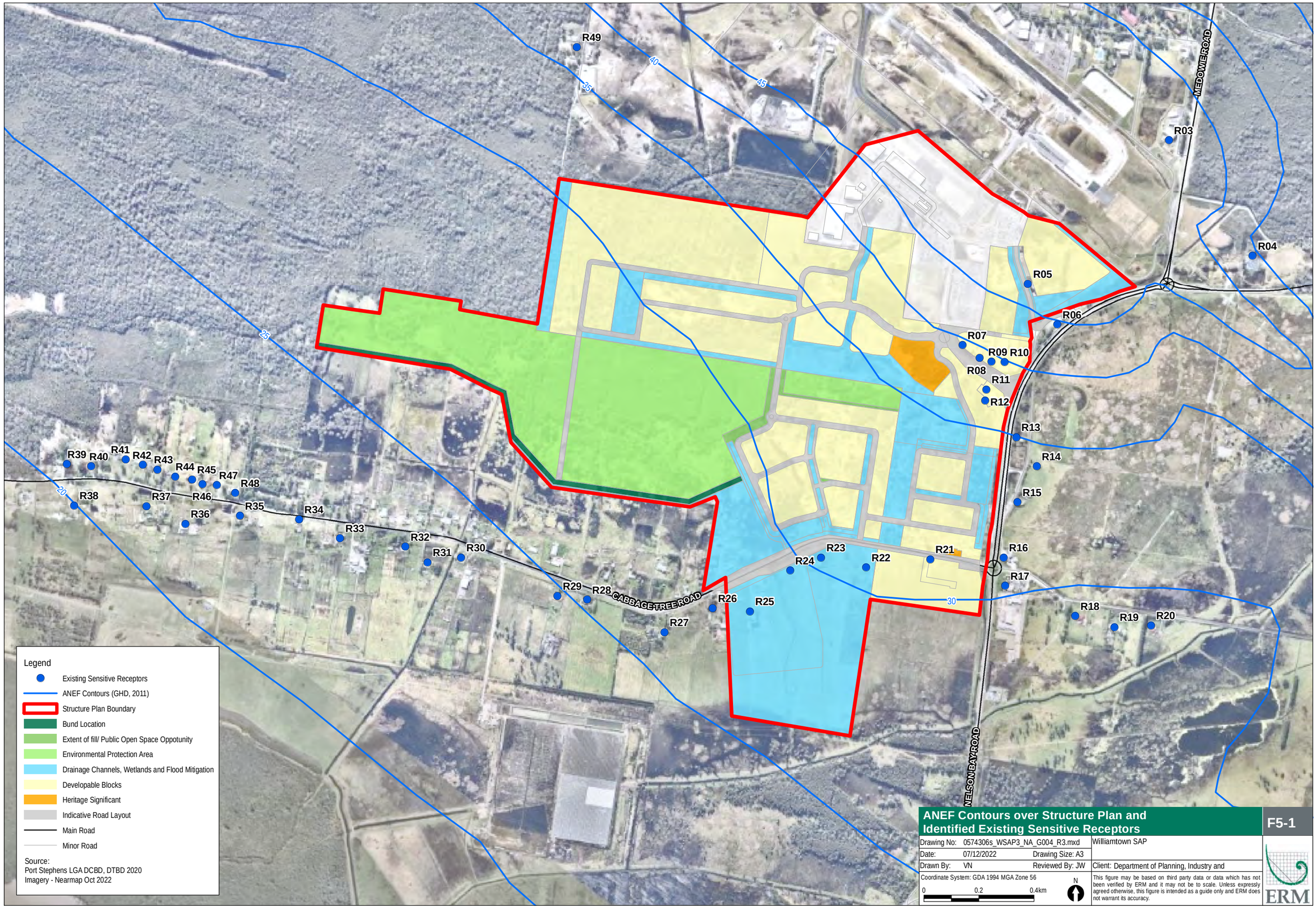
5.2 Existing Sensitive Receptors

This section summarises the existing sensitive receptors around the structure plan of the SAP. The sensitive receptors are summarised in **Table 5-2** and presented in **Figure 5-1**.

Table 5-2: Existing Sensitive Receptors Located around the Structure Plan of the SAP

ID	Easting	Northing	Direction	Receptor Type	Description	Address	PNTL, in dBA (Most Stringent)
R01	391046	6370928	N	Commercial	NTL Aviation Services	5/1 Williamtown Dr, Williamtown	60
R02	391467	6370733	N	Commercial/ Residential	RAAF Base Williamtown (Living quarters)	Williamtown RAAF	35
R03	392354	6369933	NE	Commercial	Fighter World	49 Medowie Rd, Williamtown	60
R04	392657	6369514	NE	Commercial	Newcastle OnRoad RC Car Club	Williamtown	60
R05	391842	6369412	NE	Commercial	The Monarch Historical Museum	2/8 Slades Rd, Williamtown	60
R06	391949	6369265	NE	Public Building	Williamtown Public Hall	2 Sandeman St, Williamtown	60
R07	391605	6369190	NE	Hotel	Mercure Newcastle Airport	2 Williamtown Dr, Williamtown	40
R08	391667	6369143	NE	Commercial	Lockheed Martin Australia	2 Williamtown Dr, Williamtown	60
R09	391710	6369130	NE	Commercial	Martin-Baker Australia	Building F/1 Technology Pl, Williamtown	60
R10	391758	6369128	NE	Commercial	Milskil	Unit 2.01, E1 Technology Place, Williamtown	60
R11	391692	6369029	NE	Commercial	Thrifty Vehicle Rental	1 Williamtown Dr, Williamtown	60
R12	391687	6368989	NE	Commercial	Metro Petroleum Williamtown	3 Williamtown Dr, Williamtown	60
R13	391800	6368856	E	Residential	Residential	14 Moxey Cl, Williamtown	35
R14	391874	6368751	E	Residential	Residential	20 Moxey Cl, Williamtown	35
R15	391804	6368621	E	Residential	Residential	24 Moxey Cl, Williamtown	35
R16	391755	6368419	E	Commercial	Metro Petroleum	1 Lavis Ln, Williamtown	60
R17	391760	6368317	E	Commercial	McDonald's Williamtown	Cnr Nelson Bay Rd &, Lavis Ln, Williamtown	60
R18	392014	6368208	E	Residential	Residential	12 Lavis Ln, Williamtown	35
R19	392156	6368167	E	Residential	Residential	16 Lavis Ln, Williamtown	35
R20	392289	6368173	E	Residential	Residential	20 Lavis Ln, Williamtown	35
R21	391488	6368413	S	Residential	Residential	Cabbage Tree Rd, Williamtown	35
R22	391256	6368384	S	Residential	Residential	41 Cabbage Tree Rd, Williamtown	35
R23	391092	6368419	S	Residential	Residential	63 Cabbage Tree Rd, Williamtown	35
R24	390980	6368373	S	Residential	Residential	75 Cabbage Tree Rd, Williamtown	35
R25	390834	6368224	S	Residential	Residential	89 Cabbage Tree Rd, Williamtown	35

ID	Easting	Northing	Direction	Receptor Type	Description	Address	PNTL, in dBA (Most Stringent)
R26	390699	6368236	S	Residential	Residential	103 Cabbage Tree Rd, Williamtown	35
R27	390524	6368149	S	Residential	Residential	121 Cabbage Tree Rd, Williamtown	35
R28	390243	6368267	S	Residential	Residential	Cabbage Tree Rd, Williamtown	35
R29	390136	6368281	S	Office	Port Stephens Council	157 Cabbage Tree Rd, Williamtown	60
R30	389786	6368419	S	Office	Encantador The Riding School	199 Cabbage Tree Rd, Williamtown	60
R31	389664	6368402	S	Residential	Residential	213 Cabbage Tree Rd, Williamtown	35
R32	389584	6368459	S	Residential	Residential	223 Cabbage Tree Rd, Williamtown	35
R33	389347	6368490	S	Residential	Residential	243 Cabbage Tree Rd, Williamtown	35
R34	389199	6368558	S	Residential	Residential	259 Cabbage Tree Rd, Williamtown	35
R35	388984	6368571	SW	Residential	Residential	279 Cabbage Tree Rd, Williamtown	35
R36	388786	6368542	SW	Residential	Residential	303 Cabbage Tree Rd, Williamtown	35
R37	388645	6368606	SW	Residential	Residential	313 Cabbage Tree Rd, Williamtown	35
R38	388383	6368608	SW	Residential	Residential	343 Cabbage Tree Rd, Williamtown	35
R39	388356	6368759	W	Residential	Residential	350 Cabbage Tree Rd, Williamtown	35
R40	388444	6368751	W	Residential	Residential	340 Cabbage Tree Rd, Williamtown	35
R41	388570	6368776	W	Residential	Residential	328 Cabbage Tree Rd, Williamtown	35
R42	388632	6368756	W	Residential	Residential	322 Cabbage Tree Rd, Williamtown	35
R43	388684	6368738	W	Residential	Residential	318 Cabbage Tree Rd, Williamtown	35
R44	388749	6368713	W	Residential	Residential	312 Cabbage Tree Rd, Williamtown	35
R45	388810	6368702	W	Residential	Residential	306 Cabbage Tree Rd, Williamtown	35
R46	388848	6368686	W	Residential	Residential	298 Cabbage Tree Rd, Williamtown	35
R47	388900	6368683	W	Residential	Residential	296 Cabbage Tree Rd, Williamtown	35
R48	388967	6368654	W	Residential	Residential	290 Cabbage Tree Rd, Williamtown	35
R49	390206	6370270	W	Industrial	Industrial	1 Williamtown Dr, Williamtown	65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MEDOWIE ROAD
CABBAGE TREE ROAD
NELSON BAY ROAD
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Legend
Existing Sensitive Receptors
ANEF Contours (GHD, 2011)
Structure Plan Boundary
Bund Location
Extent of fill/ Public Open Space Oppotunity
Environmental Protection Area
Drainage Channels, Wetlands and Flood Mitigation
Developable Blocks
Heritage Significant
Indicative Road Layout
Main Road
Minor Road
Source:
Port Stephens LGA DCBD, DTBD 2020
Imagery - Nearmap Oct 2022
ANEF Contours over Structure Plan and Identified Existing Sensitive Receptors
F5-1
Drawing No: 0574306s_WSAP3_NA_G004_R3.mxd
Williamtown SAP
Date: 07/12/2022
Drawing Size: A3
Drawn By: VN
Reviewed By: JW
Client: Department of Planning, Industry and
Coordinate System: GDA 1994 MGA Zone 56
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This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
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6. NOISE MITIGATION STRATEGIES

Based on the noise impact levels from proposed development at noise sensitive receivers, mitigation strategies to reduce the likely noise impact need to be considered. This section provides a general guidance on the recommended strategy to successfully implement noise mitigation measures.

More specific and detailed guidance is provided in the NSW Noise Policy for Industry (NPI) in regard to definition of 'feasible' and 'reasonable' mitigation and this is described in Appendix B.

From an acoustic perspective, possible strategies to mitigate noise are typically investigated in the following order (decreasing preference):

1. Land use planning and provision of appropriate buffer distances;
2. Noise control at the noise source;
3. Noise control along the noise transfer path; and
4. Noise control at the receiver.

It is also likely that a combination of various strategies will be required to provide the most feasible and reasonable acoustic outcome. Mitigation measures and strategies are recommended to be listed in the development standards for the Williamtown SAP.

6.2 Land Use Planning and Provision of Appropriate Buffer Distances

From a noise perspective, consideration to provide greater buffer distances between industrial/ high noise-generating development and high sensitive receivers (e.g. residential dwellings) is highly recommended. Although providing greater buffer distances may not always be feasible, it is the most effective way to control noise impact at sensitive locations. Providing buffer distances has its limitations and should be considered along with other factors unrelated to noise.

The structure plan has carefully been structured such that high noise emitting land uses are proposed to be located in the higher ANEF zone, and sensitive land uses are proposed in the lower ANEF zones. Generally, the structure plan has incorporated appropriate buffer distances, however, acoustic mitigation measures may still be required to be considered and developed at the SSD stages.

Noise levels are relatively less sensitive to small variances in distances. A doubling or halving of buffer distances typically achieves a notable noise level change. Theoretically, every doubling of buffer distance provides a noise reduction in the order of approximately 6dB.

Provision of buffer distances should be the first cause of action in terms of noise mitigation between high noise activities and highly sensitive areas. Buffer distances may not always be sufficient and additional noise mitigation strategies may be required to be implemented to achieve the noise goals of the development.

Where it is not practical or viable to provide a buffer, then mitigation will be via acoustic design of the building envelopes.

6.3 Assessment and Mitigation Recommendations

As detailed in the Stage 2 report, the recommendations to the Williamtown SAP remain largely unchanged. From a noise impact perspective, there are different approaches that can be taken to pursue noise mitigation strategies for the SAP. One approach is to focus on achieving a better acoustic outcomes in clusters of receivers.

On the basis of the selected principles above, the following are recommended:

- Consideration of mitigation as per NPI should be provided to allow the proposed Williamtown SAP in achieving the determined NPI project noise trigger levels at all receivers where possible; and
- The NPI does not consider the trigger levels as mandatory but strong justification must be provided if they cannot be met. Any exceedances will require consideration of receiver-based mitigation. On this basis, achieving the project noise trigger levels for the residential is likely to result in better overall project outcome (to the northeast and east of the Williamtown SAP) as any trigger to consider receiver-based treatment will involve a relatively large number of properties.

It should be noted that the level of detail in this report is considered suitable for planning considerations of the Williamtown SAP. A high level discussion of possible noise mitigation measures is provided in the NPI, however it is not possible to determine a more precise range of measures to be implemented (and to determine the likely final noise levels outcome) as this is dependent on numerous variables and can take many forms and combinations. It is expected possible further considerations will be required to account for the following:

- Upon availability of indicative total number of establishments within the Williamtown SAP, determine the project amenity noise trigger level for each establishments. It should also be noted that individual establishments will be subjected to a further reduced trigger levels than for the overall Williamtown SAP to ensure the overall trigger levels are not exceeded when considering cumulative noise impact from all land uses within the Williamtown SAP;
- Further development of the overall mitigation approach to be pursued (based on principles of the NPI); and
- Further consideration should be provided in determining strategies in implementing receiver-based treatment at the identified receivers. As the development of Williamtown SAP is expected to be progressive in nature, so can the roll-out of these treatments. The noise impact predicted and discussed in this report applies to a generally conservative cumulative impact, assuming all identified developable land areas to be noise generating. This is however not likely to represent the noise conditions in the early phase of development of the Williamtown SAP.

One robust way to determine the timing of implementation of receiver-based treatment is by continually assessing in-situ noise levels associated with the Williamtown SAP as it becomes developed. This can be achieved by:

- An overarching 3-dimensional computer noise model for the Williamtown SAP that is maintained and updated periodically by the SAP Development Corporation. The computer noise model created as part of this assessment can act as the basis for that noise model;
- A noise monitoring regime established and managed by the Development Corporation to measure changes in noise level as Williamtown SAP becomes developed. The noise monitoring regime will likely be comprised of permanent noise monitoring devices as well as regular/ strategic operator-attended noise monitoring at strategic locations; and
- These strategies will be beneficial in identifying noise contribution associated with on-site, off-site, transportation noise sources, as these are assessed differently managed using different trigger levels.

A level of acoustic assessment is likely to be required by future individual proponents to ensure any nominated constraints to limit noise impact in the Structure Plan noise report are complied with. The level of detail of the acoustic assessment required will likely vary depending on the complexity of the proposed development.

6.4 Development as a Noise Management Precinct

A Noise Management Precinct (NMP) is a form of economic instrument. Economic instruments enable environmental requirements to be achieved at a lower cost than strict controls alone. In the case of a Noise Management Precinct, the options for mitigating or managing noise are increased compared to traditional approaches. The ability to relocate a noise source, or trade or purchase noise mitigation at another site once standard mitigation measures have been applied, can reduce the cost of development when compared to traditional approaches.

The precinct approach allows noise from multiple sites to be managed as a single site by giving the operator of an activity or proposed activity the flexibility to take action to reduce noise in another nearby location, or work with others to take action to reduce noise on their behalf.

While a new noise source always adds to existing noise levels, the precinct approach ensures any nominal increase from a single development is not significant and not detectable by the community. By maintaining the requirement to implement the usual suite of reasonable and feasible mitigation options, there is also potential for noise levels to be reduced over time.

Noise management precincts should follow these principles:

- all reasonable and feasible mitigation options must be implemented consistent with this policy;
- all standard regulatory requirements must still be met;
- a precinct will not be put in place to authorise poor environmental performance;
- a precinct must complement other regulatory instruments such as land-use planning requirements; and
- the use of a precinct must be expected to result in a net reduction in noise impacts over time.

To achieve a favourable outcome for the precinct, it is proposed to implement a NMP for each high noise generating area by setting boundary limits with the aim of developing acoustic mitigation measures for the area, such as boundary barriers, etc. The NMP is proposed to be further developed in the SSD stages.

6.5 Future Aircraft Noise Impact

One of the major noise sources which will impact the land use compatibility is aircraft noise from the Royal Australian Air Force (RAAF) Base Williamtown and Newcastle Airport. It is anticipated that additional aircraft noise modelling will be conducted to reflect aircraft noise impact in the future after Year 2025. The most up to date ANEF contour maps will be required to be used to assess land compatibility of the SAP.

The compatibility of future development within the ANEF contours are required to adhere to the compatibility guide given in Section 2.1 of this report in accordance with AS2021.

It is expected that with the runway upgrade/extension of the airport and future aircraft movements beyond Year 2025, new ANEF contours will be required to be modelled to understand land compatibility after Year 2025.

The future aircraft noise impact beyond Year 2025 is dependent on a number of factors which should be considered in the modelling. The modelling parameters include forecast annual aircraft movements, noise emission levels of future aircraft (noting potential advancement in technology), new runway infrastructure and updated flight paths.

It is important to note that based on future ANEF contours beyond Year 2025, land uses previously identified as compatible for development may no longer be considered acceptable for certain uses.

Should there be significant infrastructure upgrades such as a new runway, this will likely result into new flight paths being developed. New flight paths will result into new receptors being impacted by aircraft noise, and the land compatibility reflecting those new receptors will be included in the updated ANEF contours beyond Year 2025. With the introduction of a new runway and flight paths, the Aircraft Noise Reduction (ANR) for building envelopes are expected to change, which is based on the maximum aircraft noise. This may result into additional upgrades to building envelopes to maintain an appropriate level of indoor acoustic amenity.

The ANR is a design parameter used to determine appropriate building components and should be calculated separately for each room within a building.

In general, specialist acoustic advice will need to be sought to ensure that the sound transmission loss of all individual building components is appropriate to achieve the required ANR values. This is the most cost effective method to ensure aircraft noise is adequately mitigated.

6.6 Future Road Traffic Noise Impact

As expected, new development in the region will give rise to an increase number of road traffic volume on the existing road network. All road traffic noise impact related to new development are required to be assessed in accordance with the NSW Department of Environment and Climate Change (DECC), Road Noise Policy (RNP) (2011).

Williamtown SAP will generate additional vehicle movements on the existing road network which may impact sensitive receivers. An assessment of relative change in road traffic noise associated with the SAP was conducted for the entire SAP. The noise model is based on the predicted number of movements on the existing road network from the number of jobs created, along with other key parameters as required by the modelling standard. In theory and as a guide, an increase of road traffic noise by 2dB is equivalent to approximately a 60% increase in road traffic volume.

Existing road infrastructure may likely require upgrades to facilitate the development of the SAP. During the planning and design phases of potential upgrades, careful consideration should be taken to minimise road traffic noise impact on existing sensitive receivers such as the road surface, speed limits and physical acoustic barriers.

Based on the current and future transport performance, as reported in the Williamtown SAP Traffic and Transport Report, prepared by Aurecon (Report Reference: 510674, Revision: 0, dated 21 May 2021), an analysis of relative change in road traffic noise levels is provided in **Table 6-1**.

Table 6-1: Predicted Relative Change in Road Traffic Noise Levels

Intersection	Midblock	Direction	Current Volume Capacity	Critical Peak Volume Year 2020	Critical Peak Volume Year 2041	Predicted Change in Road Traffic Noise Levels, in dB
Nelson Bay Road / Williamtown Drive (Newcastle Airport)	Nelson Bay Rd north of Williamtown Dr	NB	3,400	1,940	2,044	0.2
		SB	3,400	1,770	1,438	-0.9
	Williamtown Dr west of Nelson Bay Rd	EB	1,700	494	1,633	5.2
		WB	1,700	313	1,394	6.5
	Nelson Bay Rd south of Williamtown Dr	NB	3,400	1,860	3,065	2.2
		SB	3,400	1,745	2,263	1.1
Nelson Bay Road / Cabbage Tree Road	Nelson Bay Rd north of Cabbage Tree Rd	NB	3,400	1,756	2,798	2.0
		SB	3,400	1,655	2,071	1.0
	Cabbage Tree Rd west of Nelson Bay Rd	EB	1,700	656	1,673	4.1
		WB	1,700	438	1,685	5.9
	Nelson Bay Rd south of Cabbage Tree Rd	NB	1,700	1,376	2,992	3.4
		SB	1,700	1,505	2,947	2.9
	Lavis Lane east of Nelson Bay Rd	EB	1,700	220	728	5.2
		WB	1,700	402	1,214	4.8
Cabbage Tree Road / SAP Access Road	Cabbage Tree Rd east of SAP Access Rd	EB	1,700	-	1,895	-
		WB	1,700	-	1,617	-
	SAP Access Rd north of Cabbage Tree Rd	NB	1,700	-	1,538	-
		SB	1,700	-	1,538	-
	Cabbage Tree Rd west of SAP Access Rd	EB	1,700	-	1,654	-
		WB	1,700	-	1,581	-
Tomago Road / WesTrac Drive	Tomago Rd east of WesTrac Dr	EB	1,700	738	1,520	3.1
		WB	1,700	493	1,497	4.8
	WesTrac Dr south of Tomago Rd	NB	3,400	280	382	1.3
		SB	3,400	181	248	1.4
	Tomago Rd west of WesTrac Dr	EB	1,700	668	1,686	4.0
		WB	1,700	576	1,748	4.8

Intersection	Midblock	Direction	Current Volume Capacity	Critical Peak Volume Year 2020	Critical Peak Volume Year 2041	Predicted Change in Road Traffic Noise Levels, in dB
Pacific Highway / Tomago Road	Pacific Hwy east of Tomago Rd	EB	3,400	2,057	2,812	1.4
		WB	3,400	1,417	1,937	1.4
	Tomago Rd south of Pacific Hwy	NB	1,700	1,384	2,852	3.1
		SB	1,700	988	2,311	3.7
	Pacific Hwy west of Tomago Rd	EB	3,400	2,701	4,229	1.9
		WB	3,400	2,482	4,353	2.4
Industrial Drive / Tourle Street	Industrial Dr east of Tourle St	EB	3,400	2,651	3,778	1.5
		WB	3,400	2,734	3,891	1.5
	Tourle St north of Industrial Dr	NB	3,400	1,876	3,765	3.0
		SB	3,400	1,876	3,765	3.0
	Industrial Dr west of Tourle St	EB	3,400	2,681	4,506	2.3
		WB	3,400	2,764	4,619	2.2

The predicted change in road traffic noise levels are based on the change of road traffic volumes only. Other factors such as change in road surface, change in speed limits, percentage of heavy vehicles, etc., have not been considered in the noise model. All these factors may increase or decrease future noise levels and should be considered while considering road traffic noise mitigation measures.

It is observed that the existing road traffic volumes are generally low, so any new development will generate a significant increase in future traffic. The RNP states that a relative increase in road traffic noise of 12dB represents slightly more than an approximate doubling of perceived loudness (AS2659.1–1988) and is likely to trigger community reaction, particularly in environments where there is a low existing level of traffic noise. Residences experiencing increases in total traffic noise level above the relative increase criteria should be considered for mitigation.

The highest predicted increase in noise level is on Williamtown Dr west of Nelson Bay Rd with a predicted increase of 6.5dB. This increase does not necessarily indicate a requirement for further mitigation measures. An increase in road traffic levels may still be within the recommended noise limits in accordance with the RNP, but is recommended to be investigated via noise monitoring post COVID conditions.

The impact of future road traffic noise will further be investigated during the SSD stages.

7. GENERAL GUIDE TO CONSTRUCTION NOISE AND VIBRATION

Regardless of the land use or type of development, noise and vibration impact from construction activities associated with the Williamtown SAP is required to be assessed and managed. This section presents a preliminary review and qualitative assessment of potential construction noise and vibration impact associated with the SAP.

7.1 Assessment Process

Noise and vibration generated during construction is generally subject to assessment by EPA's ICNG as discussed in Section 2.4. General guidance on its assessment and management are also provided by other agencies such as:

- NSW Transport for NSW – Construction Noise and Vibration Strategy (2018).
- NSW Roads and Maritime Services– Construction Noise and Vibration Guideline (2016).

Future development within the SAP are likely to be in proximity to various sensitive receivers. Potential construction noise and vibration impacts on these receivers are required to be assessed and managed accordingly.

The ICNG broadly nominates the following steps in assessing and managing construction noise, as follows:

1. identify sensitive land uses that may be affected;
2. identify hours for the proposed construction works;
3. identify noise impacts at sensitive land uses; and
4. select and apply the best work practices to minimise noise impacts.

The above steps generally encompasses the assessment process for each development. Should various development occur at the same time, the cumulative impact of construction noise and vibration is recommended to be assessed.

7.2 Guide to Mitigation and Management Measures

A construction noise and vibration management plan should generally be developed for each project or a group of projects where common sensitive receivers may be impacted, prior to commencement of the works. The management plan would consider the detailed construction stages and methods, and proposed machinery and equipment. The plan generally includes the following and will be developed in the SSD stages:

- list of responsibilities to be assigned to contractor on site, such as site's manager;
- identified nearby residences and other sensitive land uses;
- approved hours of work and what work will be undertaken;
- significant noise and vibration generating activities, machinery and equipment;
- details of noise mitigation and management measures to be applied;
- information for worker training to minimise noise impacts;
- community consultation protocols; and
- complaints' handling protocols.

More information about standard mitigation measures area contained in the EPA's ICNG. Specific mitigation and management measures will be considered and developed as more information about each project is known.

8. CONCLUSION

ERM have prepared this report for the Williamtown Special Activation Precinct (SAP) Structure Plan. This report establishes noise performance criteria specifically for the structure plan while considering existing sensitive land uses. The noise performance criteria allows for the investigation and development of noise control strategies

Potential developments were analysed to derive the noise management and project noise trigger levels. The applicable operational assessment criteria and potential limitations within each land use zoning area were derived and discussed.

Potential mitigation strategies, including recommendations for the development of a Noise Management Precinct, were discussed. Provision for buffer distances between high noise generating activities and sensitive areas has also been discussed and should be the first cause of action in terms of noise mitigation. Mitigation strategies should be refined when more information about specific locations and noise emissions sources of industries are determined.

Following confirmation of particular industries or activities, a detailed noise assessment will allow for a more concrete investigation to ensure the acoustic amenity of the local community and individual sensitive land uses is not adversely impacted. This process will also allow for a more cost effective way of noise mitigation/management.

Land compatibility due to aircraft noise impact may slightly change beyond Year 2025. However, the Aircraft Noise Reduction (ANR) for building envelopes are not expected to change, as it is calculated based on the maximum aircraft noise. This will typically result in no additional upgrades to building envelopes to maintain an appropriate level of indoor acoustic amenity. The ANR is a design parameter used to determine appropriate building components. In general, specialist acoustic advice is recommended to be sought to ensure that the sound transmission loss of all individual building components is appropriate to achieve the required ANR values. This is the most cost effective method to ensure aircraft noise is adequately mitigated.

Recommendations to develop a Noise Management Precinct has also been discussed to control cumulative noise impact.

9. REFERENCES

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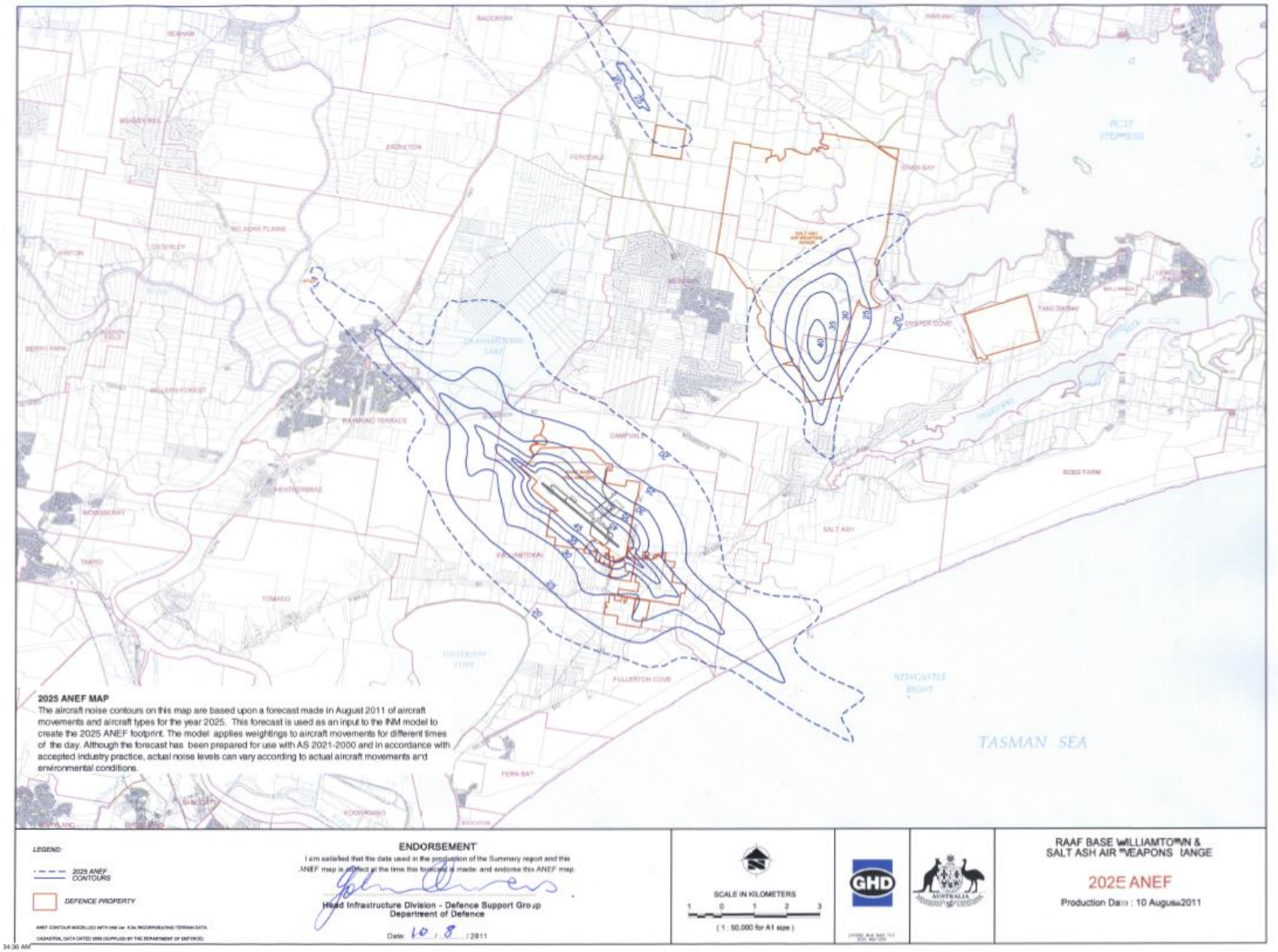
APPENDIX A 2025 ANEF CONTOURS


2025 ANEF MAP
The aircraft noise contours on this map are based upon a forecast made in August 2011 of aircraft movements and aircraft types for the year 2025. This forecast is used as an input to the INM model to create the 2025 ANEF footprint. The model applies weightings to aircraft movements for different times of the day. Although the forecast has been prepared for use with AS 2021-2000 and in accordance with accepted industry practice, actual noise levels can vary according to actual aircraft movements and environmental conditions.
TASMAN SEA
LEGEND:
2025 ANEF CONTOURS
DEFENCE PROPERTY
ENDORSEMENT
I am satisfied that the data used in the production of the Summary report and this ANEF map is correct at the time this forecast is made and endorse this ANEF map.
Head Infrastructure Division - Defence Support Group
Department of Defence
SCALE IN KILOMETERS
1 0 1 2 3
(1 : 50,000 for A1 size)
GHD
RAAF BASE WILLIAMTOWN &
SALT ASH AIR WEAPONS RANGE
2025 ANEF
Production Date : 10 August 2011

APPENDIX B FEASIBLE AND REASONABLE MITIGATION

'Feasible' and 'reasonable' mitigation is defined as follows.

A **feasible** mitigation measure is a noise mitigation measure that can be engineered and is practical to build and/or implement, given project constraints such as safety, maintenance and reliability requirements. It may also include options such as amending operational practices (for example, changing a noisy operation to a less-sensitive period or location) to achieve noise reduction.

Selecting **reasonable** measures from those that are feasible involves judging whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the mitigation measure. To make such a judgement, consider the following:

- Noise impacts:
  - existing and future levels, and projected changes in noise levels;
  - level of amenity before the development, for example, the number of people affected or annoyed; and
  - the amount by which the triggers are exceeded.
- Noise mitigation benefits:
  - the amount of noise reduction expected, including the cumulative effectiveness of proposed mitigation measures, for example, a noise wall/mound should be able to reduce noise levels by at least 5 decibels; and
  - the number of people protected.
- Cost effectiveness of noise mitigation:
  - the total cost of mitigation measures;
  - noise mitigation costs compared with total project costs, taking into account capital and maintenance costs; and
  - ongoing operational and maintenance cost borne by the community, for example, running air conditioners or mechanical ventilation.
- Community views:
  - engage with affected land users when deciding about aesthetic and other impacts of noise mitigation measures;
  - determine the views of all affected land users, not just those making representations, through early community consultation; and
  - consider noise mitigation measures that have majority support from the affected community.

Take into account the above considerations when determining the mitigation measures proposed to be incorporated into the development. In practice, the detail of the mitigation measures applied will largely depend on project-specific factors. These are the measures that minimise, as far as practicable, the local impacts of the project. Project approval conditions that flow from this process should be achievable. They need to provide clarity and confidence for the proponent, local community, regulators and the ultimate operator that the proposed mitigation measures can achieve the predicted level of environmental protection.

APPENDIX C ACOUSTICAL CONCEPTS AND TERMINOLOGY

What Is Noise And Vibration?

Noise

Noise is often defined as a sound, especially one that is loud or unpleasant or that causes disturbance[2] or simply as unwanted sound, but technically, noise is the perception of a series of compressions and rarefactions above and below normal atmospheric pressure.

Vibration

Vibration refers to the oscillating movement of any object. In a sense noise is the movement of air particles and is essentially vibration, though in regards to an environmental assessment vibration is typically taken to refer to the oscillation of a solid object(s). The impact of noise on objects can lead to vibration of the object, or vibration can be experienced by direct transmission through the ground, this is known as ground-borne vibration.

Essentially, noise can be described as what a person hears, and vibration as what they feel.

What Factors Contribute To Environmental Noise?

The noise from an activity, like construction works, at any location can be affected by a number of factors, the most significant being:

- How loud the activity is?
- How far away the activity is from the receiver?
- What type of ground is between the activity and the receiver location e.g. concrete, grass, water or sand?
- How the ground topography varies between the activity and the receiver? For example, is it flat, hilly, mountainous? Blocking the line of sight to a noise source will generally reduce the level of noise; and
- Any other obstacles that block the line of sight between the source to receiver e.g. buildings or purpose built noise walls.

How To Measure And Describe Noise?

Noise is measured using a specially designed 'sound level' meter which must meet internationally recognised performance standards. Audible sound pressure levels vary across a range of 10^7 Pascals (Pa), from the threshold of hearing at 20μPa to the threshold of pain at 200Pa. Scientists have defined a statistically described logarithmic scale called Decibels (dB) to more manageably describe noise.

To demonstrate how this scale works, the following points give an indication of how the noise levels and differences are perceived by an average person:

- 0 dB - represents the threshold of human hearing (for a young person with ears in good condition);
- 50 dB – represents average conversation;
- 70 dB – represents average street noise, for example local traffic;
- 90 dB – represents the noise inside an industrial premises or factory; and
- 140 dB - represents the threshold of pain – the point at which permanent hearing damage may occur.

[2]

Human Response to Changes in Noise Levels

The following concepts offer qualitative guidance in respect of the average response to changes in noise levels:

- Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice, an increase of 2 dBA is hardly perceivable;
- Differences in noise levels of around 5 dBA are considered to be significant;
- Differences in noise levels of around 10 dBA are generally perceived to be a doubling (or halving) of the perceived loudness of the noise. An increase of 10 dBA is perceived as twice as loud. Therefore an increase of 20 dBA is four times as loud and an increase of 30 dBA is eight times as loud;
- The addition of two identical noise levels will increase the dBA level by about 3 dBA. For example, if one car is idling at 40 dBA and then another identical car starts idling next to it, the total noise level will be about 43 dBA;
- The addition of a second noise level of similar character which is at least 8 dBA lower than the existing noise level will not add significantly to the overall dBA level;
- A doubling of the distance between a noise source and a receiver results approximately in a 3 dBA decrease for a line source (for example, vehicles travelling on a road) and a 6 dBA decrease for a point source (for example, the idling car discussed above); and
- A doubling of traffic volume for a line source results approximately in a 3 dBA increase in noise, halving the traffic volume for a line source results approximately in a 3 dBA decrease in noise.

Terms to Describe the Perception of Noise

The following terms offer quantitative and qualitative guidance in respect of the audibility of a noise source:

- **Inaudible / Not Audible** - the noise source and/or event could not be heard by the operator, masked by extraneous noise sources not associated with the source. If a noise source is 'inaudible' its noise level may be quantified as being less than the measured L_{90} background noise level, potentially by 10 dB or greater;
- **Barely Audible** – the noise source and/or event are difficult to define by the operator, typically masked by extraneous noise sources not associated with the source. If a source is 'barely audible' its noise level may be quantified as being 5 - 7 dB below the measured L_{90} or L_{eq} noise level, depending on the nature of the source e.g. constant or intermittent;
- **Just Audible** – the noise source and/or event may be defined by the operator. However there are a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator;
- **Audible** - the noise source and/or event may be easily defined by the operator. There may be a number of extraneous noise sources contributing to the measurement. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator; and
- **Dominant** – the noise source and/or event are noted by the operator to be significantly 'louder' than all other noise sources. The noise level should be quantified based on instantaneous noise level contributions, noted by the operator.

The following terms offer qualitative guidance in respect of acoustic terms used to describe the frequency of occurrence of a noise source during an operator attended environmental noise measurements:

- **Constant** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible for the duration of the noise measurement e.g. an air-conditioner that runs constantly during the measurement;
- **Intermittent** – this indicates that the operator has noted the noise source(s) and/or event to be audible, stopping and starting intervals for the duration of the noise measurement e.g. car pass-by's; and
- **Infrequent** – this indicates that the operator has noted the noise source(s) and/or event to be constantly audible, however; not occurring regularly or at intervals for the duration of the noise measurement e.g. a small number of aircraft are noted during the measurement.

How to Calculate or Model Noise Levels?

There are two recognised methods which are commonly adopted to determine the noise at particular location from a proposed activity. The first is to undertake noise measurements whilst the activity is in progress and measure the noise, the second is to calculate the noise based on known noise emission data for the activity in question.

The second option is preferred as the first option is largely impractical in terms of cost and time constraints, notwithstanding the meteorological factors that may also influence its quantification. Furthermore, it is also generally considered unacceptable to create an environmental impact simply to measure it. In addition, the most effective mitigation measures are determined and implemented during the design phase and often cannot be readily applied during or after the implementation phase of a project.

Because a number of factors can affect how 'loud' a noise is at a certain location, the calculations can be very complex. The influence of other ambient sources and the contribution from a particular source in question can be difficult to ascertain. To avoid these issues, and to quantify the direct noise contribution from a source/site in question, the noise level is often calculated using noise modelling software packages. The noise emission data used in may be obtained from the manufacturer or from ERM's database of measured noise emissions.

Acoustic Terminology & Statistical Noise Descriptors

Environmental noise levels such as noise generated by industry, construction and road traffic are commonly expressed in dBA. The A-weighting scale follows the average human hearing response and enables comparison of the intensity of noise with different frequency characteristics. Time varying noise sources are often described in terms of statistical noise descriptors. The following descriptors are commonly used when assessing noise and are referred to throughout this acoustic assessment:

- **Decibel (dB is the adopted abbreviation for the decibel)** – the unit used to describe sound levels and noise exposure. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure;
- **dBA** – the unit used to measure 'A-weighted' sound pressure levels. A-weighting is an adjustment made to sound-level measurement to approximate the response of the human ear;
- **dBC** – the unit used to measure 'C-weighted' sound pressure levels. C-weighting is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans;
- **dBZ or dBL** – the unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear;

- **Hertz (Hz)** - the measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz;
- **Octave –** a division of the frequency range into bands, the upper frequency limit;
- **1/3 Octave** – single octave bands divided into three parts;
- **L_{eq}** - this level represents the equivalent or average noise energy during a measurement period. The $L_{eq,\ 15\ minute}$ noise descriptor simply refers to the L_{eq} noise level calculated over a 15 minute period. Indeed, any of the below noise descriptors may be defined in this way, with an accompanying time period (e.g. $L_{10,\ 15\ minute}$) as required;
- **L_{max}** - the absolute maximum noise level in a noise sample;
- **L_N -** the percentile sound pressure level exceeded for N% of the measurement period calculated by statistical analysis;
- **L_{10} -** the noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels;
- **L_{90}** - the noise level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used as a basis for determining noise criteria for assessment purposes;
- **Sound Power Level (L_W)** - this is a measure of the total power radiated by a source. The Sound Power of a source is a fundamental property of the source and is independent of the surrounding environment;
- **Sound Pressure Level (L_P)** - the level of sound pressure; as measured at a distance by a standard sound level meter with a microphone. This differs from L_W in that this is the received sound as opposed to the sound 'intensity' at the source;
- **Background noise** – the underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L_{90} descriptor;
- **Ambient noise** – the all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the L_{eq} descriptor;
- **Assessment Background Level (ABL)** - is a single figure background level representing each assessment period (day, evening and night). Its determination is by the tenth percentile method, of the measured L_{90} statistical noise levels;
- **Rating Background Level (RBL)** - is the overall single figure background level representing each assessment period (day, evening and night) over the whole monitoring period (as opposed to over each 24 hour period used for the ABL). This is the level used for assessment purposes. It is the median value of:
  - All the day assessment background levels over the monitoring period for the day;
  - All the evening assessment background levels over the monitoring period for the evening; or
  - All the night assessment background levels over the monitoring period for the night.
- **Cognitive noise** – noise in which the source is recognised as being annoying;
- **Masking** – the phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street;

- **Extraneous noise** – noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous;
- **Most affected location(s)** – locations that experience (or will experience) the greatest noise impact from the noise source under consideration. In determining these locations, one needs to consider existing background levels, exact noise source location(s), distance from source (or proposed source) to receiver, and any shielding between source and receiver;
- **Noise criteria** – the general set of non-mandatory noise level targets for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (for example, noise levels for various land uses);
- **Noise limits** – enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action;
- **Project Specific Noise Levels** – target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or propose noise generating facility;
- **Compliance** – the process of checking that source noise levels meet with the noise limits in a statutory context;
- **Non-compliance** – development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit by more than 2 dBA, dBC or dBZ;
- **Feasible and Reasonable measures** – feasibility relates to engineering considerations and what is practical to build. reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors:
    - Noise mitigation benefits (amount of noise reduction provided, number of people protected);
    - Cost of mitigation (cost of mitigation versus benefit provided);
    - Community views (aesthetic impacts and community wishes); and
    - Noise levels for affected land uses (existing and future levels, and changes in noise levels).
- **Meteorological Conditions** – wind and temperature inversion conditions;
- **Temperature Inversion** – an atmospheric condition in which temperature increases with height above the ground; and
- **Adverse Weather** – weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).

Operator Attended Noise Measurements

Table A.1 below presents typical abbreviations that are used to describe common noise sources that may be noted during environmental noise measurements.

Table A.1 General Field Note Abbreviations

Noise Source	Abbreviation
'Wind-blown vegetation'	WBV
'Car pass-by'	CP
'Operator Noise'	OP
'Animal Noise'	AN
'Distant Traffic'	DT
'Near Traffic'	NT
'Aircraft Noise'	AN
'Metal on Metal contact'	MMC

During operator attended noise measurements, the sound level meter will present the instantaneous noise level and record acoustical and statistical parameters. In certain acoustical environments, where a range of noise sources are audible and detectable, the sound level meter cannot measure a direct source noise level and it is often necessary to account for the contribution and duration of the sources.

Noted Percentile Contribution – ***Table A.2*** presents noise level deductions that are typically applied based on the percentage contribution of a noise source(s). **Noted Time Contribution** – ***Table A.3*** presents noise level deductions that may be applied based on the percentage of time that a noise source(s) is audible during a 15 minute measurement.

Where the noise emission from a source is clearly detectable and the contribution can be measured, these deductions are not necessary.

Table A.2 Noise Level Deductions – Noted Percentile Contribution

Percentage Contribution	Noise Level Adjustment, dBA
5%	-13.0
10%	-10.0
15%	-8.2
20%	-7.0
25%	-6.0
30%	-5.2
35%	-4.6
40%	-4.0
45%	-3.5
50%	-3.0
55%	-2.6
60%	-2.2
65%	-1.9
70%	-1.5
75%	-1.2
80%	-1.0
85%	-0.7
90%	-0.5
95%	-0.2
100%	0.0

1. **EXAMPLE:** the measured $L_{eq,\ 15\ minute}$ noise level is 49 dBA and the site contribution was observed to be 10% of this level (extraneous noise sources were noted to dominate the measurement), therefore the $L_{eq,\ 15\ minute}$ noise level deduction is 10 dBA, with a resultant noise level contribution of approximately 39 dBA.

Table A.3 Noise Level Deductions – Noted Time Contribution

Event Duration (minutes)	Noise Level Adjustment, dBA
1	-11.8
2	-8.8
3	-7.0
4	-5.7
5	-4.8
6	-4.0
7	-3.3
8	-2.7
9	-2.2
10	-1.8
11	-1.3
12	-1.0
13	-0.6
14	-0.3
15	0.0

1. **EXAMPLE:** the measured $L_{eq,\ 15\ minute}$ noise level contribution of an excavator was noted to be 56 dBA, however it was only audible for six minutes during the 15 minute measurement period, therefore the $L_{eq,\ 15\ minute}$ noise level deduction is 4 dBA, with a resultant noise level contribution of approximately 52 dBA.

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