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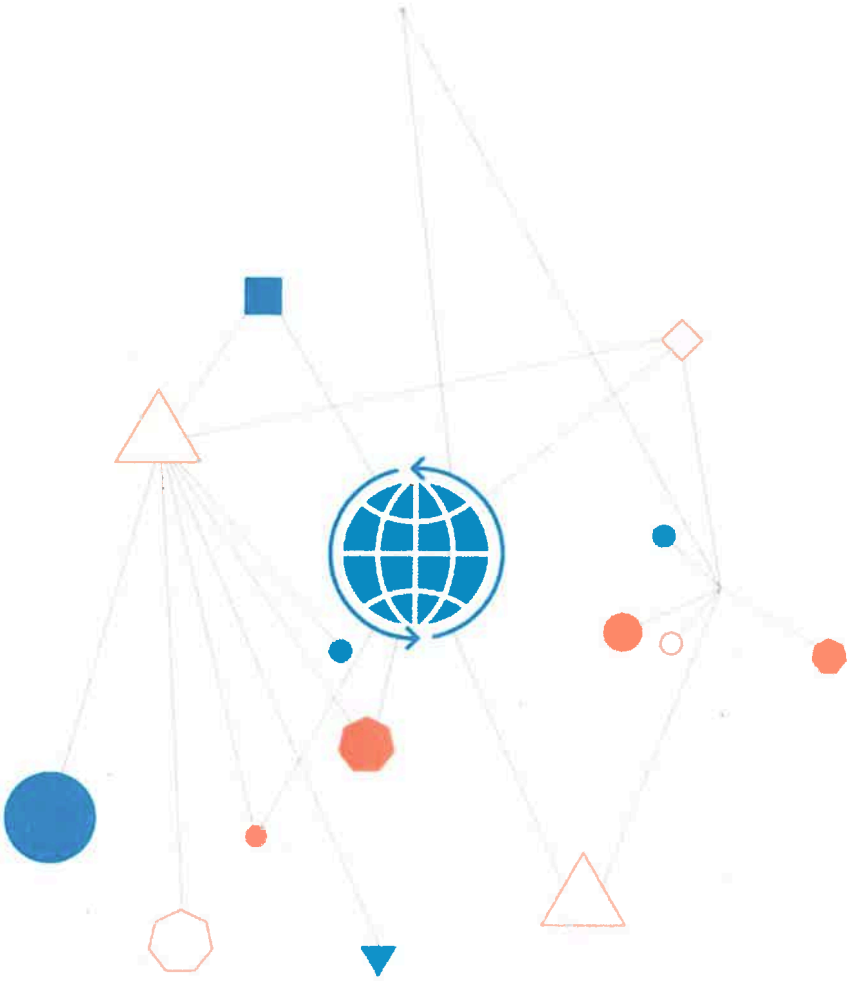
Fauna management plan

RAAF Base Williamtown Flying Operations of the F-35A Lightning II

February 2016



When you think with a global mind problems get smaller

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Fauna management plan

Prepared for
Department of Defence

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February 2016

ENAUABTF11616_1_v3

Quality information

Revision history

Revision	Description	Date	Originator	Reviewer	Approver
v1 draft	Draft report	13/11/2015	Amy Hallion	Kristen Hall	Kristen Hall
v2	Final draft report	30/11/2015	Amy Hallion	Kristen Hall	Kristen Hall
v3_markup	Final report with markup	04/02/2016	Amy Hallion	Kristen Hall	Kristen Hall
v3	Final report	05/02/2016	Amy Hallion	Kristen Hall	Kristen Hall

Distribution

Report Status	No. of copies	Format	Distributed to	Date
v1 draft	2	Word and PDF	Department of Defence	13/11/2015
v2	2	PDF	Department of Defence Department of the Environment	30/11/2015
v3_markup	1	PDF	Department of Defence for submission to Department of the Environment	04/02/2016
v3	1	PDF	Department of Defence for submission to Department of the Environment	05/02/2016

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1. Introduction

1.1. Purpose

The purpose of this fauna management plan (FMP) is to provide a framework to conduct noise measurements at selected environmentally sensitive locations near Royal Australian Air Force (RAAF) Base Williamtown, and to verify the impact of F-35A aircraft noise on selected environmentally sensitive species at these locations, as required under the approval conditions of the Environmental Impact Statement (EIS) for the flying operations of the F-35A Lightning II (F-35A aircraft).

1.2. Background

The proposed flying operations of the F-35A aircraft were assessed under the requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Final EIS (comprised of the Draft EIS and a Supplementary EIS) was submitted to the Minister for the Environment in March 2015. In July 2015 the Commonwealth's Department of the Environment published its approval decision for the flying operations of the F-35A Lightning II aircraft. The project was approved with four core conditions.

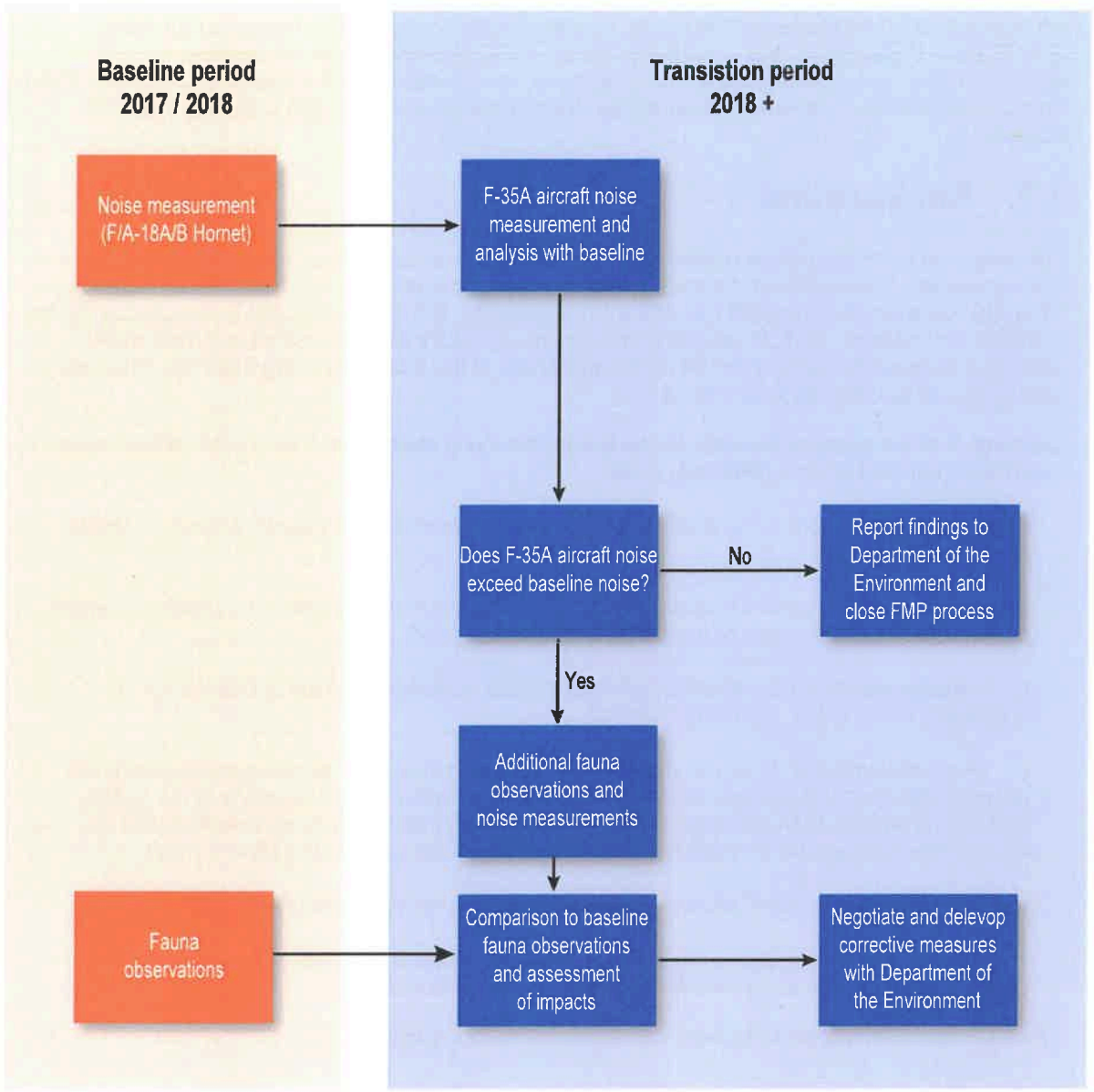
Condition 4 of the approval decision on the EIS for the flying operations of the F-35A aircraft states that Department of Defence (Defence) must:

> *Prepare and implement a Fauna Management Plan. This plan must include, but not be limited to:*
>
> *a. establishing a baseline measurement of noise levels at environmentally sensitive locations prior to the flying operations of the F-35A Lightning II aircraft;*
>
> *b. measurement of noise levels at environmentally sensitive locations during the flying operations of the F-35A Lightning II aircraft;*
>
> *c. if measured F-35A Lightning II aircraft noise levels exceed the baseline measurement of noise levels at environmentally sensitive locations prior to the flying operations of the F-35A Lightning II aircraft, then corrective measures must be developed and implemented until an appropriate assessment of noise impacts is reached, as agreed with the Minister; and*
>
> *d. reporting the results of noise level measurements to ensure data is publically available.*
>
> *The plan must be submitted to the Department for approval. The approval holder must not commence the action unless the Minister has approved this plan.*

This FMP has been prepared to meet the requirements of Condition 4.

1.3. Scope

This plan describes how Defence will conduct noise and fauna assessments, report findings and states the triggers for negotiation of corrective measures with Department of the Environment to comply with Condition 4. It is proposed that baseline observation of the selected fauna species will be conducted in conjunction with noise measurements in 2017, prior to the commencement of the flying operations of the F-35A aircraft. Subsequent assessment of the impact of F-35A aircraft noise on the selected fauna species is only proposed if noise levels following the introduction of the F-35A aircraft exceed baseline levels at the measurement locations. Figure 1 maps out the implementation process.



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Implementation of this FMP is the responsibility of Defence. The Sections of the FMP relevant to each requirement of Condition 4 are provided in Table 1.

Table 1 Compliance with Condition 4 requirements

Condition 4 requirement		Section of FMP
a	Establishing a baseline measurement of noise levels at environmentally sensitive locations prior to the flying operations of the F-35A Lightning II aircraft.	3 Site selection 4 Noise measurements
b	Measurement of noise levels at environmentally sensitive locations during the flying operations of the F-35A Lightning II aircraft.	3 Site selection 4 Noise measurements
c	If measured F-35A Lightning II aircraft noise levels exceed the baseline measurement of noise levels at environmentally sensitive locations prior to the flying operations of the F-35A Lightning II aircraft, then corrective measures must be developed and implemented until an appropriate assessment of noise impacts is reached, as agreed with the Minister; and	5 Fauna assessment 6 Performance standards 7 Corrective measures
d	Reporting the results of noise level measurements to ensure data is publically available.	8 Reporting

2. Environmentally sensitive species

Under Condition 4 of the approval decision, environmentally sensitive species are defined as:

> *...bird and bat listed threatened species and communities or listed migratory species, including, but not limited to, the Australasian bittern (Botaurus poiciloptilus), Australian painted snipe (Rostratula australis), Gould's petrel (Pterodroma leucoptera) and grey-headed flying-fox (Pteropus poliocephalus).*

After review of the findings of the EIS for the flying operations of the F-35A aircraft and consultation with the Department of the Environment, the following species, or species groups, are considered environmentally sensitive species in the context of this FMP:

- Australasian bittern (*Botaurus poiciloptilus*).
- Australian painted snipe (*Rostratula australis*).
- Gould's petrel (*Pterodroma leucoptera*).
- Grey-headed flying-fox (*Pteropus poliocephalus*).
- Migratory shorebirds.

Other species such as the green and golden bell frog (*Litoria aurea*) were considered for inclusion in this FMP. The EIS predicted that there would be negligible impact on the green and golden bell frog due to the flying operations of the F-35A aircraft and therefore this species was not considered a species of interest for this FMP.

3. Site selection

This section provides a discussion on how and why the proposed measurement locations were selected.

3.1. Environmentally sensitive locations

Under Condition 4 of the approval decision, environmentally sensitive locations are defined as:

> *...locations near to RAAF Base Williamtown and the Salt Ash Weapons Range that provide habitat for or includes: listed threatened species and communities, including, but not limited to, the grey-headed flying-fox (Pteropus poliocephalus), Australasian bittern (Botaurus poiciloptilus) and Australian painted snipe (Rostratula australis); listed migratory bird species; and wetlands of international importance (The Hunter Estuary Wetlands and Myall Lakes Ramsar sites).*

3.2. Location selection requirements

Identification of measurement locations was based on a review of the key species listed in Appendix I of the Draft EIS (Coffey, 2014). This identified the environmental values (important populations and/or critical habitat as defined under the EPBC Act and accompanying significant impact guidelines) that have a credible potential to be impacted by the proposed flying operations of the F-35A aircraft. This was determined as sites providing critical habitat in proximity to areas where increases in the 70 dB L_{Amax} extent around RAAF Base Williamtown are predicted. The threshold of 70 dB L_{Amax} was adopted from the EIS, which was based on a review of available literature regarding aircraft noise impacts on biodiversity. The 85 dB L_{Amax} extent was also considered however there were no areas of critical habitat within the predicted areas of increase. A site survey was conducted to verify the suitability of the identified locations on the basis of local geography, access, security, noise measurement constraints, and species presence and distribution.

3.3. Selected locations

The selected measurement locations and selection rationale are presented in Table 2.

Table 2 Selected measurement locations

Measurement location	Selection rationale
Kooragang Island	This site provides critical habitat (reed bed areas as well as areas of shallow waterbodies) for migratory shorebirds. This area is a sensitive location in the Hunter Estuary complex and is potentially subject to an increase in noise levels above 70 dB L_{Amax} on the departure on Runway 30 to the Hunter Region overflight.
Fullerton Cove	This is an intertidal site for migratory shorebirds. This area is a sensitive location in the Hunter Estuary complex and is potentially subject to an increase in noise levels above 70 dB L_{Amax} on departure from Runway 30 to the Hunter Region overflight.
Stockton Sandspit	This is the largest wader roost in the area and is potentially subject to an increase in noise levels above 70 dB L_{Amax} on departure from Runway 30 to the Hunter Region overflight.
Hexham Swamp*	This is the main breeding area for Australasian Bittern and is potentially subject to an increase in noise levels above 70 dB L_{Amax} on departure from Runway 30 to the Hunter Region overflight.

Table 2 Selected measurement locations (cont'd)

Measurement location	Selection rationale
Northern margin of Port Stephens around Myall River entrance	This area provides foraging and roosting habitat for migratory shorebirds and is potentially subject to an increase in noise levels above 70 dB L_{Amax} on easterly departure from Runway 30.
Swan Bay	This area provides potential foraging and roosting habitat for migratory shorebirds and is potentially subject to an increase in noise levels above 70 dB L_{Amax} on the Salt Ash Air Weapons Range overflight.
Cabbage Tree Island*	This is a known breeding island for Gould's petrel and is subject to potential increases in 70 dB L_{Amax} extent on the easterly departure on runways 12 and 30.
Tilligerry Nature Reserve (Bob's Farm) or Schnapper Island†	These areas are known flying-fox camps where the grey-headed flying fox were recorded in February 2015 and November 2014, respectively (Department of the Environment, 2015). This area is also subject to potential increases in the 70 dB L_{Amax} extent on the easterly departures on runways 12 and 30.

* Indicates sites where only noise measurements will be conducted as the main species of interest at these sites (Gould's petrel and Australasian bittern) will not be visually observed, rather population monitoring data will be reviewed (see Section 5).
† Flying-fox camps are also recorded at Anna Bay and Hawks nest, however no populations of flying-foxes have been recorded there in the last 3 years. These sites were not visited during the site survey as it was indicated that given the variable nature of flying-fox camps it would be best to survey closer to the time of monitoring.

These locations are shown on Figure 2 and global positioning system (GPS) coordinates are provided in Table 3.

Table 3 GPS coordinates of measurement locations

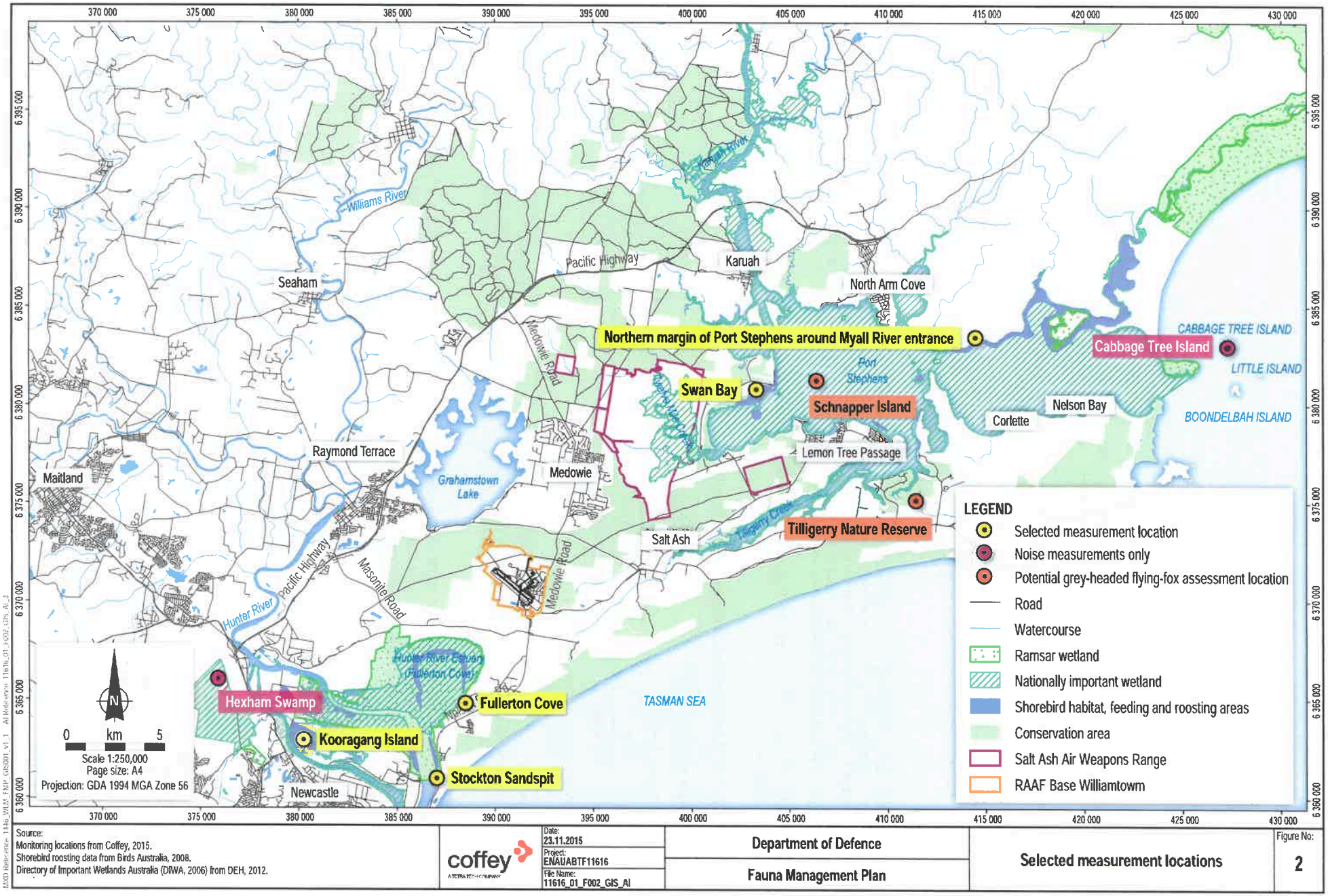
Measurement location*	Easting	Northing
Kooragang Island	380258	6362952
Fullerton Cove	388493	6364811
Stockton Sandspit	386939	6360928
Northern margin of Port Stephens around Myall River entrance	414470	6383424
Swan Bay	403322	6380806

* GPS coordinates are not provided for Hexham Swamp, Cabbage Tree Island, Tilligerry Nature Reserve and Schnapper Island as they were not visited during the site survey. Selection of these locations was based on advice from NSW Parks and Wildlife and will require further refinement.

Siting of noise measurement equipment should be within 500 m of these locations. Myall Lakes Ramsar site was not selected as a measurement location given its distance from RAAF Base Williamtown and Salt Ash Air Weapons Range. Due to its remoteness, it fell outside of the 70 dB L_{Amax} noise contour where impacts were considered possible. Future overflights in this area by the F-35A aircraft were not predicted to cause higher noise levels than are currently experienced.

3.4. Access requirements

The majority of the selected locations are accessible by public roads and tracks. Access to some sites may require permission from private landholders. Access requirements for each site are provided in Table 5.



Source:
Monitoring locations from Coffey, 2015.
Shorebird roosting data from Birds Australia, 2008.
Directory of Important Wetlands Australia (DIWA, 2006) from DEH, 2012.

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Selected measurement locations

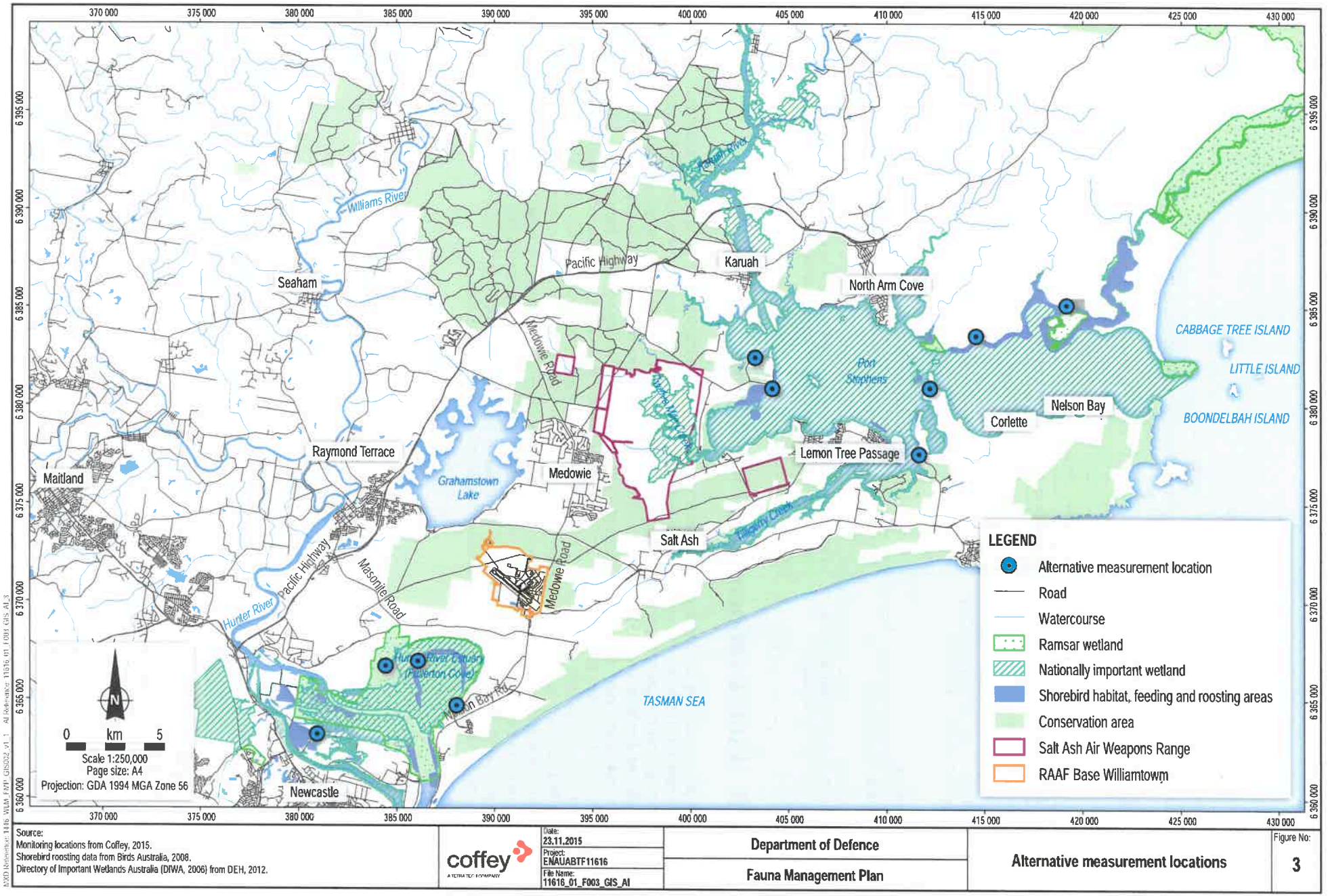
Figure No: 2

Table 4 Access requirements for selected locations

Measurement location	Access requirements
Kooragang Island	There is limited general public access to this site, predominantly visited by birdwatchers. Access to this location is along a public gravel track.
Fullerton Cove	There is no public access to the shore at this location. Paddocks line the area between the road and the cove and will require liaison with property owner to provide access and permission to place noise measurement equipment close to the shore.
Stockton Sandspit	The area is accessible by a public road off Fullerton Street.
Hexham Swamp	Hexham swamp is accessible from the north by maintenance tracks off Woodlands Close.
Northern margin of Port Stephens around Myall River entrance	The area is accessible by public road however measurements would likely be conducted on private property. This will require liaison with property owners.
Swan Bay	The area is public land accessible by a track off Davis Road.
Cabbage Tree Island	Access to this island is limited and will require assistance from NSW Parks and Wildlife.
Tilligerry Nature Reserve (Bob's Farm) or Schnapper Island	Tilligerry Nature Reserve can be accessed by public roads and tracks. Access to Schnapper Island would require liaison with NSW Parks and Wildlife.

3.5. Future refinement of locations

The proposed measurement locations have been selected on the basis of being sensitive areas potentially incurring an increase in noise levels, and the current presence of environmentally sensitive species. There is potential that a location selected now may not be hosting the relevant species when measurement begins in 2017. Generally, shorebird species are quite site faithful, returning to the same site each year, however, in areas such as the Hunter Estuary complex, they often move to different sites within the area on an annual to daily basis. This is dependent on food resources and other factors outlined in Section 5.1. Species such as the grey-headed flying-fox also exhibit variability in site selection, with flying fox camps being used either on a long or short-term basis as one camp is abandoned and the whole roost moves to a new location. For these reasons measurement locations will need to be reviewed nearer the time of measurement. Alterative locations that were visited during the site survey that could be used for measuring noise levels and fauna behaviour are shown in Figure 3. A minimum of six measurement locations will still be selected.



Source:
Monitoring locations from Coffey, 2015.
Shorebird roosting data from Birds Australia, 2008.
Directory of Important Wetlands Australia (DIWA, 2006) from DEH, 2012.

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Project: ENAUABTF11616
File Name: 11616_01_F003_GIS_AI

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Alternative measurement locations

Figure No: 3

GDA Reference: 11616_WLM_FMP_GIS002_v1_1 AI Reference: 11616_01_F003_GIS_AI_3

4. Noise measurements

This section outlines the method and equipment requirements for noise measurements.

4.1. Noise metrics

Measurement systems and methodologies adopted in this FMP involve the collection of two forms of noise metric:

- Sound Exposure Level (SEL) for rating the sound energy of each event. The SEL provides the benefit of enabling direct comparison of the total sound energy of different aircraft events. The SEL is similar to the equivalent noise level (L_{Aeq}), but is normalised to a time period of 1 second to facilitate direct comparisons of the sound energy for different event durations.
- Maximum noise levels (L_{max}) for rating the highest levels of each event. This parameter is most commonly used for rating human responses to high noise level events, and is frequently referenced in literature for assessing impacts.

The SEL and maximum noise levels shall be recorded for individual aircraft noise events as both linear and A-weighted sound pressure levels.

The levels shall be based on the acquisition and storage of one-third octave band frequency information spanning from 20 hertz (Hz) to 16,000 Hz (notional minimum frequency range). This data will enable post-processing of the measurement results to convert total sound pressure levels to alternative frequency weighting characteristics, thus enabling any emerging knowledge on suitable species-dependent frequency weightings to be factored in the measurement comparison of baseline and future operational noise levels.

4.2. Noise measurement survey duration

Measurements of aircraft noise levels are highly variable. These variations relate to a range of factors including changes in aircraft operating patterns and procedures, as well as atmospheric conditions that influence sound propagation.

To enable a meaningful comparison of baseline and transition period noise levels, it will be necessary for the survey duration to capture a range of operating and atmospheric conditions. The duration of noise measurements at each location shall extend over a period of two months for both baseline measurements and during the transition period.

Baseline noise measurements will be conducted in 2017 prior to the arrival of the F-35A aircraft. Noise measurements will be conducted within the months when migratory shorebirds are present in the area (September to February). The baseline fauna assessment will be conducted at the same time as baseline noise measurements.

If noise levels during the transition period are found to exceed baseline levels (as defined in Section 6) further noise measurements shall be conducted during the period of subsequent fauna measurement in order to correlate noise levels with disturbance factors and bird reactions (see Section 5.3).

A review of weather and operational records will be conducted prior to decommissioning measurement campaigns. This will determine the adequacy of the range of conditions encountered and, if necessary, evaluate the need for an extension of the noise measurement period.

4.3. Equipment requirements

4.3.1. Siting and setup

Noise measurements will be conducted using solar powered unattended sound level meters including a microphone, wind shield and recorders. As a minimum, the following shall be considered in the procurement, siting and installation of measurement equipment:

- Sound level metres shall meet the performance specifications of a class 1 sound level meter, specified in AS IEC 61672-1 *Electroacoustics - Sound Level Meters - Part 1: Specifications.*
- One-third octave band measurement instrumentation systems shall meet the Class 1 filter, specified in AS/NZS 4476:1997, *Acoustics — Octave band and fractional octave band filters* or IEC 61260-1 *Electroacoustics - Octave-band and fractional-octave-band filters - Part 1: Specifications*.
- Suitable windshields shall be installed around each microphone in accordance with the manufacturers' specification.
- Microphone height shall be a minimum 4 metres (m) and preferably 6 m above ground level, where local equipment siting arrangements permit, to minimise interference effects with ground reflections.
- Microphones shall be a minimum 3 m from any acoustic reflecting surface, such as buildings or vegetation.

Sound level metres will be sited within 500 m of the selected locations (see Section 3.3) and consider the following:

- The general noise environment i.e., is the area affected by man-made (e.g., existing traffic, industry) or natural noise sources (e.g., wind in trees, ocean, frogs, insects).
- The ambient noise and whether it is likely to vary significantly across the area, given the single measurement point within a large monitoring area of interest.
- Any transient swamp or estuary conditions, noting changes from dry ground to swamped conditions affects ground reflected aircraft noise.

4.3.2. Calibration

A class 1 sound calibrator shall be applied to the microphone at the beginning and end of each measurement survey. The class 1 sound calibrator shall conform to the performance specifications in AS IEC 60942 *Electroacoustics – Sound calibrators*. This shall be applied in accordance with the recommended operating procedures for the sound level meter to check the calibration of the entire measurement system. It is recommended that equipment be calibrated daily however given the nature of the noise measurement surveys, using long-term deployed unattended noise measurement equipment, this will not be possible. Therefore measurement equipment may require additional automated field checks of the microphone response at one or more discrete frequencies.

4.4. Analysis

4.4.1. Data capture

Noise measurement data from each measurement location shall be analysed to identify instances in which an aircraft overflight is likely to have occurred. This analysis shall be based on a range of considerations including:

- Identification of periods in which the measured noise level time history exhibits periodic rises and falls consistent with the characteristics of an aircraft overflight event.
- Duration of elevated noise levels during periods of suspected aircraft overflights.
- Comparison of simultaneous noise data records from the other noise measurement systems in the area to differentiate between localised noise level increases attributable to ambient noise sources and area wide noise levels that are characteristic of aircraft operations.
- Frequency characteristics of the measurement data, including any low frequency contributions which may be used as further indication of the likelihood of an aircraft event having occurred.

The objective of this analysis will be to collate a database of suspected aircraft events that details:

- Event start time.
- Event end time.
- Measured linear and A-weighted SEL.
- Measured linear and A-weighted maximum noise level.

4.4.2. Correlation

The suspected aircraft events and noise levels will then be correlated with Defence operational records to confirm aircraft type and operation. Such detail is required to:

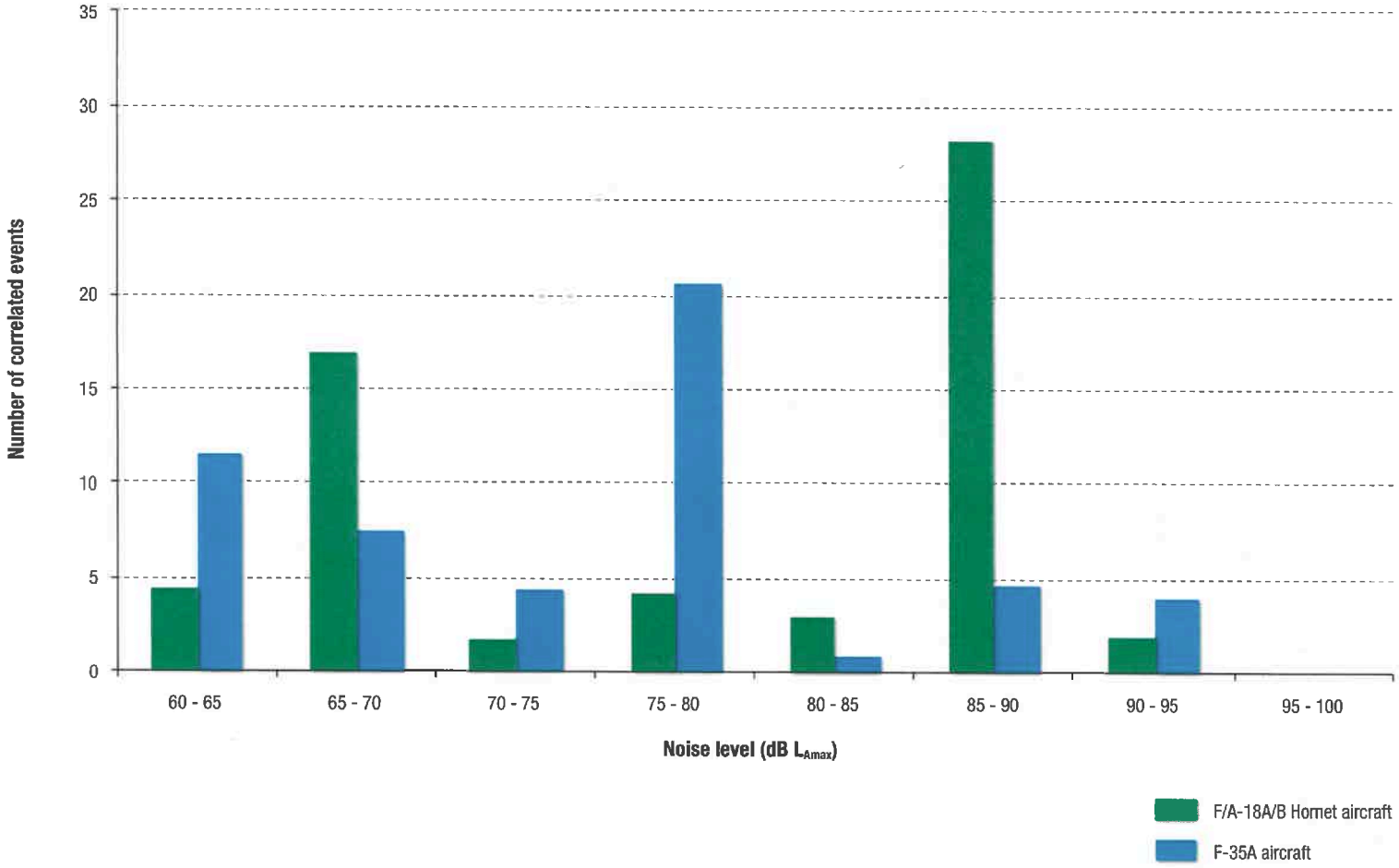
- Identify where an aircraft event has occurred at the noise measurement location.
- Determine if the event is attributable to military or non-military aircraft movement.
- Identify the type of aircraft (F/A-18A/B Hornet, F-35A aircraft or other).
- Categorise the movement according to the general type of operation:
  - Departure to eastern or western airspace.
  - Instrument or visual arrival.
  - Salt Ash Air Weapons Range circuit.
  - Circuit movement or touch and go.

Additional information should be detailed and recorded, specifically the runway used, aircraft heading, track used and altitude at measurement location. This information allows for grouping of aircraft events and enables the assessment of change in noise levels between the F/A-18 A/B Hornet and F-35A aircraft to be consistent between operations. An example of how this information should be presented is provided in Table 5.

Table 5 Example aircraft event data

Aircraft type	Date	Event start time	Event end time	Noise level		Operation/ runway	Altitude
				dB L_{Amax}	dB L_{AE}		

The data will be summarised and a comparison of the measured range of maximum noise levels and number of correlated events for the aircraft types of interest will be presented visually in a histograph similar to those presented in the EIS. An example of this is provided in Figure 4.



	coffey	Date: 25.01.2016	Department of Defence	Example aircraft noise level information and event numbers	Figure No: 4
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4.4.3. Assessing impacts

Assessment of noise measurements will be based on a comparison of the mean and 90th percentile values of the baseline noise measurements to the transitional noise measurements.

A statistical analysis of the L_{Amax} and SEL values for the two datasets will be conducted to determine whether any observed change in the mean or 90th percentile values is statistically significant. This will give an indication as to whether the change is related to the replacement of aircraft rather than typical variation in the noise levels that would be expected due to variables such as flying operations and/or weather conditions. The number of one off events that exceed the baseline noise levels will also be recorded.

Noise measurements recorded during the transition period will also be assessed against the results of the EIS noise modelling to determine if the noise exceedances (if any) are consistent with the EIS predictions.

5. Fauna assessment

Aircraft noise has the potential to impact on terrestrial fauna through the disruption of feeding, roosting and breeding patterns. The literature indicates that noise can have two main effects on terrestrial fauna:

- Masking of communication for breeding/territorial purposes between individuals of a species, affecting reproductive success or communication of alarm calls warning of a predator being present.
- Eliciting a reactionary response, varying from mild alert to permanent abandonment of habitat, roosting or breeding sites.

In the case of displacement, the increased energy demands of response to anthropogenic disturbance, can have an impact on breeding or migratory condition of certain species (and the ability to lay down fat reserves for migration and breeding), particularly shorebirds (Geering *et al,* 2007; Kempf and Huppop, 1998), which migrate long distances to and from northern hemisphere breeding grounds, to spend the non-breeding season in Australia.

Determining the impact of noise on environmentally sensitive species from military aircraft activity is a challenging exercise that should be conducted with consideration of several limitations such as difficulty in:

- Maintaining the consistency of other variables, such as meteorological and tidal conditions, species locations and other anthropogenic and natural disturbances.
- Isolating perceived physical reactions of the species in question to one disturbance factor or another.
- Observing key species – Australasian bittern and Australian painted snipe are cryptic species and difficult to detect visually.
- Comparing perceived physical reactions pre and post F-35A aircraft flying operations as there are many other variables which could influence activity of the species in question.
- Correlating surveys to flight activity – should the expected flying operations change and not overfly survey locations on the survey date, assessing physical reactions in species will be redundant.

5.1. Influencing factors on fauna behaviour

There are several factors other than noise that can influence the behaviour of fauna that need to be considered in the fauna assessment.

5.1.1. Seasonality

The presence of the selected species will be dependent on the season. Migratory shorebirds are predominantly present in the region during the summer months, from September to February, returning to breeding grounds in the northern hemisphere between March and April, although small numbers do overwinter (particularly young or injured birds). Observation of shorebird roosting and foraging sites should focus on the period most birds are present in the region, targeting both southern and northern migration periods, as a number of the birds using the sites in the region will use them as staging sites on their way to or from sites further south in Australia or New Zealand.

Australasian bittern and Australian painted snipe may be present in the region year round. The Australasian bittern is known to breed in the lower Hunter Valley and is present in the spring and summer. It is currently unknown whether the population winters in this area. The Australian painted snipe is a nomadic species that typically breeds inland on ephemeral waterbodies and marshes and moves coastward when these dry up. The Australian painted snipe has been recorded breeding year round in Australia, and its presence in the study area is highly unpredictable.

Gould's petrel breeds on Cabbage Tree and Boondelbah Islands between the months November to April, with most chicks fledged by late April. During the winter months they migrate to the tropical eastern Pacific Ocean.

Grey-headed flying-fox are likely to be present year round, although females typically give birth in October. This species may be surveyed at any time of year, although survey success will depend on recent data on flying-fox camps obtained through consultation with local wildlife groups, as well as visiting traditional camp sites (Tilligerry Nature Reserve and Schnapper Island).

5.1.2. Tidal cycles

The use of some habitats for roosting and foraging within the Hunter River and Port Stephens area is dependent on the state of the tidal cycle at any given time. At high tide shorebirds gather at roosting areas that are typically located just above the high water mark where they have an open field of view, access to the water and are located near preferred foraging habitats (Department of Environment, Climate Change and Water, 2010). There are several types of roosts that can be used depending on the type of tides: spring tide roosts, neap tide roosts and staging roosts. Staging roosts are where birds gather into flocks prior to high tide before moving to spring tide roosts. As the tide recedes, shorebirds leave these roosts and begin foraging as intertidal sand and mudflats become exposed (Department of Environment, Climate Change and Water, 2010). As a result the usage of these habitats by shorebirds can vary between years, or even shorter time periods within years.

5.1.3. Timing

Of the key species some are diurnal and some are nocturnal. Gould's petrel only returns to their breeding islands at night and forage widely at sea during the day. The Grey-headed flying fox is nocturnal, roosting in the camp during the day and leaving the camp around dusk to search for food. Australasian bittern and Australian painted snipe are both active during the day time but are most active around dawn and dusk (crepuscular).

5.1.4. Meteorological conditions

Certain meteorological conditions may potentially hinder the success of any observations. In general, heavy rain, or high winds will reduce the detectability of many of the key species in question, particularly if relying on aural clues of their presence.

5.1.5. Identification of other impact factors

Any disturbance of the key species should be viewed in the context of other disturbance factors in the study area. Various industrial and recreational activities have the potential to disturb the key species. Differentiating any potential reactions to F/A-18AB Hornet and F-35A aircraft noise from other disturbance factors, including presence of people, industrial noise and activity, vehicular or boat traffic is a key component of the observations. At the selected measurement locations other disturbance factors include:

- **Industrial noise and activity.** The area around Kooragang Island, Stockton Sandspit and Hexham Swamp complex is in an industrial area. Noisy construction activities (such as piling), and operational activities through vehicle and personnel movement and coal loading and shipping have the potential to disturb migratory shorebirds in this area.
- **Other aircraft noise.** RAAF Base Williamtown shares runway use with Newcastle Airport and commercial aircraft operating from this facility have the potential to disturb the species in question under the flight paths.
- **Recreational activity.** The Hunter Estuary and Port Stephens area are popular for both land and water recreation activities. Recreational activities with the potential to disturb the key species include boating (including use of jet skis), walking, nature watching, driving, model aircraft flying, fishing and dog walking. Certain activities have greater potential to cause more significant disturbance than others – for example studies have shown that birds are more likely to flush when approached on foot, particularly when a dog is present, than when approached in a vehicle. Areas such as Fullerton Cove are less disturbed, and will provide a control to monitor levels of disturbance from military aircraft activity.
- **Response to natural factors.** The key species may exhibit physical responses that relate to disturbance, or apparent disturbance, due to a number of natural factors, including presence of a bird of prey, a ground predator (e.g., fox), and movement from one foraging location to another or response to changes in tidal or weather conditions.
- **Agricultural activity.** In some areas in Fullerton Cove paddocks line the shoreline. In some cases the shorebirds forage on the paddocks. Grazing livestock can cause the key species to exhibit physical responses.

5.2. Observation method

Baseline observation of fauna behaviour will be conducted in conjunction with noise measurements in 2017, to ensure observations are made prior to the introduction of the F-35A aircraft. Population data sourced from NSW Parks and Wildlife and Hunter Birds Observers Club will be reviewed from 2016 however the review will not be conducted until 2017. The need for further fauna assessment is dependent on the outcome of the noise measurements (Section 4). Further fauna observation will only be conducted if the transition period noise levels exceed baseline levels at the selected locations (as defined in Section 7).

5.2.1. Gould's petrel

Physical reactions are not anticipated to be observed in this species, however it is noted that Gould's petrel may emit a distress call which has the potential to reveal their presence to predators

(Department of Environment and Conservation, 2006), and hence increase the risk of predation. Visual observations of Gould's petrel behaviour will not be conducted, rather population data collected by NSW Parks and Wildlife will be reviewed to identify if there have been any changes in Gould's petrel population on Cabbage Tree Island and Boondelbah Island after the introduction of the F-35A aircraft. In order to do this, Defence will:

- Obtain population data for 2016 to 2019 from NSW Parks and Wildlife.
- Use population data from 2016 to 2017 as baseline set.
- Compare population data from 2016 to 2017 with 2018 to 2019 to determine if there is any statistically significant change in population since the introduction of the F-35A aircraft.

5.2.2. Australasian bittern

The Australasian bittern is a cryptic species that is difficult to visually observe. Records of the Australasian bittern are usually made aurally by its call. The Hunter Bird Observers Club is starting a monitoring program for the Australasian bittern in Summer 2015/2016. Population data recorded by the Hunter Bird Observers Club will be used to identify any population changes. In order to do this, Defence will:

- Obtain population data for 2016 to 2019 from Hunter Birds Observers Club.
- Use population data from 2016 to 2017 as baseline set.
- Compare population data from 2016 to 2017 with 2018 to 2019 to determine if there is any statistically significant change in population since the introduction of the F-35A aircraft.

5.2.3. Australian painted snipe

The Australian painted snipe is a rare species and is also a cryptic species to detect. There are no monitoring programs in the area specific to the Australian painted snipe, however because of its rarity most records of the Australian painted snipe are published. These published records will be used to note any trends in observations during the monitoring periods. In order to do this, Defence will:

- Obtain published records from 2016 to 2019 from a range of databases including Hunter Bird Observers Club, BirdLife Australia and eBird.
- Analyse data to identify any trends/ changes in records over the monitoring periods.

5.2.4. Migratory shorebirds and grey-headed flying-fox

Observation of migratory shorebirds and grey-headed flying fox should be conducted by an experienced ornithologist and zoologist, respectively. Baseline observation shall be conducted in the following way:

- Ensure observations are not conducted during heavy rain or high winds.
- Liaise with RAAF Base Williamtown site operations to ensure monitoring is conducted when normal flying operations will be conducted near the monitoring locations.
- Observe migratory shorebirds during foraging and roosting activities. Observations shall be conducted at both high and low tide.
- Observe grey-headed flying-fox camps for two hours before dusk.
- Source high tide and sunset times for Port Stephens from Bureau of Meteorology.
- Conduct observation for two hours before peak tide time and one hour after. Monitoring shall be conducted at each shorebird location for two tide cycles.

- Conduct observation over two intervals, one in November at the beginning of the migration season and one in February/March at the end of the migration season.
- Log all potential sources of disturbance. Reactions to all disturbances to be recorded.
- Record behaviour at the time of the disturbance and 5 minutes after the disturbance occurred.
- Record behaviour at 15 minute intervals during times of no disturbance.
- Record the level of reaction and the returning behaviour using a sliding scale:

Level of reaction	**Description**
0	No reaction.
1	Alert reaction but no take-off. Disturbance caused to feeding / roosting.
2	Stressed behaviour (alarm posture/call, swimming, flying within the local area and returning immediately).
3	Take-off and leave area.
Returning behaviour	**Description**
0	No reaction.
1	Returned to previous activity quickly (30 seconds).
2	Stressed behaviour (not returned to previous activity, still disturbed).
3	Did not return to area.

- Document records in a table, including but not limited to:

Location	**Species**	**Number of birds**	**Time**	**Disturbance**	**Reaction**	**Returning behaviour**

- Estimate the number of birds for a flock.
- Record the majority reaction when observing a flock. Record the percentage of the flock that exhibited this reaction.

If further observation is required due to an exceedance of baseline noise levels, this will be conducted in the same manner as detailed for baseline observations.

5.3. Assessing impacts

5.3.1. Gould's petrel, Australasian bittern and Australian painted snipe

Where the review of population data identifies a significant change in population size, noise measurements at the relevant locations will be correlated to determine if any exceedances of baseline noise levels were recorded. National data for Australasian bittern and Australian painted snipe will also be reviewed to identify other possible influences on population size, such as migratory patterns. For Gould's Petrel, given this is the only population in Australia, consultation with NSW Parks and Wildlife will be conducted to identify if other factors identified during monitoring may potentially affect the population.

5.3.2. Migratory shorebirds and grey-headed flying-fox

The nature of the reaction observed as a result of aircraft overflights will be correlated with the noise readings, the aircraft type and altitude (if available). This data will then be analysed to determine if different reactions can be associated with different noise levels, whether the level of disturbance for aircraft overflight is similar or greater than that of other disturbance factors and whether the disturbance ratings have increased due to the introduction of the F-35A aircraft.

6. Performance standards

When quantifying the change in baseline noise levels and transition period noise levels, consideration should be given to both the change in noise level as well as the number of aircraft events.

To quantify the change in noise levels between the baseline period and transition period, a statistical analysis shall be undertaken, with reference to the mean and 90^{th} percentile of the noise levels and number of aircraft events. An exceedance of baseline noise levels, in relation to Condition 4C, is defined as a significant difference between the mean and 90^{th} percentile of the L_{Amax} and SEL of the measured baseline noise levels compared to the transition period noise levels, where the difference represents an increase in noise levels above 70 dB L_{Amax} due to the F-35A aircraft.

Observations of environmentally sensitive species will only be conducted during the transition period if and where an exceedance of baseline noise levels is recorded.

7. Corrective measures

If the results of further fauna observations record an increase in the level of reaction observed due to increased noise levels associated with the F-35A aircraft then Defence will develop corrective measures in consultation with the Department of the Environment. Development of corrective measures may also involve consultation with other relevant stakeholders such as NSW Parks and Wildlife, the Hunter Bird Observers Club, Williamtown Consultative Group, Williamtown Advisory Group and/or other local residents. Factors that will need to be considered when developing corrective measures include, but are not limited to: extent of exceedance; location; flying ability and safety; surrounding sensitive receptors; and adherence to RAAF fly neighbourly policy.

8. Reporting

Records substantiating activities associated with the implementation of this FMP will be maintained by Defence and be made available to the Department of the Environment upon request.

Data recorded from the noise measurement and fauna observation periods will be reported to the Department of the Environment in a format similar to the examples provided in this FMP (see Sections 4.4 and 5.2). Results of the data analysis will be reported to the Department of the Environment within 3 months of completion of each stage. The format in which the results are reported will be agreed between Defence and Department of the Environment. Reporting of data to the public will be conducted in accordance with Defence public reporting guidelines.

9. Glossary

ambient *n.*	noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting *n.*	the process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB *abbr.*	decibel. The unit of sound level.
Hertz (Hz) *n.*	the unit of frequency. One hertz is one cycle per second.
L_{Amax}	A-weighted maximum noise level. The highest noise level that occurs during the measurement period.
octave *n.*	interval between one frequency and its double or half.
percentile *adj.*	of or relating to a percentile or a division of a distribution by percentiles. The 90^{th} percentile tells you the value for which 90 percent of the data points are smaller.
sound exposure level (SEL) *n.*	a measure of the total sound energy associated with an individual event, such as an aircraft overflight. The SEL is similar to the equivalent noise level but is normalised to a time period of one second to facilitate direct comparisons of the sound energy for different events.
transition period	period in which both the F-35A aircraft and F/A-18A/B Hornet will be flown as the introduction of F-35A aircraft to the Australian Air Force fleet will be incremental commencing in 2018. For each F-35A aircraft introduced an F/A-18A/B Hornet will be decommissioned.

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