Audible bird scaring devices

Environmental noise guidelines

EPA South Australia

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PREFACE

This document provides a development assessment and compliance tool to assist developers, planning and enforcement authorities, and the broader community in the assessment of environmental noise impacts from audible bird scaring devices when used in an appropriate rural zone intended for agricultural activity.

The core objective of these guidelines is to provide a balance between the ability of primary producers to protect their crops from bird damage and the protection of the surrounding community from associated noise impacts.

A specific approach is required for audible bird scaring devices, one which recognises the unique noise-generating characteristics of these devices and the adverse impacts they can have on the community.

The guidelines are separated into three major sections:

- a set of agreed principles
- a performance-based objective reflecting those principles
- management guidelines reflecting best practice bird management and those principles.

INTRODUCTION

Objectives

Managing orchards and vineyards, bird populations, and efforts to scare birds from sensitive production while not impacting unreasonably upon the quality of life of nearby residents (and still returning a profit) is not a simple matter; nor is there a simple solution.

Existing measures to regulate the use of audible bird scaring devices to protect primary production tend to provide some certainty of use for operators and nearby residents, but their operation is still leading to impacts and conflicts. Although dissatisfaction with the current management system is geographically widespread, the intensity of concern appears to vary significantly between regions.

Problems seem to be most severe in cases where:

- residents are exposed to multiple impacts (ie, a number of adjacent properties, with each one operating within guidelines, but collectively generating significant disturbance)
- devices are being used with little strategic management (eg, being left to run all day by absentee managers).

The adoption of an accumulated peak level (APL) performance-based objective will shift the compliance emphasis from behaviour (eg, the number of discharges per hour) to one of impact (ie, the cumulative effect on any 'receiver'). This shift will provide a fairer means of dealing with multiple impacts and more closely reflect the duty of care established under the *Environment Protection Act 1993* (the EP Act). It also aligns with the direction that can be expected to emanate from courts as they consider the sort of evidence available from relevant research and recent cases.

This approach, however, may result in less clarity for an operator, or for nearby residents, as to what behaviour is acceptable. The proposed management guidelines section of this document (especially those for operating gas guns) address that concern by providing 'rules of thumb' for operators.

The management guidelines section (see Page 10) also recommends the development of bird management plans, in cases where there is a risk of noise impact, to promote the strategic and integrated management of audible bird scaring devices. It also introduces the concept of an area bird management plan to more effectively deter birds and to alleviate potential impacts in multi-property situations. The preparation and implementation of the plans are expected to assist the grower in improving the effectiveness of the devices while minimising their impact on the surrounding community.

REGULATORY FRAMEWORK

Duty of care

The EP Act places a duty of care for the environment, the general environmental duty, on all South Australians. Section 25 of the Act, states:

> A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

Noise is a form of pollution that may result in environmental harm.

When determining what measures are reasonable and practicable for a specific situation, the EP Act requires consideration of:

- the nature of the pollution and the sensitivity of the receiving environment
- the financial implications associated with applying a measure
- the state of technical knowledge about appropriate measures and the likelihood of that knowledge being successfully applied.

Assessments of environmental harm include consideration of:

- the degree and scale of impact
- the health and safety of people
- property damage
- unreasonable interference with the amenity of an area.

These EPA Guidelines indicate the standard of care that is likely to be required for the purposes of securing compliance with the general environmental duty (the duty). The document provides a level of flexibility for some specific situations so that the duty may be more readily applied in a range of circumstances.

These guidelines are given effect through the issue of an Environment Protection Order under Part 7 of the *Environment Protection (Noise) Policy 2007* or Noise Policy.

PRINCIPLES

The following principles for the use of audible bird scaring devices are not in any order of priority:

- **Audible bird scaring devices**

Primary production businesses are of economic value to regional communities and the state, and are a source of income for their proprietors. Their profitability can be affected by bird damage. Effective and acceptable bird control measures, including audible bird scaring devices, are required to avoid personal and community losses.

- **Noise**

Noise is an important element of bird scaring, but to be effective it must be part of a multi-faceted 'best practice' approach.

- **Unreasonable interference**

All occupiers of land have a right to be protected from unreasonable interference in the enjoyment of their property. That level of protection should be commensurate with the expected level of amenity as reflected in the development plan zoning for the area.

- **Health**

Noise from inappropriate bird scaring practices can have a severe impact on people's enjoyment of their property and may affect their mental and physical health.

- **Self-regulation**

Individual growers need better information on birds scarers and their impact. Industry may require assistance in providing education and training regarding best practice bird scaring. A pro-active approach by industry to develop and adopt self-regulation measures will provide more effective local bird management and assist in avoiding adverse impacts on local communities, conflicts and the imposition of external regulatory controls.

- **Communication and mediation**

Primary producers must accept responsibility to use scaring devices in a manner that does not unreasonably interfere with the enjoyment of the area by other residents. Communication between primary producers and with neighbours will help to minimise any unreasonable interference. However, in the event of a dispute, if all parties are to have confidence in receiving fair treatment, the whole community needs to accept a role in reconciling conflicts and providing a transparent complaint management process.

- **Planning controls**

Local government development controls could be amended to minimise future conflicts by better keeping potentially conflicting land uses (such as residential and agriculture) separate and specifying the desired amenity of each. Regional variations in industry and community structure and expectations could be reflected in local development controls.

- **Buyer advice**

Where existing development controls generate potential conflict, land occupiers and potential purchasers should be advised of the situation, the amenity they can expect within the land use zone of the property, and the likely need for communication and compromise with neighbours.

- **Regulation**

A legislative framework will be required to underpin any industry-led self-regulation program. Local and state government administrators of legislation, regulations and policies will still require adequate resources to meet their enforcement obligations.

- **Research and development**

Ongoing research and education is required into bird management and bird scaring options, and their impact on birds and property operations, and the mental and physical health of affected people.

PERFORMANCE-BASED OBJECTIVE

Objective

The operation of any audible bird scaring device or combination of devices must not result in unreasonable interference to neighbouring residents.

An unreasonable interference to neighbouring residents is defined by the following maximum limits.

Maximum accumulated peak level (APL) for impulsive noise devices

- Impulse noise, generated as part of an integrated bird scaring strategy, at an APL of 118 dB is deemed to represent the maximum level of reasonable interference in a zone specifically intended for primary production.
- Impulse noise, generated as part of an integrated bird scaring strategy, at an APL of 115 dB is deemed to represent the maximum level of reasonable interference at the interface between a zone specifically intended for primary production and one for rural living or residential amenity[1].

Table 1 Maximum APL according to location of receiver

Location of receiver	Maximum APL (dB)
Primary production zone	118
Interface between primary production zone and residential or rural living zone	115

Maximum limits

Notwithstanding compliance with the performance-based objective, the following maximum values associated with any single device must not be exceeded:

Table 2 Maximum values associated with single device

Parameter	Maximum value
Maximum noise level from any shot	100 dB(LinPeak)
Maximum number of shots in any hour	6

Noise from audible bird scaring devices before 7 am or after 8 pm must not exceed a L_{Amax} noise level of 45m dB(A).

The Maximum APL is assessed at the nearest noise-sensitive location in accordance with the measurement procedure provided in the Noise Policy.

[1] A buffer zone can be used to separate horticultural and residential land use to ensure that an interface between these conflicting land uses does not occur. The maximum APL should be specifically determined in such a situation. It should also be determined where the noise-sensitive land uses differ from a typical dwelling, such as schools, animal-holding areas or public roads.

The APL has been established based on relevant research and does not require adjustment penalties that may be applied to other noise sources under the Noise Policy.

Explanatory note

The EP Act requires a balance between long- and short-term economic, environmental, social and equity considerations.

The principles that provide guidance in this balance are:

- audible bird scaring devices—bird damage can substantially affect the profitability of primary production
- noise—noise is an important element of bird control, but must be part of a multi-faceted approach to be of lasting effectiveness
- unreasonable interference—the Act requires that the surrounding community should not be subject to unreasonable interference in the enjoyment of their premises.

The factors that will affect the balance between the generation of noise and its impact upon neighbours are:

- the effectiveness of audible bird scaring devices
- the amenity of the area in which the surrounding community is located.

The effectiveness of bird scaring devices

The balance will be very different should the devices provide limited effectiveness. With limited effectiveness and the associated loss of economic value, unreasonable interference will start at much lower levels of noise.

Audible bird scaring devices are only effective when part of a multi-faceted approach.

A central concept in these guidelines, therefore, is to establish that primary producers are using audible bird scaring devices as part of a multi-faceted or integrated approach to bird control. This can be done through the review of a bird management plan as prepared and implemented by the primary producer. This is discussed further in the management guidelines section.

Amenity of the area

The balance will also be affected depending on the amenity of the surrounding community. If the community is located in a dedicated zone for primary production, higher levels of noise will be acceptable compared to that of a community located in a dedicated residential or rural living zone.

Unreasonable interference from impulsive noise

The study *Community Reaction to Noise from an Artillery Range*[2] found that the APL was the superior measure in relation to estimating the community reaction to a broad range of impulsive noise.

The performance-based objective draws on the results of this study.

Appendix 1 provides a detailed analysis and measurement procedure associated with the APL descriptor.

The study is considered to provide the best available information to underpin these guidelines. A search of available literature around the world indicates there is limited information to provide a relationship between impulsive noise and health effects at noise levels at and beyond those recommended.

The World Health Organization published a comprehensive document (*Guidelines for Community Health 1999*) linking noise levels with health effects. Although comprehensive, the document does not specifically address the impact of repetitive impulsive noise. As such, it provides limited guidance with respect to suitable criteria for audible bird scaring devices.

[2] Bullen RB, Hede AJ and Job RFS 1991, 'Community reaction to noise from an artillery range', *Noise Control Engineering Journal*, 37/3, pp 115–127.

MANAGEMENT GUIDELINES

Introduction

This section outlines the elements that should be considered in the application and achievement of the performance-based objective and is intended to assist in interpreting the grower's requirements under the EP Act.

Reasonable and practicable measures

The following practices are elements of what would be expected to be 'reasonable and practicable measures' to mitigate any impacts from bird scaring devices.

Bird management plan

A grower must have a bird management plan if the operation of audible bird scaring devices has an unreasonable interference on the surrounding community.

A bird management plan should outline the grower's integrated bird scaring and management strategies, and should contain certain elements to achieve this. An outline of the elements of a bird management plan is provided in Appendix 2.

It is expected that each site will have a specific plan that may vary from season to season and from one crop or part of the property to another.

Operating gas guns

The technical discussion relating to APL in Appendix 1 will assist in understanding the options associated with acceptable gas gun location and operation. An acoustic engineer can assist in exploring these options further.

An understanding of these options will provide the grower with a flexible approach to gas gun use while limiting the impact on the surrounding community.

Notwithstanding the options available, the following four general operating procedures could be used to assist in complying with the performance-based objective.

1 Separation

The greater the separation between the gas gun and the nearest residence, the greater the noise level reduction. Noise levels will reduce noticeably for each doubling of this distance. As a rule of thumb:

- a typical gas gun located more than 300 m from a residence in a horticultural zone (or similar), restricted in operation to six shots per hour for 10 hours of the day should achieve the performance-based objective
- a typical gas gun located more than 500 m from a residence in a residential, country township, or rural living zone (or similar) restricted in operation to six shots per hour for 10 hours of the day should achieve the performance-based objective.

Testing of gas gun devices indicates that the resultant noise levels from one shot to the next, and from one model of gas gun to another can vary substantially. This variation can result in a need to increase significantly the separation distances nominated.

Care should also be taken to take topography into account, or where weather conditions may assist in propagating noise.

Topographically, the separation distance required will increase where the residence and gas gun are located on separate ridges with a valley between or, meteorologically, where temperature inversions may occur (eg, conditions approaching those that are suitable for the

formation of frost, typically restricted to the early morning hours) or where a slight breeze from the gas gun to the residence is prevailing.

Similarly, the distance may decrease under certain topographies (eg, a hill between the gas gun and receiver) or weather conditions (eg, a prevailing breeze away from the receiver).

Where there is reliance on achieving the performance-based objective through using the above simple 'rules of thumb', care should be taken to account for all the possible sources of this variation, and greater separation distances may be required.

Where more than one device is used on a property, or where concerns have been raised by the surrounding community, professional advice from an acoustic engineer should be sought to ensure compliance with the performance-based objective.

2 Rotation

Testing has also shown that substantial noise level reductions can be achieved by rotating the device away from the receiver. Subjectively, the loudness of a device can be perceived as being halved (approximately a 10-dB reduction) by rotating the device through 180^{o} to face away from the receiver.

Primary producers should therefore face audible bird scaring devices away from the nearest residential receivers.

3 Reflection

The construction of a localised barrier adjacent to the gas gun that reflects and possibly absorbs the sound (in one direction) from the discharge of the gun can result in noise level reductions at the residence.

A barrier may provide additional flexibility in the possible location of the guns.

It is recommended that if a barrier is relied upon to achieve the performance-based objective, an acoustic engineer should assist in the design and testing of the barrier.

4 Hours of operation

Noise from audible bird scaring devices before 7 am or after 8 pm must not exceed a maximum noise level or L_{Amax} of 45 dB(A).

In comparison to the performance-based objective, a noise level of 45 dB(A) is extremely low and would require substantial separation distances to achieve.

As a rule of thumb, where it is likely that the devices will be audible at a residence, their operation in accordance with these guidelines should be restricted to between 7 am and 8 pm.

Electronic/speaker devices

Electronic/speaker devices are another common form of audible bird scarer. Their noise characteristics generally comprise intermittent bursts of noise that attempt to imitate distress calls or to engender a bird distress response.

Therefore, the noise level is typically high in tone (similar to that of a screeching bird) and can modulate in amplitude (from being on or off), or modulate in frequency (ie, different screeching noises) as a result of the type of call.

The Noise Policy provides a means for adjusting noise levels that exhibit these types of characteristics.

The acceptable noise levels presented below for these types of devices should be achieved when accounting for penalties under the Noise Policy. For a typical electronic device, a 5-dB(A) penalty under the Noise Policy must apply as a minimum for tonality. Further penalties

may be applicable depending on the fundamental characteristics of noise from the actual device/s used.

The APL is a suitable noise descriptor for impulse noise. Electronic/speaker devices generally do not generate impulse noise.

A more suitable descriptor for electronic/speaker devices is the equivalent noise level (L_{Aeq}), which is effectively an average noise level over the period of time that a device is operating. (Refer to the definitions section for the technical definition.)

The operation of any electronic/speaker audible bird scaring device must not result in an unreasonable interference to neighbouring residents.

An unreasonable interference to neighbouring residents is defined by the following maximum limits.

Maximum noise level for electronic/speaker devices

- Electronic/speaker noise, **generated as part of an integrated bird scaring strategy**, at an **L_{Aeq} of 57 dB(A)** when measured and adjusted in accordance with the Noise Policy, is deemed to represent the maximum level of reasonable interference in a zone specifically intended for primary production.
- Electronic/speaker noise, **generated as part of an integrated bird scaring strategy**, at an **L_{Aeq} of 52 dB(A)** when measured and adjusted in accordance with the Noise Policy, is deemed to represent the maximum level of reasonable interference at the interface between a zone specifically intended for primary production and one for rural living or residential amenity (or similar)[3].

The maximum noise levels specified above are appropriate for use in development assessment and compliance. A 5-dB(A) adjustment for development assessment, as applied to other noise sources under Part 5 of the Noise Policy, should not be applied to them.

The noise level is assessed at the nearest noise-sensitive location in accordance with the measurement procedure provided in the Noise Policy.

The general operating procedures that apply to gas guns for rotation, reflection, and hours of operation should also apply to electronic/speaker devices as practicable. Some speaker systems are omnidirectional, in which case rotating and reflection will not be practicable noise reduction options.

Rule-of-thumb separation distances are not provided for electronic/speaker systems, given the large variation in noise levels that are possible from one system to the next. This is due to the number of speakers in the system, their distribution and the volume control associated with those speakers.

Noise level testing should be carried out when establishing a speaker system where interference with neighbouring properties may occur.

Multiple properties

The performance-based objective is based on the total impact at a receiver.

It is not uncommon, particularly with gas gun use, for multiple properties with different owners to contribute to the noise level at a single receiver, and for this receiver to be adversely impacted due to the cumulative effect of noise.

Therefore, the maximum APL under these guidelines may be exceeded at a residence where multiple properties, all using audible bird scaring devices, exist.

[3] Where a buffer zone exists, the recommended noise level should be specifically determined.

A resident should not be exposed to levels that are in excess of the criteria under these guidelines either from a single property or as the result of the cumulative effect of a number of properties, due to the potential impacts this may cause.

Where multiple properties using audible bird scaring devices generate cumulative noise levels in excess of the performance-based objective at a single receiver, each individual property that contributes to this cumulative impact must meet a maximum APL that is at least 5 dB less than that recommended in Table 1 unless a coordinated approach amongst the growers in accordance with these guidelines is implemented.

Requiring an APL that is 5 dB less than that recommended in Table 1 is a simplistic approach in that it assumes each property contributes the same impact to that single receiver.

An alternative is to achieve the cumulative maximum APL in Table 1 through a coordinated approach amongst the growers.

It may be possible to reduce the cumulative impact of noise at a single receiver to achieve the objective criteria by concentrating on certain properties or devices used on those properties. Such an approach is expected to require the cooperation and coordination of the growers in the immediate region and the input of acoustic engineering advice.

The advantage of such an approach is that it may result in existing successful practices remaining unaltered while delivering more effective bird management over an area rather than just over a property. In addition, the issues of habituation of the birds to a scaring strategy and relocating the problem to another property can be better addressed through a coordinated approach.

It would be acceptable under these circumstances for the group to prepare an **area bird management plan.**

Examples of the responses that could be built into area bird management plans are:

- rationalisation of the number of audible devices, their relative locations and their discharge rate and timing
- rotation of the use of devices to different properties or portions of orchards during the day
- increased array and variation in the bird management measures, including visual as well as auditory measures.

Communication for effective bird deterrence

Given the potential for disturbance and misunderstanding associated with the use of audible bird scaring devices, it is sound practice for operators to consult with neighbours about their planned operation, to explain the reason for their use, and to discuss options for their operation. In some cases this may not be feasible (eg, the number of people involved, uncertainty about who may be able to hear the devices in different conditions, or historic bad relations) but, if possible, it could help prevent some problems from arising.

In cases where a number of properties may all be using gas guns, if it is possible to identify sensible groupings of properties, much could be gained by working collectively as a unit, both in terms of the effectiveness of the devices and their impact on the surrounding community. A multi-property (area) bird management plan could address both rationalising the number of guns to an even distribution over the total area and their discharge rates and timing.

Identifying gas guns and other audible devices

Local authorities such as councils and police have expressed frustration at identifying the owners of devices, particularly during out-of-hours operation or operation on properties that do not have a site manager or may be unattended for long periods of time.

Operators should ensure there is clear identification displayed on the devices, or at the entry to a property, to enable contact if an authorised officer needs to enter the site.

Case studies

The following case studies are examples of typical complaint situations and the application of the management guidelines to achieve the performance-based objective.

Case study 1

A grower operates a gas gun that is approximately 200 m from the nearest residence. Both the grower's property and the residence are in a horticultural zone that promotes the grower's land use.

The gun begins to detonate at sunrise and continues through to sunset, with 10 shots per hour over that period.

A measurement of the noise level from the guns, taken at the residence by the authorised officer investigating a complaint made by the resident, is approximately 100 dB(LinPeak).

The total number of shots during the day is 130 (approximately 13 hours times 10 shots per hour).

The APL is calculated by adding the noise level and the logarithm of the number of shots:

$$APL = 100 + 10 \log(130) = 121$$

The APL for a receiver in a horticultural zone is 118, and so the grower is substantially in excess of this.

The grower also advises that he does not regularly use any other method of bird management on his property other than the gas gun.

The investigating officer requires the grower, through the issue of an Environment Protection Order under Part 7 of the Noise Policy, to:

- prepare a bird management plan and meet an APL of 118 within a certain timeframe
- restrict the operation of the gun from 7 am to 8 pm on the property, given that it will not achieve the maximum noise level requirement L_{Amax} of 45 dB(A) after 8 pm or before 7 am.

While on site, the investigating officer tests the noise level at various distances and advises the grower that by relocating the gas gun to 400 m from the residence and restricting the number of shots to six per hour over 13 hours, the APL of 118 could be achieved.

The grower, in conjunction with an industry representative group, prepares a plan using the outline in these guidelines and discussing best practice management options with the Department of Primary Industry and Resources South Australia.

These investigations provide the grower with a range of options that, if integrated, are expected to improve the effectiveness of the bird scaring program on the property. The plan outlines the range of measures that will be applied.

Implementation of the range of measures results in a reduction in the use of the gun and an APL of 118 being achieved. In addition, the strategy improves the effectiveness of bird scaring on the property.

Case study 2

The same grower continues to operate using the bird scaring management plan, monitoring its effectiveness over time, and adjusting management options to suit.

As the horticultural zone develops, neighbouring properties develop similar land uses that require bird management programs.

The cumulative effect of the additional growers using gas guns results in an adverse impact on the residential use. This is determined by measuring the number and noise level of the gas gun discharges at the residence.

The investigating officer identifies four properties in the vicinity that contribute to the cumulative impact, including the original grower. Contact is made with the owners of the properties and it is stated that each property must show they can achieve an APL that is 5 dB(A) less than 118, and that they have an effective bird management regime.

The original grower considers this to be an unfair solution given the property's bird management regime and control of gas gun use.

The alternative, in accordance with these guidelines, is for the four growers to coordinate a single approach that meets the performance criteria.

The original grower organises the group and it is found that the other three growers are relying on gas guns alone for bird scaring. The bird management plan used by the original grower is considered by the group and adapted to provide an integrated area bird management plan.

As a result of the plan, the number of audible devices and their discharge rates and timing are rationalised. Further testing at the residence indicates the required APL resulting from the cumulative effect of all four properties is met, and the original grower is able to operate without change.

GLOSSARY

a-weighted	frequency weighted as specified in *Australian Standard AS 1259–1990 Noise Level Meters* or its replacement
authorised officer	a person appointed to be an authorised officer under Division 1 of Part 10 of the *Environment Protection Act 1993*
ambient noise	the total noise in a given environment not including the noise source under investigation
background noise	the ambient noise, measured using time weighting F, that is equalled or exceeded for 90% of the measurement time interval. Expressed as $L_{A90,T}$, where T refers to the measurement time interval in minutes
dB(A)	the noise level in decibels, obtained using the 'A' weighted network of a noise level meter as specified in Australian Standard AS 1259–1990 Noise Level Meters or its replacement
EPA	South Australian Environment Protection Authority
equivalent noise level	the equivalent continuous A-weighted sound pressure level, obtained using time weighting F, over the measurement time interval. Expressed as $L_{Aeq,T}$, where T refers to the measurement time interval in minutes
extraneous noise	noise from animals, excessive wind effects, insects, birds, aircraft or unusual traffic conditions, or any other infrequently occurring component of the ambient noise
maximum noise level	the value, expressed in dB(A), of the highest instantaneous noise level using fast time weighting F, expressed as L_{Amax}
measurement place	a place at the receiver where the noise level is to be measured.
noise source	premises at which an activity or process is undertaken that results in the emission of noise
premises	any land, or the whole or part of a building or structure

receiver	premises that may be affected by the noise source, other than premises on the same land as the noise source
zone	an area of land delineated as a zone, precinct or otherwise in the relevant Development Plan under the *Development Act 1993* that is subject to a set of land use rules under that plan

APPENDIX 1 ACCUMULATED PEAK LEVEL TECHNICAL INFORMATION (APL)

Accumulated peak level

The study *Community Reaction to Noise from an Artillery Range* found that the APL was the superior measure in relation to estimating the community reaction to a broad range of impulse noise.

The APL is a single number that represents the cumulative effect of the number of shots and their noise levels over the course of a day.

Effectively, it is the logarithmic addition of the noise levels experienced at a receiver over the course of a day.

The logarithmic scale

Noise is propagated as a local fluctuation in pressure. The eardrum is a thin membrane that vibrates when exposed to this fluctuation. The amplitude of the vibration (level) is interpreted as loudness. The perceived loudness is also dependent on the speed of the vibration (frequency). The frequency of a sound is interpreted as pitch or tone.

Subjectively, a high frequency noise at a given level is interpreted as louder than a low frequency noise of the same level. Noise must therefore be 'weighted' by a sound level meter and microphone to simulate this subjective response.

The microphone incorporates a thin metallic strip, commonly known as a diaphragm, to replicate the function of the ear.

The sound level meter, when operated in A-weighting mode, weights the pressure input (electrical signal) from the microphone to simulate the response of the brain to high and low frequency noise.

The unit for pressure is the Pascal (Pa). This is a measurable physical quantity. However, noise is not represented in this form.

This is because the human ear can interpret (and a sensitive microphone can measure) pressures in the range from effectively 0 Pa to the order of millions of Pa. A scale of the order of millions is impractical to use.

The logarithmic scale condenses larger scales into an order that is manageable by determining how many times the number 10 must be multiplied by itself to make up the number in question.

For example:

- the 'log' of 10 is 1
- the log of 100 is 2
- the log of 1000 is 3
- the log of 1,000,000 is 6.

A scale in Pa that ranges from 0 to a million can be converted to a logarithmic scale that ranges from 0 to 6.

A logarithmic scale, when referenced against the lowest pressure the ear can detect, is expressed in the unit dB.

The most common representation of a noise level reading is seen as dB(A), which indicates it has been converted to a logarithmic scale and has been A-weighted to simulate the human response.

Addition in the logarithmic scale

The addition of numbers in a logarithmic scale is different to addition in a linear scale because a vast difference in the pressure (in Pa) corresponds to a relatively small difference in dB, as described below:

- A doubling of pressure (from 10,000 to 20,000 Pa) will result in a 3-dB increase
- A tripling of pressure (from 10,000 to 30,000 Pa) will result in a 5-dB increase
- A tenfold increase in pressure (from 10,000 to 100,000 Pa) will result in a 10-dB increase
- A 3-dB increase is subjectively described as 'just noticeable'
- A 5-dB increase is subjectively described as 'noticeable'.

Another way to think of the information above is that, if exposed to a noise source such as an idling truck standing 10 metres away, you would need three of them to clearly notice a change in noise level and 10 of them to make the noise seem twice as loud.

When adding noise levels in dB the following rules apply:

Difference between 2 numbers (dB)	Total noise
0	add 3 to the number to get the total
1	add 3 to the highest number
2	add 2 to the highest number
3	add 2 to the highest number
4 to 9	add 1 to the highest number
10 and above	add 0 to the highest number

For example:

- the total noise from two sources producing 100 dB each is 103 dB
- the total noise from one source at 100 dB and another at 103 dB is 105 dB
- the total noise from one source at 100 dB and another at 110 dB is 110 dB. (This effect is known as 'masking'.)

A way of expressing this addition formula when all **noise sources are at the same level** is by adding 10xlog(N) to the base level, where N is the total number of sources.

For example, if you have 6 sources, each producing 100 dB, the total noise can be derived from adding 10xlog(6) to 100 (=108). A scientific calculator will provide the answer to 10xlog(6) by entering 6, pressing the log key and multiplying the answer by 10.

The same result can be derived by adding each level individually using the tabulated method. For example:

- 100 + 100 = 103 (adding two of the six noise sources together)
- 103 + 100 = 105 (adding another noise source to the result)
- 105 + 100 = 106 (adding another noise source to the result, etc)
- 106 + 100 = 107
- 107 + 100 = 108.

How does this relate to APL?

The APL is effectively the logarithmic summation of all of the noise levels measured at the receiver during the course of the day.

For example, if an officer measured the following during a day (in practice, this would normally be estimated by inspection during (a) period(s) throughout the day and extrapolated to estimate the APL):

- 1 shot at 110 dB
- 7 shots at 100 dB
- 60 shots at 95 dB,

using the formula 10 x log(N) and **logarithmically** adding together each answer to get the total:

$$(110 + 10 \times \log(1)) + (100 + 10 \times \log(7)) + (95 + 10 \times \log(60)) = 110 + 108 + 112$$
$$= 112 + 112 = 115$$

It can be seen that the above method accounts for the effect of the number of shots and not just the level of those shots.

The logarithmic scale means that you need a substantial increase in the number of shots to make a difference to the APL. Intuitively this makes sense because you would expect that a person exposed to 60 shots would have a similar reaction when exposed to 80 shots in that day. However, their reaction would be expected to change if they were exposed to 800 shots.

For example:

- 10 x log(60) = 18
- 10 x log(80) = 19 (no noticeable difference)
- 10 x log(800) = 29 (twice as loud).

The other thing to notice about the APL is that the noise level provides the biggest influence on it. Therefore, a gas gun deemed to be excessive will be more easily reduced to a satisfactory APL by reducing its noise level by shielding, rotation and/or relocation than by reducing its number of shots.

Why is the APL expressed as dB (LinPeak)?

The study, Community Reaction to Noise from an Artillery Range, found that the unweighted peak level was acceptable as a measure of impulse noise.

'Unweighted' means the result has not been adjusted to account for the subjective response of humans to sounds of varying frequency. This is referred to as the Linear (or 'Lin') scale.

The 'peak' refers to measurement of the absolute level prior to mathematical manipulation by the meter.

LinPeak can therefore be thought of as a descriptor that captures the actual impulse without modification.

The most common descriptor for other types of noise would average the pressure levels received by the meter and apply the A-weighting network to the result. This has been found to be a less reliable descriptor in predicting the human response to impulse noise, as would be intuitively expected.

How would the APL be applied?

A value of APL responds to an expected percentage of the community being 'seriously affected'.

Environmental policy generally accepts a percentage of 10% seriously affected, rather than no effect at all, to account for economic and technical considerations, and the large variation in individual responses to a given environmental nuisance issue.

This balance changes according to the location of the receiver. It is well accepted that the greatest level of protection should be afforded to a resident in a residential zone. The 10%-rule would apply in this situation.

A resident located within a horticultural zone will have a different balance, with economic factors for the horticulturist providing more weight in this situation.

A resident located at the interface of a horticultural zone will have a different balance or amenity again. The general philosophy is that both the horticulturist and the resident will need to make equal compromises in this situation.

The APL for the existing EPA guidelines of 6 shots per hour at 100 dB (LinPeak) over a 10-hour day is 100 + 10 log(10x6) = 118.

An APL of 118 corresponds to 30% seriously affected. This level of effect would only be considered acceptable for a resident located in a primary production zone; the balance in this situation falls with the primary producer.

The APL that corresponds to 10% seriously affected is approximately 112.

Therefore, the APL that would be applied at the interface of these two land uses is derived from an equal compromise (halfway between 118 and 112 = 115).

The Maximum APL provided in Table 1 of these guidelines therefore becomes 118 for a noise-sensitive receiver in a primary production zone, and 115 for a noise-sensitive receiver in a residential zone that interfaces with a primary production zone.

What are the advantages of using the APL?

- It has a solid technical basis.
- It provides ultimate flexibility for the horticulturist while protecting the surrounding community.
- It better reflects the real impact and the real use of the devices.
- It accounts for the cumulative impact of a number of devices or properties.
- It consolidates a number of different rules into a single number approach.
- What are the disadvantages of using the APL?
- It will require some additional training for the investigating officers.
- It may be difficult for the broader community to get an intuitive feel for it.

How about the cumulative effect of multiple guns from multiple properties?

The APL can be calculated for the noise from multiple gas guns on a single property.

Where multiple properties exist that impact on a receiver, it may be difficult to identify the property from which the sound is emanating but an overall APL can be determined.

If that APL exceeds the relevant level, an adverse impact on that receiver can occur. These guidelines require all persons contributing to that impact to prevent or minimise their contribution in accordance with the general environmental duty.

APPENDIX 2 BIRD MANAGEMENT PLAN OUTLINE

Bird management plans for individual properties should offer sufficient information to allow the property owner to make an informed decision on dealing with bird problems. The type of information and the level of detail required will vary according to the nature and scale of the problem.

The following checklist provides an indication of the type of information that may need to be collected to assist growers to write their own bird management plans.

More detailed information for growers, especially on options for management actions, can be found in *Guidelines for Best Practice Bird Management*[4].

Property map

A property map should be prepared, detailing:

- different crops
- varietal blocks
- surrounding vegetation
- features around the property such as:
  - powerlines
  - roads
  - dams
  - other watering points.
- sensitive areas such as:
  - your house(s)
  - neighbours' houses
  - nearby townships
  - horse stables.

Bird problem

The following information should be prepared and marked on the property map.

Where damage occurs

Identify where damage occurs on the property:

- bird flight paths
- areas often frequented by birds
- areas of high human activity
- alternative potential feed
- alternative feeding sites.

[4] Sinclair, R 2003, *Guidelines for Best Practice Bird Management*, Department of Water, Land and Biodiversity Conservation, Adelaide.

Which species cause damage

List the pest species known to visit your property.

Determine an order of importance for each species based on damage caused.

Determine which species are causing damage in which crop/varietal block.

Determine a pattern of presence for each species:

- those present most of the year (locals)
- those present as the crop ripens (visitors)
- those present at other specific times.

When damage occurs

Record the expected harvest dates for each crop/varietal block.

Record when damage starts.

Compare the data to previous years to establish any patterns.

Cost of bird damage to the property

You should have two components:

- record(s) from previous years' experience
- an ongoing record of what is happening through the current year/season.

For each year estimate the following:

- the amount of crop lost due to birds, as a percentage of total crop
- the value of crop lost due to birds, as a dollar value
- the level of reduced quality of fruit that has occurred.

For each year estimate the cost of bird control activities:

- initial set-up cost of equipment
- annual depreciation costs of capital equipment
- consumable items (fuel, ammunition, etc)
- labour.

Add the above sub-totals together to achieve an annual cost to the business.

Management resources

List the devices you intend to use:

- visual scarers (eg hawk-kites, scarecrows, plastic bags on poles, streamers)
- noise scarers (eg firearms, gas guns, electronic bird scarers)
- noise and movement (eg motor bike without a muffler, model or real aircraft)
- exclusion (netting)
- habitat management (eg decoy feeding, strategic mowing, irrigation)
- culling.

Management strategies

The following information should be recorded as part of the plan:

Aims

State the aim(s) you seek to achieve, eg:

- a reduction in the loss of crop
- an increase in yield
- a reduction in current control costs.

Management actions

Briefly describe what you intend to do to achieve your aim(s), for example:

- how you intend to manage the main pest species (as listed above)
- when you intend to manage the problem
- where you intend to manage the problem.

Prepare approaches for both local and visitor species detailing:

- the variety of management resources you are going to use
- the actions you are going to implement to maintain the ongoing effectiveness of each resource.

Monitoring

Document the monitoring of:

- each management resource that you have used
- each action plan you have implemented
- what needs to be done to improve the effectiveness of both the resource and the action plan.

Monitoring records could include:

- an estimate of loss from the same place(s) within the crop on regular occasions throughout the season/period
- a regular estimate of the number and species of birds feeding on the crop at a particular time of the day.

Communications

The following information should be recorded as part of the plan:

- List of neighbours on your property boundaries and contact details.
- List of other sensitive receptors, eg, schools, hospitals, churches.
- Determine what information you will supply to your neighbours:
  - name(s) of owners/managers
  - contact details including mobile and after hours phone numbers.

List what action you intend to take to notify your neighbours:

- prior to the commencement of the season
- during the season

- when there are unusual circumstances.

List the method of communication you intend to use, eg:

- phone call
- fax/email
- personal visit
- letterbox drop.

List what action you or your staff **will** implement as a result of a complaint by a neighbour.

Record what action you **did** undertake on receiving a complaint from a neighbour.