



# Rabbit Management Plan

## Willandra Lakes Region World Heritage Property

Collaborative Control of Rabbits by Willandra Lakes Region Land Managers and Western Local Land Services



**Local Land  
Services**



**National  
Landcare  
Program**





## Acknowledgements

Western Local Land Services would like to acknowledge the contributions of several sources in the development of this plan:

- NSW National Parks and Wildlife Service
- Willandra Landholders' Alliance
- Individual landholders of the Willandra Lakes Region
- Sunraysia Environmental Pty Ltd
- Western Landcare NSW



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### Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of the report. However, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of Local Land Services or the user's independent adviser. © State of New South Wales through Local Land Services 2020.



Photo credit: NPWS World Heritage team

## Executive summary

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This rabbit management plan (the Plan) acknowledges the commitment and co-operation of land managers, the Aboriginal community and government agencies to develop clear guidelines on roles and responsibilities required to control rabbits and help protect the Outstanding Universal Values of the Willandra Lakes Region World Heritage property.

This Plan is designed to contribute to the maintenance and protection of the Outstanding Universal Value (OUV) of the Willandra Lakes Region (WLR) World Heritage property. The Plan recognises that the greatest threat to the OUV of the WLR is soil erosion caused by the lack of ground cover and while this is the result of total grazing pressure, the Plan will:

- assist land managers to improve the standard of rabbit control across individual properties
- encourage integrated control actions at optimal times to create a strategic and holistic approach to rabbit control
- highlight the roles and responsibilities of each stakeholder.

The Plan emphasises continuous and coordinated action is required to successfully manage rabbits and control is a mutual responsibility of both land managers and funding agencies. The Plan aims to foster a collaborative approach to improved rabbit control and financial accountability.

Under the *Biosecurity Act 2016*, land managers have a biosecurity duty to actively manage and control pest animals and plants on their property. In protecting the OUV of the WLR, the land manager is also responsible and accountable for avoiding damage to Aboriginal objects which may arise during management activities, including rabbit control activities. Due diligence must be applied to avoid prosecution for knowingly destroying Aboriginal objects.

Due diligence is defined as:

*taking reasonable and practical steps to determine whether a person's actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm.*

Funding support is available through Western Local Land Services as prescribed in the *Local Land Services Act 2013*. However, Western Local Land Services will not provide funding for activities that harm or cause significant and lasting impact to the OUV of the WLR. Information on the presence of Aboriginal objects will be obtained through a cultural heritage assessment of each warren located in sensitive areas and is an essential requirement before any control can begin. Western Local Land Services can coordinate the recording of this information and will inform land managers of the findings.

Coordinated actions across neighbours' boundaries and using a variety of measures will have greatest effect in controlling rabbit numbers. Leaving just one warren entrance and a pair of rabbits can re-infest the property and reverse any previous control work. Even if a 90% reduction in rabbit abundance results from a control activity, if follow-up control is not carried out, rabbits can easily return to pre-control numbers — under favourable conditions — within less than 12 months. Active warrens within one kilometre and up to three kilometres from the treated area will affect the success of the control program and re-infestation will occur from these active warrens.





Applying the correct techniques in the correct order (an integrated program) can provide long-term results but continual vigilance, in the form of an on-going, low-level maintenance program, is essential. Primary treatment options include baiting — which can result in a large reduction in abundance — followed by warren destruction (ripping or implosion) — to deny the remaining rabbits the opportunity to recover in abundance. While ripping is an appropriate method in many locations, concussive implosion must be used in culturally sensitive areas or on warrens that have cultural heritage material.

Concussive implosion should also be used where trees or vegetation cover prevent easy use of mechanical warren destruction. Within the WLR property, pushing over trees to access warrens should be minimised — clearing vegetation will increase the potential for soil erosion, increasing the threat to the OUV of the WLR. It will also create an above ground harbour for rabbits, ultimately negating the efforts to destroy the warren. Beyond the WLR, land managers are obliged to use due diligence and to consider the core objective of the program — to reduce soil erosion. Importantly, any vegetation clearing must be done in accordance with the Vegetation Code which dictates clearing must be to the minimum extent possible.

Secondary (or follow-up) control treatments include fumigation, shooting and biological control. It is essential that pre-treatment and post-treatment assessment of rabbit abundance be conducted before and after each treatment. Without knowledge of pre-treatment rabbit abundance or distribution, it is not possible to assess the effectiveness of any control method or program. Such monitoring informs the land manager what work remains to be done. It is the land manager's obligation to conduct pre-treatment and post-treatment monitoring and to report the findings to Western Local Land Services.

Under this Plan, participation in the program is voluntary but stakeholder responsibilities are clearly stated. Western Local Land Services will provide support and assistance to land managers for:

- coordinating cultural heritage surveys
- warren destruction through ripping
- biosecurity support, e.g. supplying poison baits and investigating releases of biological control agents
- training, e.g. concussive implosion.

Land managers will be responsible for in-kind contributions consisting of:

- mapping warrens on their property
- laying poisoned bait
- pre-treatment monitoring of rabbit abundance (in accordance with the Plan)
- post-treatment monitoring of rabbit abundance (in accordance with the Plan)
- follow-up control measures (in accordance with the Plan)
- recording data (in accordance with the Plan).

Implementation of this Plan at the property level will be in accordance with an individual control and works plan. Prior to the commencement of any control activity on a property, a round table meeting will be held between the land manager, Western Local Land Services project staff, World Heritage Cultural Heritage team member(s), ripping contractor and the Western Landcare Officer. The purpose of the meeting will be to devise a property-level control and works plan which will confirm roles and responsibilities of all parties and enable any negotiation that may be required in relation to the level of in-kind support from each property, cognisant of differing rabbit densities and landscapes across the World Heritage property.

The WLR World Heritage property rabbit control management plan, while initiated under a five-year project funded by the National Landcare Program, sets the foundations to enable land managers of the Willandra Lakes Region to manage rabbit populations beyond the timeframe of the project. The establishment of an integrated system of control measures and monitoring regimes provides the tools for land managers to meet their obligations under the *Biosecurity Act 2015* and, importantly, to do so while adhering to protocols to maintain the Outstanding Universal Value of the World Heritage property.

### **How to use this Plan**

**If you are interested in the background this Plan or stakeholder responsibilities, see Sections 1–4.**

**If you are interested in ways to control rabbits and monitor their numbers, see Sections 5–7.**

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An extensive rabbit warren. Photo credit: Sunraysia Environmental Pty Ltd





## 1. Introduction

### 1.1 The purpose of the Plan

This rabbit management plan (the Plan) has been funded through the National Landcare Program 2 (NLP2) and is designed to contribute to the maintenance and protection of the Outstanding Universal Value (OUV) of the Willandra Lakes Region (WLR) World Heritage property by:

- assisting land managers to improve the standard of rabbit control across individual properties
- encouraging integrated control actions at optimal times to create a strategic and holistic approach to rabbit control
- highlight the roles and responsibilities of each stakeholder.

The Plan emphasises continuous and coordinated action is required to successfully manage rabbits, and control is a mutual responsibility of both land managers and funding agencies. The Plan aims to foster a collaborative approach to improved rabbit control and financial accountability.

A pest (including the European rabbit *Oryctolagus cuniculus*) is defined under the *Biosecurity Act 2015* as a plant or animal that has an adverse effect on the environment, the economy or the community because it has the potential to:

- out-compete other organisms for resources, including food, water, nutrients, habitat and sunlight
- prey or feed on other organisms
- transmit disease to other organisms
- cause harm to other organisms through its toxicity
- otherwise reduce the productivity of agricultural systems or the value of agricultural products
- damage infrastructure
- reduce the amenity or aesthetic value of premises
- harm or reduce biodiversity.

(<https://www.legislation.nsw.gov.au/#/view/act/2015/24>)

Under the same Act, land managers have a general biosecurity duty to actively manage and control pest animals and plants on their property; failure to do so is a liable offence under the Act. Funding support for related actions is available through the Western Local Land Services as prescribed in the *Local Land Services Act 2013*, which specifies public funding for biosecurity actions (<https://www.lls.nsw.gov.au>).

Competition with native animal species and land degradation by feral rabbits are listed as a key threatening process under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. With the help of the states and territories, the Australian Government has also developed the Threat Abatement Plan for Competition and Land Degradation by Feral Rabbits (Commonwealth of Australia 2016a). This plan lists 156 threatened species that can be adversely affected by rabbits.

### 1.2 How to use the Plan

The Plan provides options for the control of rabbits; all options may not be relevant to each property within the WHA, as individual property conditions will vary across geographical location and at different times. The Plan is non-binding for all parties and participation in a rabbit control program sponsored by Western Local Land Services is voluntary. Correspondingly, Western Local Land Services will focus funding according to fund availability, agency priorities, the protection of the values of the World Heritage region and land manager in-kind contributions, i.e. the more work a land manager contributes to the program, the greater the priority for the property.

The Plan aims to be flexible and adaptive: flexible in its application to individual properties and adaptive through regular annual review. Reviews will enable the Plan to respond to altered conditions or circumstances.



Photo credit: NPWS World Heritage team

### 1.3 Previous rabbit control programs

A series of control programs has been implemented within WLR since at least 2002 (Appendix 2). Historically, these programs have been sporadic and opportunistic. Dependent on the availability of government funding to support land managers actions, the programs have largely lacked a coordinated action and have been ineffectual in combating re-infestations. The inability to effectively plan and undertake a landscape-scale approach to control, in addition to the lack of follow-up treatments, has resulted in the unsuccessful containment and reduction in rabbits.

Some WLR land managers were involved in an Australia-wide trial release of a new strain of Rabbit Hemorrhagic Disease (RHDV1 K5) in 2017; however, this was not part of any integrated program.

The exception to this pattern of past programs is the collaborative on-ground works done by the WHA and Western Local Land Services in 2010-12 and 2016-16 to undertake actions with the Willandra Landholders' Alliance. However, there was little integration of control methods, including monitoring for the effectiveness of actions. This current document extends that collaboration by addressing those shortcomings.

See Appendix 2 for a summary of previous works and their evaluation.

### 1.4 Development of the Plan

The Plan was developed after reviewing existing management plans and related documents for the WLR, and consideration of information from additional sources:

- documents listed in Section 3
- consultation with Willandra Landholders' Alliance
- consultation with individual land managers in the WHA
- consultation with consultants expert in rabbit control
- incorporation of stakeholder comments received on draft versions of the Plan
- internet resources from State and Commonwealth governments.

The development of the Plan between the land managers of the Willandra Lakes Region and the Western Local Land Services recognises their shared responsibility (financial, in-kind and practical) for rabbit control and commitment to on-going action.



## 1.5 Rabbit ecology

Rabbits are most active from late afternoon until early morning, but they can be active at any time if they are undisturbed or if their numbers are high. Activity appears to decrease at night if there are high winds or rain, which limits their ability to detect predators.

Rabbits construct large warrens up to 3 m deep and 45 m long. Warren complexes are generally larger in more open country. Warrens provide cover and protection from predators and extreme temperatures, and allow rabbits to live in open grasslands, grazed pasture and arid land. Where there is abundant surface cover, rabbits may live above the ground in harbours such as bushes, shrubs or cleared vegetation.

Daily movements are generally within 150–200 m of the warren, but this distance can increase during droughts (up to 1.5 km has been observed) or decrease during the breeding season. Very young rabbits 20 to 60 days old are more likely to disperse than older rabbits; adult rabbits rarely disperse. Newly emerged kittens may move up to 1.5 km to a new warren complex.

The main breeding season is determined primarily by rainfall and the early growth of high protein plants, but they can breed at any time of the year provided there is short green feed supplying sufficient protein. A 50% water content level in vegetation will trigger breeding, so a significant rainfall event, regardless of season, will result in breeding. In the WLR, breeding generally occurs autumn through spring (April–November, inclusive).

Both males and females reach maturity between 3 and 4 months of age. The gestation period is 28–30 days and the doe usually mate again within an hour of giving birth. Litter size varies according to the doe's age and nutrition and social status, and the seasonal conditions, but the average number is 4–5 kittens. On average, a female has about 30 offspring in a single breeding season. The females from this first doe will reach sexual maturity during the same season, so in one breeding season, one adult doe may be responsible for in excess of 100 rabbits.

Kittens are usually weaned at about 18 days, leaving the nest at 23–25 days old but they can survive at 16–18 days. A rabbit can consume up to a third of its body weight daily with grazing generally occurring throughout the night for 2.5–6 hours. A rabbit requires about 284MJ, while a 45kg sheep requires 2438MJ. This equates to a ratio of approximately nine rabbits to one dry sheep equivalent.

Rabbits produce both soft and dry pellets. Soft pellets can be re-eaten to extract the remaining protein and moisture, enabling rabbits to survive with minimum free water. The hard pellets seen in dung heaps are the end result of this second digestion process.

Natural mortality is not sufficient to suppress rabbit populations. Kitten mortality is extremely high, up to 80% dying before 3 months but it is estimated an 85% mortality is required to prevent a 10-fold increase in population.

Two diseases are known to effect rabbit populations: myxomatosis and rabbit haemorrhagic disease virus (RHDV). Myxomatosis can cause death within 8–12 days and will kill up to 50% of rabbits it infects. RHDV kills 6–12 hours after the onset of fever, effecting up to 75% of individuals, particularly in arid and semi-arid regions.

Drought conditions will induce dispersal of individuals, which leads to exposure and vulnerability to predators (fox, dingo, cat, dog, raptors). When rabbit numbers are low, predation can reduce the number of young by approximately 25%. In denser populations this proportion decreases to about 10%, with predation playing little part in population control. Lack of food stops reproduction and can result in the death of nestlings and eventually adults. This is the time when control programs are most effective (DPI 2018).

### IMPORTANT

**Active warrens within one kilometre and up to three kilometres from the area of a control program will affect the success of the control program.**

**Re-infestation of the treated area will occur from these active warrens.**

## 2. Willandra Lakes Region overview

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### 2.1 Description of the area

The Willandra Lakes Region World Heritage property is located in south western New South Wales, Australia (Figure 1). The WLRWHA covers 240,000 hectares and contains a system of ancient lakes formed over the last two million years, most of which are flanked on their eastern margins by a crescent shaped dune or lunette. The WLRWHA was inscribed on the World Heritage List in 1981 for its outstanding cultural and natural universal values (<http://www.visitmungo.com.au/world-heritage>).

### 2.2 Values

Willandra Lakes Region is listed under the World Heritage Convention for its outstanding universal values relating to both cultural and natural heritage. Under cultural heritage values, Willandra Lakes Region is regarded as outstanding in its exceptional archaeology that is “unique, extremely rare or of great antiquity”. This is reflected in the documentation of early First Nations’ culture and its adaptation to environmental change; the rare insights offered into human interactions with the dramatic landscape of lakes, lunettes and sand dunes over at least the last 50,000 years; and the remains of a 40,000 year old female found in the dunes of Lake Mungo which are believed to be the oldest ritual cremation site in the world.

The natural heritage of Willandra Lakes Region offers “an outstanding example representing ongoing geological processes, biological evolution and human society’s interaction with the natural environment, especially its communities of plants and animals, landforms and marine and freshwater bodies.” The features are revealed in the presentation of Pleistocene climatic changes and landscape history in the geomorphological record spanning well over 100,000 years; in the evidence of variations in the earth’s magnetic field in the Late Pleistocene period; and in animal bones found in the area which have furthered our understanding the sequence of megafauna extinctions.

In addition to the World Heritage-related values of the Willandra Lakes, other values include economic values, biodiversity values, social values, and research and education values. It is important to acknowledge that all values operate at differing scales, from local, regional, state and national through to the international level and the greatest threat to these values is soil erosion arising from reduced or absent ground cover (Booth et al. 2015).

### 2.3 Land tenure and land use

The Willandra Lakes Region is divided roughly in two sections between privately managed pastoral lease properties and Mungo National Park; there are also some small areas of freehold land. Mungo National Park was gazetted in 1979, covering 15,600ha of the old soldier settlers’ block known as Mungo, and was acquired for the archaeological material discovered in Lake Mungo lunette in 1967 and 1974. Further additions occurred over successive years and the park’s current boundaries were settled in 2011 with the inclusion of Joulmi State Conservation Area, making a total of 128,250 ha managed by NSW National Parks and Wildlife Service (Sunraysia Environmental 2013). Tourism, conservation and scientific research occur in Mungo National Park.

Currently, there are eleven pastoral properties within the World Heritage area which are Western Lands Leases held in perpetuity and jointly they form the Willandra Landholders’ Alliance. Enterprises on the pastoral properties include animal grazing (merino and dorper sheep and goats) and small areas of dryland cropping (WLRWHA 2016).

A small business lease, specifically for tourist accommodation (Mungo Lodge) is located within the WLR adjacent to Mungo National Park and Top Hut Station.



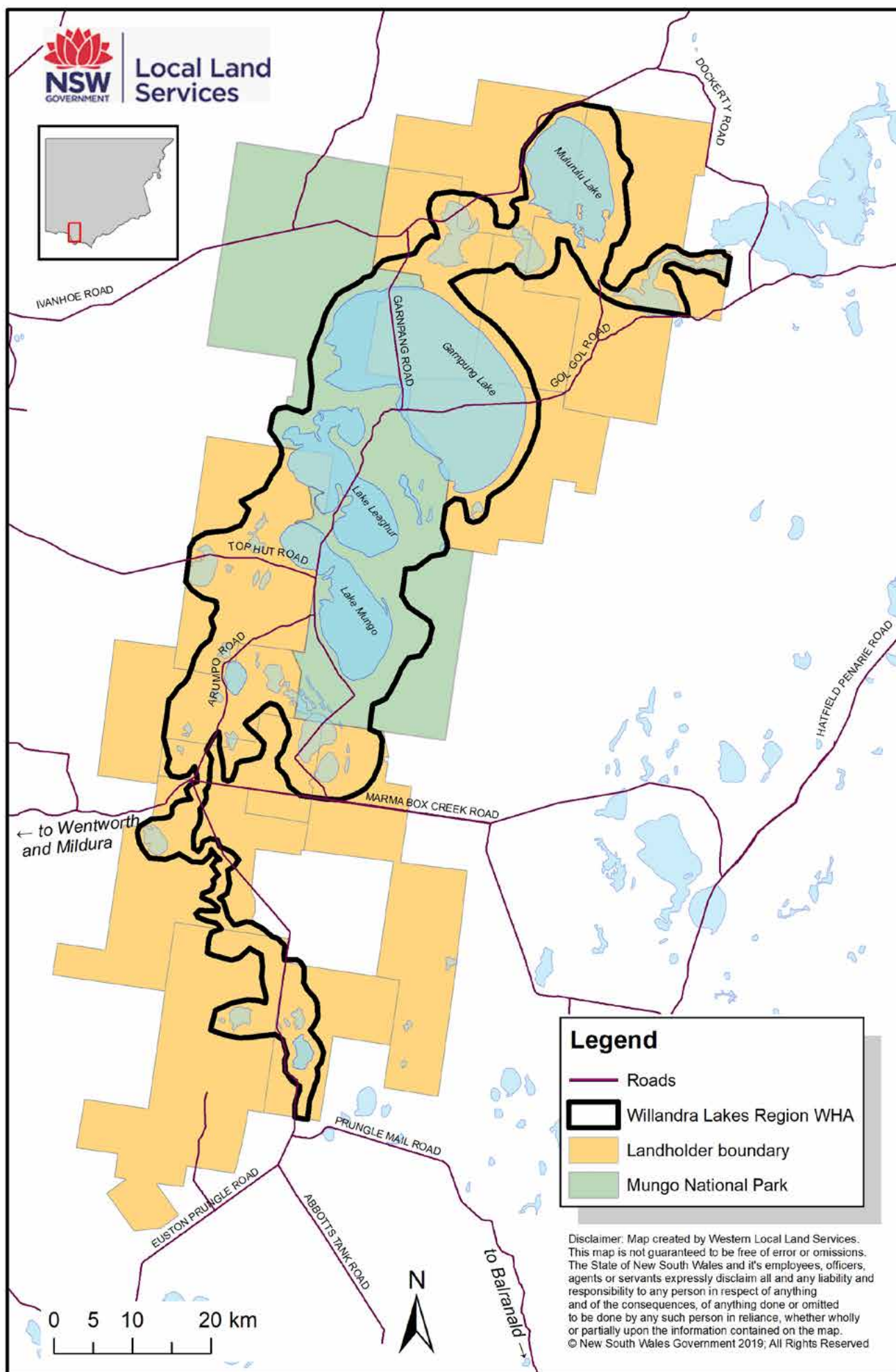


Figure 1 Willandra Lakes Region World Heritage Property

### 3. Legislation, plans and reports that underpin this Plan

Table 1 Short list of relevant legislation and regulations, reports and plans

Name of Act and regulations	Name of report or guideline	Relevance
State or Federal		
<i>Biosecurity Act 2015</i>		Land managers have a general biosecurity duty to actively manage and control pest animals on their property.
<i>Local Land Services Act 2013</i>		Specifies public funding for biosecurity actions.
<i>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</i>		Competition with native animal species and land degradation by feral rabbits are listed as a key threatening process.
	Threat Abatement Plan for Competition and Land Degradation by Feral Rabbits	Lists 156 threatened species that can be adversely affected by rabbits.
<i>National Parks and Wildlife Act 1974</i>		The primary piece of legislation which protects Aboriginal cultural heritage in NSW. Under the Act, it is an offence to harm (destroy, deface, or damage) or desecrate an Aboriginal object or Aboriginal place, or to move the object from the land on which it has been situated.
	Due Diligence Code of Practice	Supplies guidance when carrying out activities that may harm Aboriginal objects.
The Land Management (Native Vegetation) Code 2018		Covers a range of routine land management activities associated with agriculture and other common practices in rural areas.
<i>Pesticides Act 1999; the Pesticides Regulation 2017</i>		Regulates rabbit poisoning.
<i>Workplace Health and Safety (WHS) Act 2011</i>		Users of hazardous chemicals must be trained.
<i>Companion Animals Act 1998</i>		A person must not set or urge a dog to attack, bite, harass or chase any animal except when hunting.
<i>Prevention of Cruelty to Animals Act 1979</i>		Hunting must be in accordance to the Act.
<i>Game and Feral Animal Control Act 2002; the Game and Feral Animal Control Regulation 2012; Hunters' Code of Practice</i>		Information on use of dogs in hunting.
<i>Crown Land Management Act 2016</i>		Specifies the management purpose of the land.





Name of Act and regulations	Name of report or guideline	Relevance
Willandra Lakes Region specific		
	Pest Management Plan, Willandra Lakes Region World Heritage Area (Sunraysia Environmental 2013)	The Plan establishes priorities for pest plant and animal control in the WHA.
	Willandra Lakes Region World Heritage Area Pest Management Plan 2006-2007 (Sunraysia Institute of TAFE 2006)	Best practice, humane and cost-effective methods that have minimal impacts on cultural sites and the environment. An integrated approach pest plant and animal control using a range of techniques at critical times of the year.
	Sustaining the Willandra: the Willandra Lakes Region World Heritage Property Plan of Management (Mandis Roberts Consultants Australia 1996)	A plan of management to provide a framework for consistent decision making, including protecting the values of the WHA.

### IMPORTANT

**Under the *Biosecurity Act 2016*, land managers have a biosecurity duty to actively manage and control pest animals and plants on their property.**

**Funding support is available through the Western Local Land Services as prescribed in the *Local Land Services Act 2013*.**

**The Land Management (Native Vegetation) Code 2018 explains allowable activities and vegetation clearing in rural areas.**

## 4. Cultural heritage of the Willandra Lakes Region and management responsibilities

World Heritage listing does not alter land tenure but may have some effect on land management activities; ownership remains as it was before nomination. State and local laws continue to apply and the Commonwealth Government has an international obligation, under the World Heritage Convention to identify, protect, conserve, present and transfer to future generations Australia's cultural and natural heritage of Outstanding Universal Values (OUV).

To be considered of Outstanding Universal Value, a property needs to:

- meet one or more of 10 criteria
- meet the conditions of integrity
- meet the conditions of authenticity (if a cultural property)
- have an adequate system of protection and management to safeguard its future.

Under the Agreement, property management undertaken by stakeholders and partners must meet these obligations. Overall, the management of the WHA is down to land managers, i.e. leaseholders and NPWS. As per the World Heritage Convention, an advisory committee has been established to provide advice to State and Commonwealth Ministers on the operation of the WLR and to provide a strategic direction. This advisory committee is made up of stakeholder representatives from landholders, Aboriginal groups, tourism, NPWS and science.

The WLR is managed under the Sustaining the Willandra: the Willandra Lakes Region World Heritage Property Plan of Management (DEST 1996). In accordance with State legislation, Mungo National Park is managed according to the Mungo National Park Plan of Management (DEC 2006).

The contraction of the WLR boundaries to the lake edges in 2011 meant some individual properties were not captured in their entirety into the WHA. While this may affect the choice of some management activities in areas outside the WHA, it does not absolve the landholder from applying due diligence in relation to Aboriginal cultural heritage material across the whole property.

*The National Parks and Wildlife Act 1974* is the primary piece of legislation which protects Aboriginal cultural heritage in NSW. Under the Act, it is an offence to harm (destroy, deface, or damage) or desecrate an Aboriginal object or Aboriginal place, or to move the object from the land on which it has been situated. The NSW Due Diligence Code of Practice (DECCW 2019) supplies guidance when carrying out activities that may harm Aboriginal objects (see Appendix 3 for the generic due diligence process).

**Due diligence is defined as “taking reasonable and practical steps to determine whether a person’s actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm”.**

The OUV of the WLR precludes the use of any activity that has potential to cause significant impact to these values. The values of the WLR are archaeological and geological; consequently, any ground disturbance from rabbit control activities has the potential to cause a significant impact to these values and highlights the importance of having in place plans and controls. Aboriginal objects and sites, such as lake lunettes where there is high potential for material, are particularly significant and vulnerable. This is especially true if the objects are on the soil surface and already subject to degradation from the impact from hard-hooved animals, weathering and erosion.

The land manager is always obliged to conform to the NSW Due Diligence Code of Practice for activities on their property. Western Local Land Services policy states that all funded projects that disturb soil or risk disturbing culturally modified trees require an on-ground assessment of Aboriginal cultural heritage (Appendix 4) and Western Local Land Services will not provide funding for activities that harm the OUV of the WLR. For the Willandra Rabbit Control Project, the NSW National Parks and Wildlife World Heritage Team's has responsibility to lead the process of on-ground assessments, with assistance from Local Land Services specialists where required. The landholder must agree to this process, or alternatively, only activities that do not disturb soil or risk impacting culturally modified trees will be funded.

A small-scale property-level map accompanies this management plan to indicate where cultural heritage has been recorded on the property, sourced from either the Aboriginal Heritage Information Management System (AHIMS) or the NSW National Parks and Wildlife World Heritage Team's cultural heritage survey (Figure 2). The map also includes the mapped warren data (from FeralScan, see Section 6.1) and the route taken by the Cultural Heritage team. Individual property maps are **indicative only** and should not be interpreted to mean that cultural heritage material does not occur at places or in areas not marked. It is each land manager's responsibility to apply due diligence. If a land holder is unsure how to recognise cultural material, expert advice should be sought before any soil disturbance — for any activity — occurs. The NSW National Parks and Wildlife World Heritage Team can provide this assistance.





NPWS World Heritage team member recording cultural heritage material. Photo credit: NPWS World Heritage team

In the context of rabbit control, due diligence requires that clear communication be established between contractors and the agent who has engaged the contractor. This is to ensure activities are appropriate for the site (see section 6 and Appendix 5).

Information relayed to the contractor will include how each warren is to be treated (e.g. ripping permissible or not, depending on the presence of cultural heritage material) and the location of heritage items. The bulldozer operator can then avoid sensitive areas which would be vulnerable to damage or destruction from machinery travelling between warrens.

#### **IMPORTANT**

**The land manager is responsible and accountable for avoiding damage to Aboriginal objects which may arise during management activities.**

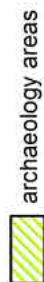
**Western Local Land Services will not provide funding for activities that harm or cause significant and lasting impact to the Outstanding Universal Value of the WLR.**

**For activities conducted under the Willandra Rabbit Control Project, Western Local Land Services will coordinate specialist staff to conduct the Aboriginal cultural heritage assessments on all warrens in the treatment area.**

# Cultural Heritage Material

Property name  
inserted here

## Legend



archaeology areas



cultural heritage material



Disclaimer: Map created by Western Local Land Services. This map is not guaranteed to be free of error or omissions. The State of New South Wales and its employees, officers, agents or servants expressly disclaim all and any liability and responsibility to any person in respect of anything and of the consequences, of anything done or omitted to be done by any such person in reliance, whether wholly or partially upon the information contained on the map.  
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Figure 2 Example of cultural heritage map





## 5. Integrated rabbit control

Effective rabbit control is achieved by using a combination of measures, not just one. There is no single quick-fix solution and land managers must be vigilant. The primary goal in rabbit control is to minimise the economic cost and reduce the environmental damage caused by rabbits by reducing their number to a level where it cannot quickly build up.

In order to effectively manage rabbits and maximise effectiveness, control should be:

- targeted to protect sites where rabbits pose the greatest threat to biodiversity and cultural heritage
- undertaken in a strategic manner taking into account other activities such as grazing and stock management
- monitored to ensure that objectives are met and allow management options to be adapted to changing circumstances.

Successful, long term, and cost-effective rabbit control is more likely to be achieved where integrated approaches are undertaken. When reliance is placed on only one technique and follow-up control is not implemented, initial gains are lost as rabbits readily re-colonise in the absence of further control. Furthermore, as the behaviour of rabbits varies between individuals, the use of a single method is unlikely to ensure the capture or death of all individuals (e.g. some rabbits stay close to the warren while others move greater distances, some are shy feeders (in taking bait) and some are not).

Integrated control should ensure the planning of control activities is undertaken in a strategic manner to take advantage of the environmental conditions. In this way, control effectiveness is maximised over the longer period and costs are minimised (Commonwealth of Australia 2016b).

### **IMPORTANT:**

**Coordinated actions across neighbours' boundaries using a variety of measures will have greatest effect in controlling rabbit numbers.**

**Leaving just one warren entrance and a pair of rabbits can re-infest the property and reverse any previous control work.**

**Even if a 90% reduction in rabbit abundance results from a control activity, if follow-up control is not carried out, rabbits can easily return to pre-control numbers, under favourable conditions, within less than 12 months.**

## 6. Control options

Land managers should organise their control programs according to the recognised sequence of actions (Figure 3 and Table 2). Successful rabbit control relies on the timely application of a number of techniques after first determining rabbit abundance and distribution. Research has shown that the application of the correct techniques, in the proper order, can result in long-term benefits (DPI 2018). Any deviation from this order can result in reduced efficacy.

### 6.1 Property maps

Knowledge of rabbit abundance and distribution, determined before and during control activities, are important for successful rabbit control. This will identify higher-density (or hotspot) areas. Rabbit hotspots can be identified in the first instance from land manager knowledge to qualify areas of low, m-]oderate or high relative rabbit abundance. These maps may be used as part of the overall property management plan and to assess progress over the years. Maps can also be a powerful tool in communicating control outcomes to other land managers. These advantages apply equally to individual properties and across the whole WLR.

#### Willandra property maps

Property maps have an additional role in the WLR. Areas with higher potential for cultural material must be assessed before any treatments can commence (see section 4 and Appendix 5). The property map which accompanies this plan is indicative only and does not contain sufficient detail to evaluate each warren. If a land manager is unsure how to recognise cultural material, expert advice should be sought before any soil disturbance occurs. The NSW National Parks and Wildlife World Heritage Team can provide this assistance. Western Local Land Services can also provide further advice or assistance in constructing a property map.

Benchmark data on the location of warrens on each WLR property and the number of active burrows in each warren is to be gathered by the land manager, entered into FeralScan and uploaded into the database (Appendix 9). Western Local Land Services can provide training in the use of FeralScan, if required, and Western Local Land Services should be notified when the data is uploaded.

### 6.2 Reduce rabbit abundance – primary control

This phase is the most important part of the control program and should achieve large reductions in rabbit abundance. It is essential to follow this phase with secondary controls; otherwise, abundance can revert to pre-control levels in less than 1 year.

#### Baiting

Baiting is the first step to reduce rabbit abundance. If populations are large, baiting can quickly reduce rabbits but must be used in combination with other control measures to ensure long-term effective rabbit control. Two main poisons are used in NSW, 1080 and pindone. In the WLR, 1080 is the preferred bait as pindone requires a minimum of two feeds of poison bait over 2–3 nights to ensure enough poison to result in death of the rabbit (a single feed of pindone is unlikely to kill a rabbit). In NSW, rabbit poisoning is regulated by the *Pesticides Act 1999* and the *Pesticides Regulation 2017*.

The use of the poisons currently requires a minimum AQF3 Chemical Accreditation. Also, under the *Workplace Health and Safety (WHS) Act 2011*, anyone who uses hazardous chemicals must be trained.

Poisoning rabbits with 1080 is most effective during the non-breeding season (when rabbits are less territorial and less tied to warrens) and when feed is scarce and does not provide an alternative feed source. The best time in the WLR is usually during early summer to April (see Figure 3) as long as these previously mentioned conditions are met.

Baiting should be undertaken where rabbits naturally feed. Rabbits do not generally feed on the warren. Look for grazed grass areas or areas where there are scratching and digging to identify feeding areas. These will quite often be at least several meters away from the warren.

A bait layer is required to undertake broad-scale baiting with 1080. The bait layer has two functions. Firstly, it creates a furrow by turning over soil which is attractive to rabbits. Secondly, the bait layer scatters small amounts of bait across the bait trail allowing more rabbits to access the bait. The depth of the furrow created by the bait layer is variable and it is recommended that in culturally sensitive areas, no furrow is created and in the remaining areas, furrows should be to a maximum of 1 cm.

Oats can be used but carrots are the preferred bait for distributing poison in the WLR. A minimum of three free feeds over the same trail, preferably over consecutive days, are required prior to laying 1080 poison bait. Free feeding provides a more accurate determination of the location of feeding grounds and the amount of poisoned bait required to give maximum knock-down yet leave minimum bait for non-target species. Rabbits vary in their readiness to accept strange food and free feeding over a number of days allows rabbits to become accustomed to the food. Some dominant rabbits may monopolise the trail and keep the shy feeders away. Consequently, the longer free feeding bait is available the more chance there is of controlling the maximum number of rabbits. Free feeding is a compulsory action.

Lay poison baits as close to dusk as possible to reduce non-target impacts and to ensure the carrot baits are palatable. Western Local Land Services recommends laying bait in a circular pattern approximately 20–30 metres from the warren.

Any poisoned bait remaining after poisoning is a danger to non-target herbivore species, highlighting the need for pre-baiting spotlight transects to determine abundance and density of rabbits to avoid distributing excess baits. While it is generally agreed 100 mm of steady rainfall may breakdown 1080, this is only a guide and is not guaranteed in the WLR. Alternatively, the uneaten poison bait can be removed and disposed of as per the product label.



On each day of the control program, the baited area and surrounding areas should be thoroughly searched for dead rabbits. Carcasses should be collected and properly disposed of, as per the product label, to lessen the risk to non-target species. The main non-native predators of rabbits (fox, dog and feral cat) and secondary poisoning of these species may be considered desirable. Even old rabbit carcasses can be a significant food for foxes in winter (Williams et al. 1995).

However, anecdotal evidence suggests that secondary poisoning of predators may be counter-productive to the long-term aim of sustained, strategic management. Rabbits are the staple diet of the medium and large diurnal birds of prey in pastoral districts. The diet of the wedge-tailed eagle is 97% rabbits in habitats where alternative prey is scarce. In these habitats, eagles are obligate predators on the rabbit and do not breed if rabbit density is less than 0.6 per hectare. Subsequently, the predators may be too few to keep rabbit abundance low.

Western Local Land Services staff will be able to assist landholders by providing carrots and bait. Accredited Western Local Land Services Biosecurity Officers run a short training course regularly which allows the use of 1080 baits or pindone on individual properties. The three-hour course will give landholders a clear understanding of 1080 use and their legal obligations.

The training covers topics such as baiting techniques, toxicity, storage, transport, legislation and WHS. Those completing the course will be issued a certification card and will remain accredited to use 1080 for five years.

### Warren destruction

The aim of warren destruction is to simultaneously destroy the structure of the warren and kill rabbits. Warren destruction is best undertaken when numbers are low (such as in the non-breeding season) or have been reduced by poisoning. Generally speaking, this is from early summer to late autumn but can continue through to

winter if there is no season break (Figure 3). If control must be carried out during the breeding season, use warren ripping or fumigation (see below). Rabbits do not readily dig new warrens, so destruction of warrens greatly inhibits resurgence and re-colonisation of treated areas and exposes rabbits to the elements and predators.

Warren destruction is best undertaken in the middle of day when temperatures are hottest and rabbits are most likely to be underground.

The aim should be to destroy all warrens on a property in the first stage of the program. This will help to reduce re-invasion and protect any investment. This approach will save time, money and effort in the long term.

Research shows that well designed and implemented destruction programs, using best practice principles, can retain rabbit abundance at low levels well after the initial control program. However, sustained on-going monitoring and follow-up treatment is required for to achieve the long-term effectiveness (Williams et al. 1995).

Harbour removal is integral to warren destruction. Harbour may exist naturally, result from warren destruction (e.g. felled timber) or arise from other activities (e.g. piles of soil and woody debris from track maintenance). As a general principle, land managers and contractors should be aware of the potential to create more rabbit harbour by their operations. Removal of harbour created from rabbit control activities may have little benefit if pre-existing harbour on a property is allowed to remain. However, harbour must be carefully evaluated as fauna habitat, or as valued native vegetation, especially in areas where there remains minimal standing vegetation.

Rabbits can survive warren destruction (and fumigation, see below) and surviving rabbits will re-colonise treated areas by re-opening warrens or digging new ones. It is therefore essential to follow up warren destruction with supplementary control methods.



Rabbit warren ripping. Credit: Sunraysia Environmental Pty Ltd

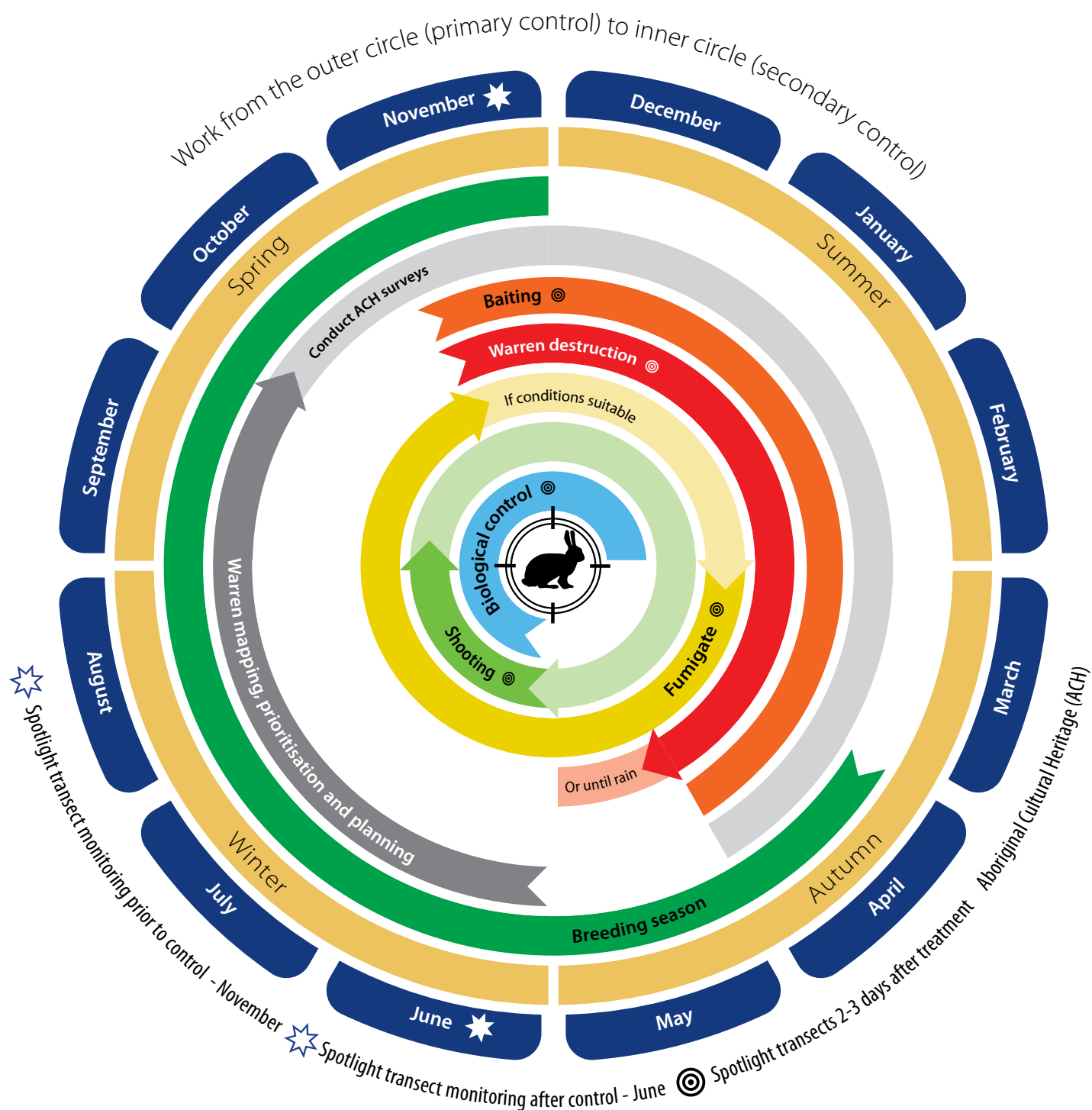


Figure 3 Rabbit control techniques for Willandra Lakes Region World Heritage Property. To be used in conjunction with Figure 5 Integrated control measures for rabbit control and Table 2 Frequency and type of activity monitoring





Ripped warren free of reopening. Photo credit: Sunraysia Environmental Pty Ltd



Ripped warren re-opened. Photo credit: Sunraysia Environmental Pty Ltd

## Ripping

Effective warren ripping at best practice is the key to a successful rabbit control program. Ripping techniques depend heavily on soil type, location of the warren — including slope, vicinity of waterways and erosion potential of the site — as well as available equipment. The tractor and rippers used must be suitable for the job and the driver should be experienced and competent; commercial operators should have the appropriate accreditation.

Ripping should take place, as soon as practical, after the baiting program to minimise the chance of rabbit recovery

Make sure all rabbits are driven underground before ripping commences, either by running dogs over the area or by making enough noise to flush rabbits into their warren.

Use tines at least 900 mm long and keep tine rip-lines ≤ 50 cm apart. Start ripping at least three metres beyond the outermost burrow openings of the warren. This allows the ripper to get to a maximum depth before the warren is reached and increases the chance of ripping tunnels outside the visible warren diameter. If the warren is uneven it is worth levelling the warren with a bulldozer or front-end loader blade to allow better and more even penetration of the tines on a level surface.

**If dogs are to be used in the control works, be mindful that there are specific requirements for the use of dogs for hunting. Under Section 17 of the *Companion Animals Act 1998*, a person must not set or urge a dog to attack, bite, harass or chase any animal except when hunting in accordance with the *Prevention of Cruelty to Animals Act 1979*. Refer to the *Hunters' Code of Practice* which is part of the *Game and Feral Animal Control Act 2002* and the *Game and Feral Animal Control Regulation 2012* for specific information on the use of dogs in hunting.**

If parts of a warren cannot be ripped because of obstructions such as trees or fences, be sure to fumigate these burrows a few hours before ripping. If ripping near trees or stumps, back the tractor up to the trees and rip away from them so that the tines travel along roots and not cut across.



Rip the sandy soils of the WLR during higher temperatures when soils are hot, dry, more friable and more prone to collapse. Unless ridges and hollows are severe there is no need to smooth them over. These ridges tend to catch water and wind-blown seed and disperse the rabbit smell, allowing for a faster rejuvenation of the site. Backfilling with the tractor blade can remove excessive ridges or furrows to prevent rabbits digging back in. Smaller or shallow warrens can be successfully destroyed with a chisel plough or discs, but regular monitoring is essential with openings treated as soon as they occur. However, the use of cultivation implements will usually not reach the full depth of the warren.

One ripping technique, particularly applicable to open country, is to begin ripping from one of the long sides of the warren and to avoid turning completely around for the second rip line, move across and follow with the second rip down the centre. Next rip towards the centre from the first rip and out toward the other edge from the second rip, Figure 4a; repeat until the warren is fully covered.

An alternative ripping technique that can also be used in more hilly terrain is to begin ripping from one of the long sides of the warren, each time reversing over the last pass, Figure 4b. Each new rip starts only in the same direction as the first rip; this technique increases the packing effect of the ripped warren. It is recommended that all ripping be done across the slope to prevent erosion gullies developing, and that slopes exceeding 18° should not be ripped. If it is not possible to rip the entire warren across the slope, at least two or three cross rips should be used to reduce the risk of erosion.

In some cases, cross-ripping might be necessary or advisable if the soil type is 'tight'. Cross ripping means to rip in one direction and then again at 90° to the original rip line to completely destroy the warren complex.

If the bulldozer or tractor is fitted with a stick-rake blade then this may be used to level the ripped warren by back blading across the slope leaving closely spaced even furrows that capture runoff and provide a good seedbed for regeneration.

In accordance with due diligence, any warrens newly discovered by the bulldozer operator — those not identified in the FeralScan mapping — will be marked and left until a cultural heritage survey indicates ACH is not present (see Appendix 6). This protocol will apply to any warren within the treatment area regardless of its location, i.e. in or out of the WLR area.

In line with the Land Management (Native Vegetation) Code, any clearing, i.e. pushing over trees, undertaken in the course of ripping or accessing a warren or warrens, must be to the minimum extent necessary. If landholders use an allowable activity (as described in the Code) as part of rabbit control, it is always best practice to keep records of all activities undertaken. These records can include:

- photographs of the native vegetation before and after clearing
- the number of trees and species cleared
- GPS points of the trees.

The main considerations when conducting an allowable activity:

- It is the responsibility of the land manager — and contractor who is removing the native vegetation — to be fully aware of the legal requirements (ignorance is no excuse).
- It is the responsibility of the land manager to keep records of any native vegetation cleared or removed.
- **Clearing native vegetation under an allowable activity is always to minimum extent necessary.**
- Other approvals may also be required, e.g. Council or Western Lands.
- Clearing activities on vulnerable and sensitive category 2 land is restricted as per the fact sheet (see Useful Links section).

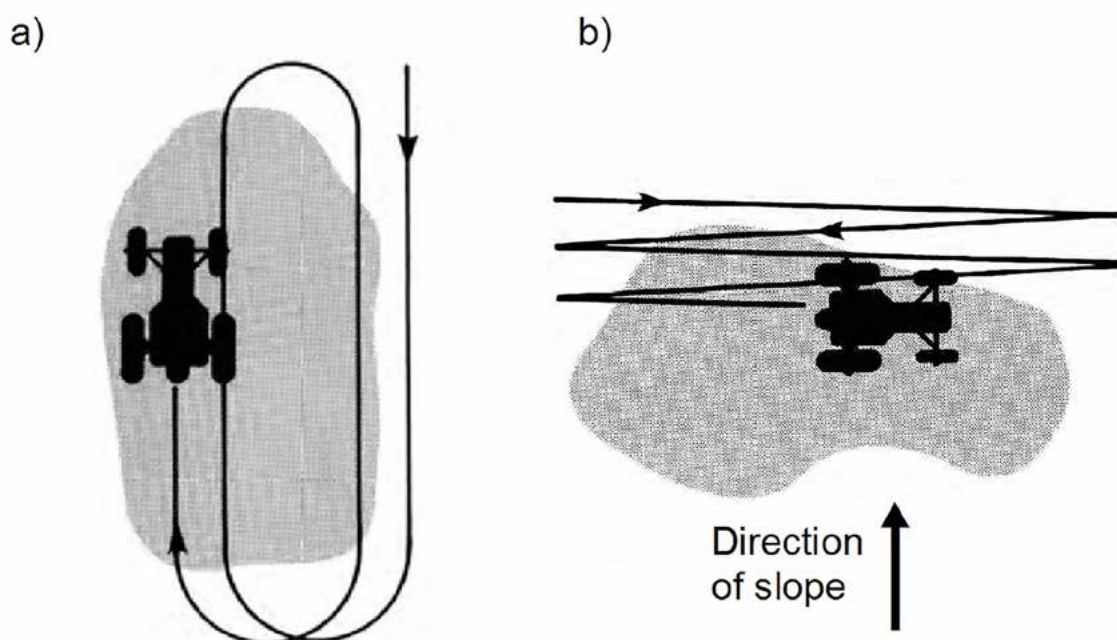


Figure 4 Typical ripping patterns (a) on flat ground and (b) on hilly terrain (Adapted from DPI 2018)





Rodenator nozzle inserted into burrow entrance. Photo credit: Western Landcare NSW

### Implosion

In susceptible locations where cultural heritage is present, implosion — using gasses to collapse the warren — is the appropriate alternative warren destruction method as it is considered to cause the least damage to surface artefacts and sites. The timing of imploding action is similar to that for ripping, i.e. during summer when soils are hot and dry and more prone to collapse.

Warren destruction is most effective when rabbit numbers are already low, such as after a baiting program, drought or disease outbreak or at a time when rabbits are not usually breeding (Figure 3). The aim of implosion is to destroy the warren, not to kill large numbers of rabbits.

A concussive devise known as the Rodenator is available from Western Local Land Services. The device has two lines going into the warren, one containing liquefied propane gas (LPG) and the other, oxygen. Operators are required to be qualified to the level of Accreditation AHCMON 305 – Operate Specialist Machinery.

It is essential operators are adequately trained in handling and using the devise and hold the appropriate certificate, both for safe handling of equipment and for the humane killing of rabbits. A humane kill will be achieved with a proper mix of gases (97% oxygen and 3% LPG) and sufficient pressure for the size of the warren (maximum size approximately 20 burrows) although depth of the warren is also important. If inadequate pressure and mix are used, the complete collapse of the warren will not be achieved. This may result in some rabbits becoming trapped and injured in partly destroyed tunnels and then slowly dying of their injuries or asphyxiation. It is essential that the tunnel system is completely destroyed so that the rabbit dies as quickly as possible.

The effectiveness of warren implosion should be monitored by noting the presence of re-opened entrances 2-3 days after treatment. Any re-openings should be re-treated using implosion or alternatively, fumigation (see below).

#### **IMPORTANT:**

**Concussive implosion must be used in culturally sensitive areas or on warrens where cultural heritage material has been recorded.**

**Concussive implosion should also be used where trees or vegetation cover prevent easy use of mechanical warren destruction. The pushing over trees to access warrens should be minimised — clearing vegetation will increase the potential for soil erosion, increasing the threat to the OUV of the WLR. It will also create an above ground harbour for rabbits, ultimately negating the efforts to destroy the warren. Importantly, any vegetation clearing must be done in accordance with the Vegetation Code which dictates clearing must be to the minimum extent possible.**





Fumigation work being carried out. Photo credit: PestSmart website

### 6.3 Reassess rabbit abundance

After each treatment, rabbit abundance should be reassessed to evaluate if population reduction has been achieved. Evaluating the success of a treatment should not be viewed as number of rabbits killed; it is the number left alive that is the important figure. For example, 5% residual from an original population of 5,000 is 250 rabbits, but 5% of an original population of 500 is only 25 rabbits and the latter is much easier to manage in follow-up control treatment. As the complete eradication of rabbits is often unachievable, a threshold level of rabbit abundance has been set to be used as a trigger for action and as a management goal.

Categorisation of rabbit abundance varies according to habitat, environment and the method of measurement. In the semi-arid WLRWHA, rabbit abundance is categorised according to number of rabbits/spotlight transect (Parks Victoria 2010):

- HIGH >6 rabbits/spotlight km
- MODERATE 3–6 rabbits/spotlight km
- LOW <3 rabbit/spotlight km

The threshold for primary action measures in the WLR is >6 rabbits/spotlight km and the management goal is to reduce abundance to <3 rabbit/spotlight km. The goal to reduce rabbit abundance to this level, and to maintain that level, has the advantage of providing land managers with a clear, readily monitored, long-term goal; a density as close to zero is also encouraged. The zero density will counter any tendency of land managers to develop tolerance to rabbits which would undermine efficient long-term management (Williams et al. 1995). Land managers need to be committed to a long-term strategy for a successful outcome and for assisting to maintain the OUV of the WLR.

See section 7 for monitoring techniques.

Any abundance level above the management goal of <3 rabbit/km requires the application of secondary control measures.

### 6.4 Reapply control techniques – secondary control

Secondary control methods can improve on the percentage of the population removed during primary control and must be used for mopping up residual populations. However, by themselves, they generally produce only a short-term reduction in rabbit abundance of a few months to a year and consequently, are not to be the only actions undertaken for controlling rabbits (ACT 2015). Use secondary techniques when rabbit abundance is low.

#### Fumigating

##### Chemicals used

Two fumigants are potentially used to control rabbits: phosphine and chloropicrin. Both are classified as a dangerous poison (Schedule 7) as they have high potential to cause harm, especially chloropicrin even at low exposures.

Phosphine gas is released when aluminium phosphide tablets (e.g. Phostoxin) are activated by moisture. Phosphine is the most commonly used fumigant but it is extremely dangerous in enclosed spaces. Operators must strictly follow the directions on the label when using and storing aluminium phosphide tablets. For example, partly used tubes of the tablets must not be returned to storage unless the tube is placed in a sealable can.

Chloropicrin is a colourless, toxic liquid that is currently used in Australia as an insecticide, soil and warren fumigant, and rodenticide. Chloropicrin has been placed under review by the Australian Pesticides and Veterinary Medicines Authority because of environmental, human health and human safety concerns. **It is not recommended for use as it is considered highly inhumane**, even though it is still registered in some states. Pressure fumigation using chloropicrin (e.g. Larvicide<sup>®</sup>) has been phased out as an approved fumigant in NSW.



## Legal requirements

These poisons are regulated by the Pesticides Act and the Pesticide Regulations which specify handling and training requirements.

The use of phosphine gas does not require a fumigator's licence if:

- the use of the pesticides is by the land manager, or their employee, in connection with agricultural activities on their land
- the fumigation work is carried out on the land manager's land and only for the control of insect pests in stored products or for the control of rabbits, mice or rats.

For more details consult clause 8 to 12 of the Pesticides Regulation.

In addition, there are currently exemptions issued by the EPA from the requirement to hold a pest management technician or fumigator licence for trained staff of Local Land Services and National Parks and Wildlife Service to use phosphine fumigants for the control of mice, rats or rabbits.

However, to be exempt from holding a licence for these activities, the land manager must hold the AQF3 chemical user accreditation and must meet all other requirements of the Pesticides Regulation, including pesticide use notification, following directions for use on the chemical label and keeping the relevant chemical use records (<https://www.epa.nsw.gov.au/your-environment/pesticides/licences-and-advice-for-occupational-pesticide-users/pest-management-technicians-fumigators-training-permits>). An example chemical use record sheets and further information regarding agricultural chemical use can be found on the NSW EPA website.

Contact Western Local Land Services for training opportunities.

## Application

Fumigation is a very dangerous procedure and the relevant personal protective equipment is essential (overalls, eye protection, rubber gloves and full-face respirator). Fumigation must always be carried out by two trained persons and must not be carried out in wet conditions when it is likely that the tablets will become wet before insertion in the burrows. Always follow the directions on the label.

Dry sandy soils are prone to leak the gas so fumigate when soil is moist, e.g. in the wetter months. Fumigating in the middle of the day may also be more effective as more rabbits will be underground.

More rabbits may suffer adverse animal welfare outcomes during fumigation if population numbers are high. Fumigation works best as a mop-up method, coupled with other control techniques, to give the longest-term effect (ACT 2015).

To apply aluminium phosphide tablets (static fumigation), the standard operating procedure (RAB005) is listed below.

- It is recommended to use a smoker to identify all entrances to the warren; not all will be easily seen.
- Dig back the opening of the burrow so there is a 30 cm lip between the surface and the burrow. This exposes any branching tunnels and provides a solid shelf against which to back-fill soil.
- The operator should first apply their personal protective equipment before handling the tablets.
- Place two aluminium phosphide tablets at least 60 cm into the burrow. Wrap the tablets in damp newspaper to start the release of gas. To facilitate the easy placement of the tablet into the hole, a length of polythene pipe or wire can be inserted into the hole.
- Remove the pipe and block the hole with newspaper to prevent gas escaping. Newspaper also acts as a deterrent for rabbits attempting to escape as rabbits do not like to dig through foreign objects. The hole should then be filled, digging back the sides of the entrance and tamping down the soil. The ground should end up relatively flat to discourage opening up from the outside. If a rabbit does attempt to re-open the burrow, the newspaper acts as a deterrent.
- The entire procedure, with two tablets and backfilling, should be repeated for each hole. Always work toward the windward side of the warren.
- It is essential that all entrances to the warren are sealed. Check under nearby scrub and fallen timber for any missed burrows.
- Complete decomposition of the tablets may take up to 72 hours if the humidity in the warren is low.

Full details of the standard operating procedure are in Appendix 10.

## Biological control

Two biological controls are active in the Willandra Lakes Region.

### Myxomatosis

Rabbit numbers were radically reduced in the 1950s with the introduction of the myxoma virus (myxomatosis) but since then the virus has become much less effective, as the genetic make-up of the virus has changed and rabbit resistance has built-up. Myxomatosis is spread by biting insects such as fleas and mosquitoes. Death due to myxomatosis is prolonged and while in acute cases death can occur within 8–12 days (or 3–5 days after clinical signs develop), quite often death can occur anytime within 2–6 weeks (DPI 2018). Myxomatosis currently kills 30–50% of the rabbits it infects and is still an effective biological control agent in some areas of the country, including the WLR (DPI 2018).

## Rabbit Hemorrhagic Disease

Rabbit Hemorrhagic Disease (RHD, also known as Rabbit Calici Disease, or RCD) was introduced to Australia in 1996. It is an infectious and lethal disease that only affects rabbits. RHDV is one of the more humane methods of controlling wild rabbits with infected rabbits basically end up with 'cold-like' symptoms. Rabbits usually develop signs of fever within 36 hours of infection and are often dead within 6–12 hours after the onset of fever. Rabbits with RHDV often become lethargic and can die suddenly. Occasionally rabbits may squeal, become excited or exhibit paddling behaviour. In most of animals, no symptoms are observed. Outwardly, animals that have died from RHDV appear healthy. On occasions a bloody discharge from the nose may be present. RHD is transmitted to rabbits through direct contact, most likely from infected rabbits, birds, insects and other animals but only if the virus particles move from the carrier to the rabbit within a few hours. The disease may also spread in rabbit droppings or on vehicles, clothes and footwear.

Two strains of RHDV are present in Australia, RHDV1 and RHDV2. RHDV1 generally only infects adult rabbits; RHDV2 affect both adult and young (~30 days old) rabbits. RHDV1 are still effective across much of Australia, particularly in the arid and semi-arid regions with an average mortality of 75%. The 2017 trial release of RHDV-K5 showed an average 40% reduction in rabbit number across the four properties that were selected for the release (NPWS unpublished report).

The impact of RHDV2 on the Australian rabbit population is yet to be determined (DPI 2018).

### Release of pathogens

Both myxomatosis and RHD can spread without the need for human assistance. The most effective outbreaks of RHD occur in autumn/early winter before the breeding season, although most natural outbreaks occur in spring (Commonwealth of Australia 2016b). Mortality rates from myxomatosis are higher in winter than in summer (Williams et al. 1995).

Releases of the RHDV1 K5 or v351 strains of the virus can be coordinated with DPI through Western Local Land Services. An estimate of the prevalence of immune wild rabbit should be made prior to any release. This is best achieved by collecting cardiac blood from 8–10 freshly shot wild rabbits in the area where the virus is proposed to be released. Only people that have undergone appropriate training and are approved authorised control officers by NSW DPI can purchase RHDV.

RHDV should only be used according to the instructions supplied with the product. Do not release RHDV into areas where young rabbits are present as they are much less likely to die because of RHDV but the exposure to the virus at this age can provide lifelong immunity. Pre-feeding of non-treated bait is an essential step to allow rabbits to become accustomed to eating bait material. Rabbits should be fed carrots on at least two or three days prior to the release of RHDV.

Recent research has shown that rabbits previously exposed to myxoma virus had lower survival during rabbit haemorrhagic disease outbreaks than rabbits never exposed to either virus. The two biological agents working together might produce greater mortality of rabbits above that of a single biological control (Barnett et al. 2018). However, biological control agents will not kill all individuals; conventional control methods must continue to be used to achieve long-term reductions in rabbit abundance (Commonwealth of Australia 2016b).

## Shooting

Shooting is largely ineffective at controlling a large, rapidly breeding population of rabbits but is an easy and effective way to remove rabbits when numbers are low. Rabbits are largely nocturnal so shoot at night with a spotlight. Perform spotlighting counts before and after shooting to gauge its effectiveness but allow several months to elapse before further shooting or spotlighting activities are undertaken. Ineffective shooting produces gun-shy and spotlight-shy rabbits.

Shooting is particularly useful as a mop-up tool the night a ripping program has taken place. Good numbers can be taken this way. Shooters can sit off warrens or cover and shoot rabbits as they appear.

A .22 calibre rifle or 12-gauge shotgun is recommended. Death is usually rapid and, even when maiming occurs, the stricken animals can generally be killed quickly and humanely with a second shot. Shooting is regarded as the most humane technique but only when, in the case of rifles, head or chest shots are possible. With shotguns, maiming can occur, particularly when light shot is used over longer distances. However, shooting is time consuming, labour intensive, generally not cost effective and warrens remain open for re-infestation; hence its role only in mopping-up after other control measures. Shooting does not provide any level of long-term control (Williams et al. 1995, ACT 2015, DPI 2018).

## Other

Ferretting and trapping are not effective methods of control as the techniques are labour intensive and warrens remain open for re-infestation. Trapping also has animal welfare implications.

### 6.5 Reassess rabbit abundance and re-apply secondary controls

If the previous steps are followed correctly, this last stage is an iterative process, repeating the re-assessment of rabbit numbers and applying secondary controls, as required, as part of the overall property management program. See section 7 for assessment techniques.

#### IMPORTANT:

**Cultural heritage assessment of each warren located in sensitive areas is essential before any control can begin. Applying the correct techniques in the correct order (an integrated program) can provide long-term results but continual vigilance, in the form of an on-going, low-level maintenance program, is essential.**



## 7. Monitoring effectiveness of control

### 7.1 Why monitor?

It is pointless to undertake control activities without monitoring the effectiveness of those activities. It is important to know if the control translates into measurable benefits to the environment and to prevent false conclusions, poor management decisions and a waste of money and resources.

The objectives of a monitoring program will determine what is directly measured, what level of monitoring is needed, and how often it is undertaken. The purpose of monitoring can be to:

- conduct an initial, one-off observation of abundance as part of developing a property map (section 6.1) and establish a benchmark of pest abundance
- as a tool to evaluate the results of individual treatments close to the time of implementation (section 6.3) and to determine how the program is progressing against set objectives. The monitoring may provide an early warning that a change in the management program is required so as to achieve control success. This form of adaptive management is recommended to help achieve outcomes within time frames and budgets
- as a method to measure change in rabbit abundance over longer periods or after the program finishes to determine the success of the program against the performance indicators. For coordinated rabbit control programs being implemented across multiple land tenures and over an extended period, standardisation of monitoring techniques will allow for comparison within and between sites, and across techniques and years, for the area being managed. Western Local Land Services can provide training in selected monitoring techniques to ensure consistency in data collection and reporting.

Table 2 Frequency and type of activity and monitoring

Control activity (in order)	Timing of activity	Time of monitoring	Measure/method
<b>Before any control</b>	When numbers are lowest (i.e. summer/non-breeding season)	Pre-treatment monitoring to determine rabbit abundance and distribution	Spotlight transects
<b>Baiting</b>	Day 1	Remove carcasses each morning of baiting Monitor 2–3 days after baiting	Number of carcasses collected Spotlight transects
<b>Warren destruction (ripping or implosion)</b>	Commence warren destruction 2–3 days after baiting but no more than 6 weeks after baiting	Monitor 2–3 days after destruction to check for openings	Warren inspections Spotlight transects (including harbour near warrens)
<b>Fumigation</b>	Commence fumigation less than 6 weeks after baiting	Monitor 2–3 days after fumigating to check for openings	Warren inspections Spotlight transects
<b>Biological control</b>	When numbers are low (before breeding period) for RHD	Monitor 2–3 days after laying inoculated bait	Warren inspections Spotlight transects
<b>Shooting</b>	Commence shooting less than 6 weeks after baiting and as soon as practical after warren destruction Do not repeat shooting again for several months	Assess numbers immediately before and after shooting	Spotlight transects (including on warrens and around harbour near warrens)

## 7.2 Techniques for monitoring rabbit abundance

It is the responsibility of each land manager to conduct both pre-control and post-control monitoring; the frequency and monitoring method will vary for each control method (Table 2). Without knowledge of rabbit abundance and distribution before a control action, it is not possible to assess the effectiveness of any action to reduce their abundance or impact. Monitoring after the implementation of an action informs the land manager what work remains to be done.

Rabbit abundance can be monitored using observation, indirect and direct counts.

Observations are non-systematic, incidental sightings and can be used to confirm the presence (not absence) of a species in a particular area. This method is not to be used as a measure of the effectiveness of control techniques (see below for recommended options) but it can be useful to detect expansion or contraction in the range of rabbits (including new incursions) or to determine the feasibility of management options and the scale of management required.

The methods listed below cover direct and indirect methods. Indirect counts of rabbits include using measures of sign of rabbits (e.g. active burrow count, pellet transects, scratchings) or cameras and can be used to calculate a relative measure of abundance. Direct counts are counts of the number of rabbits over a given area. Both techniques can be useful to monitor a change in the abundance after a control action.

### Spotlighting transects – direct counts

Spotlighting transects are easy to conduct and can cover large areas in a relatively short time. Spotlighting can produce a simple index of abundance, such as number rabbits/spotlight km.

Results of spotlight transects have a bias caused by the difference in skills between observers and also in visibility of the target, which can change with vegetation density. Spotlighting is also unsuitable in high wind or rainy conditions, as these affect rabbit behaviour. Other sources of potential variation include the time of night that the survey is done, seasonal variations in animal behaviour and abundance, and the use of roads as transects (vegetation types will not be surveyed evenly). However, these shortcomings can be managed (Mitchell and Balogh 2007).

To overcome the shortcomings and to ensure the reliability and repeatability of spotlight transects, efforts must be made to reduce as much as possible any variation:

- The transect must be plotted on a map, including landmarks such as gates, tanks, etc. Take care to ensure that the transect passes through areas that represent all vegetation types in the area being sampled and that the route is passable in all weather conditions. If possible, record the track on a GPS unit. Use this transect for all further surveys so that valid comparisons with prior surveys can be made.
- A survey needs to be made up of counts repeated on three or four consecutive nights. Where possible, repeat the counts until they give similar indexes in order to achieve a consistent level of precision. Standard error of counts should be within 10% of the mean.
- Weather conditions must be similar for all counts; avoid nights of high wind or heavy rain, low temperatures or a bright moon.
- Start at the same time for each survey. To be effective, the spotlight count needs to coincide with the period of highest activity of the rabbit. Generally, a start time of at least half an hour after sunset will be adequate.
- Use the same vehicle each survey night, travel at the same speed (10-15km/hr) over the entire length of the transect and use the same spotlight (or same wattage spotlight). This will ensure similar amount of time is spent covering the route on each survey.
- Use the same observers to make the counts to avoid differences in observer skills.

See Appendices 7 and 8 for a how-to-guide on conducting a spotlight transect and a copy of a recording sheet.

Once the number of rabbits/spotlight km has been determined, the results need to be uploaded into the FeralScan database and Western Landcare notified.

### Warren mapping – indirect counts

Initial information on warren distribution and activity is gathered during the property mapping stage (section 6.1), undertaken by land managers, recorded in FeralScan and uploaded into the FeralScan database. Land managers will need to re-visit warrens after warren destruction and fumigation activities to record, in FeralScan, any burrows opened by surviving rabbits. Data is to be uploaded into the FeralScan database and Western Local Land Services notified.

### Cameras – indirect counts

Remote, motion activated cameras may have a role in recording rabbit activity over a longer time frame than that offered by individual spotlight transect nights. Cameras can be set up at a single warren or at a number of warrens to assess activity on the warren prior to treatment, or to monitor re-colonisation after treatment.

Contact Western Local Land Services for advice on the most suitable type of camera and for discussing candidate warrens.





Groundcover established on successfully ripped warren. Photo credit: Sunraysia Environmental Pty Ltd

### Drones – indirect counts

Drones are a new technology with potential to capture a larger perspective on rabbit warren distribution and impact, and potentially rabbit abundance.

While there is potential to utilise drones in mapping warren location, it is not yet feasible due to the size of the area to be monitored. The current achievable mapping extent, with the available drones, is approximately 100 ha or 1 km x 1 km. With this in mind, the greatest role for drones will be in monitoring targeted areas to assess the effectiveness of the control techniques. Drone mapping should take place prior to applying control methods with periodic mapping thereafter. The imagery then can be compared over time to monitor rehabilitation/revegetation of the landscape.

The suite of actions comprising the integrated control program is summarised in Figure 5.

#### **IMPORTANT:**

**Monitoring informs the land manager what work remains to be done.**

**Without knowledge of pre-treatment and post-treatment rabbit abundance or distribution, it is not possible to assess the effectiveness of any control program.**

**It is the land manager's obligation to conduct pre-treatment and post-treatment monitoring.**

**Results are to be reported to Western Local Land Services.**



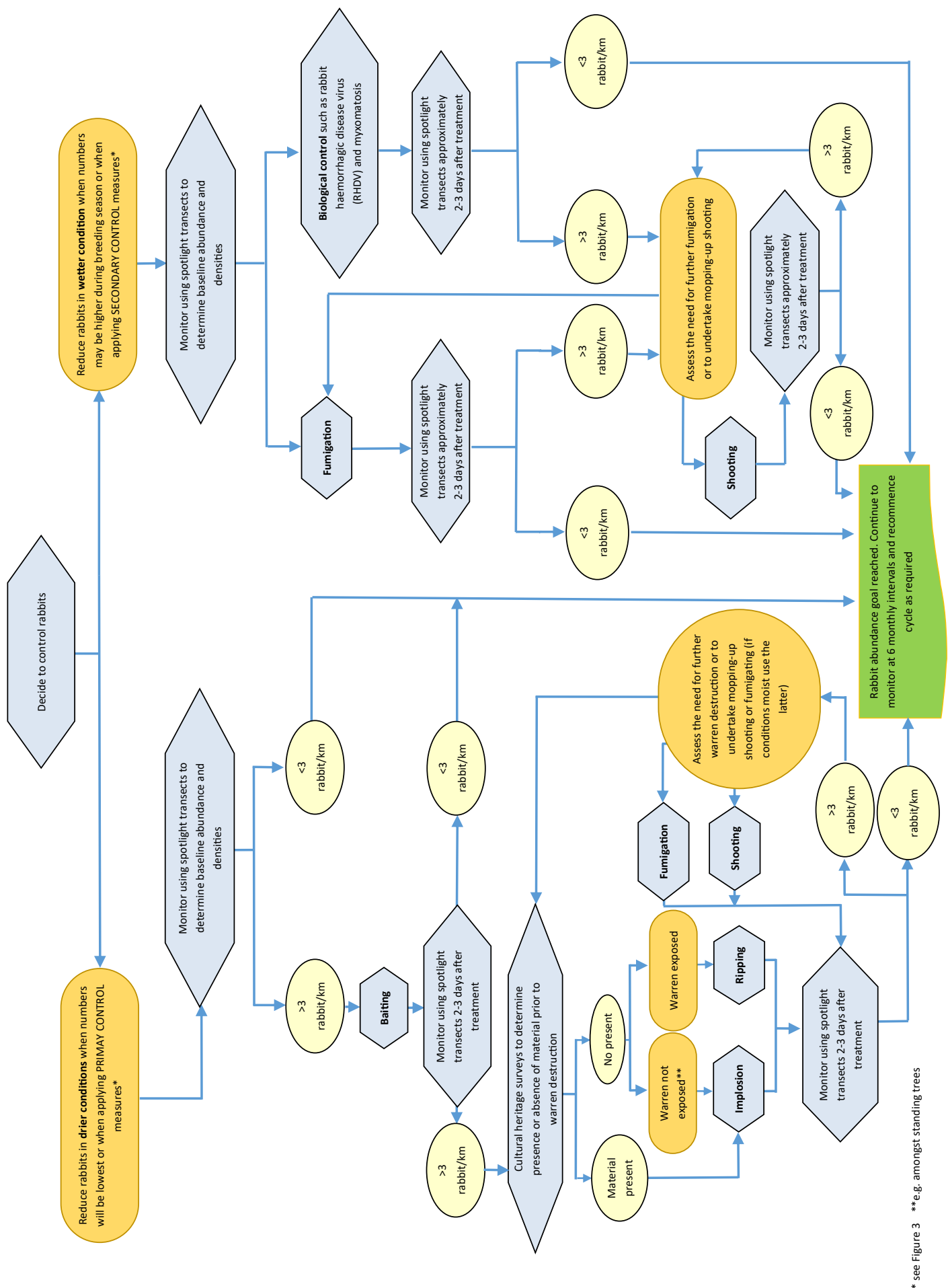


Figure 5 Summary of integrated actions to control rabbits



## 8. Program-level and property-level project structure and responsibilities

Each stakeholder at the program level of the WLR World Heritage property rabbit control program has specific roles and responsibilities relating to actions, finances and reporting (Appendix 1).

Implementation of the WLR Plan at the property level will be in accordance with an individual control and works plan. Prior to the commencement of any control activity on a property, a round table meeting will be held between the land manager, Western Local Land Services project staff, World Heritage Cultural Heritage team member(s), ripping contractor and the Western Landcare Officer. The purpose of the meeting will be to devise a property-level control and works plan which will confirm the roles and responsibilities of all parties (Table 3) and enable any negotiation that may be required in relation to the level of in-kind support from each property, recognising differing rabbit densities and landscapes across the World Heritage property (Figure 6).

The property-level plan confirms the commitment of each party to undertake their specified activities.

**Table 3 Type of control activity, responsible stakeholder and financial responsibility — property level**

Activity	Who undertakes or coordinates the activity	Who is financially responsible for the activity
Coordinating cultural heritage surveys in sensitive areas	Western Local Land Services	Western Local Land Services funds
Biosecurity support, e.g. supplying carrots and poison baits and investigating releases of biological control agents		
Training, e.g. concussive implosion and 1080 handling		
Recording and mapping warrens using FeralScan	Land manager	Land manager in-kind support (direct financial, i.e. money, or indirect financial, e.g. time, use of vehicle, fuel)
Pre-treatment monitoring of rabbit abundance (in accordance with the Plan)		
Laying carrots and poisoned bait		
Post-treatment monitoring of rabbit abundance (in accordance with the Plan)		
Follow-up control measures (in accordance with the Plan). This includes fumigation and shooting, as required*.		
Recording data (in accordance with the Plan)		
Warren destruction (ripping or implosion)	Negotiated*	Negotiated*

\* to be negotiated at property-level round table meeting held before control activities commence

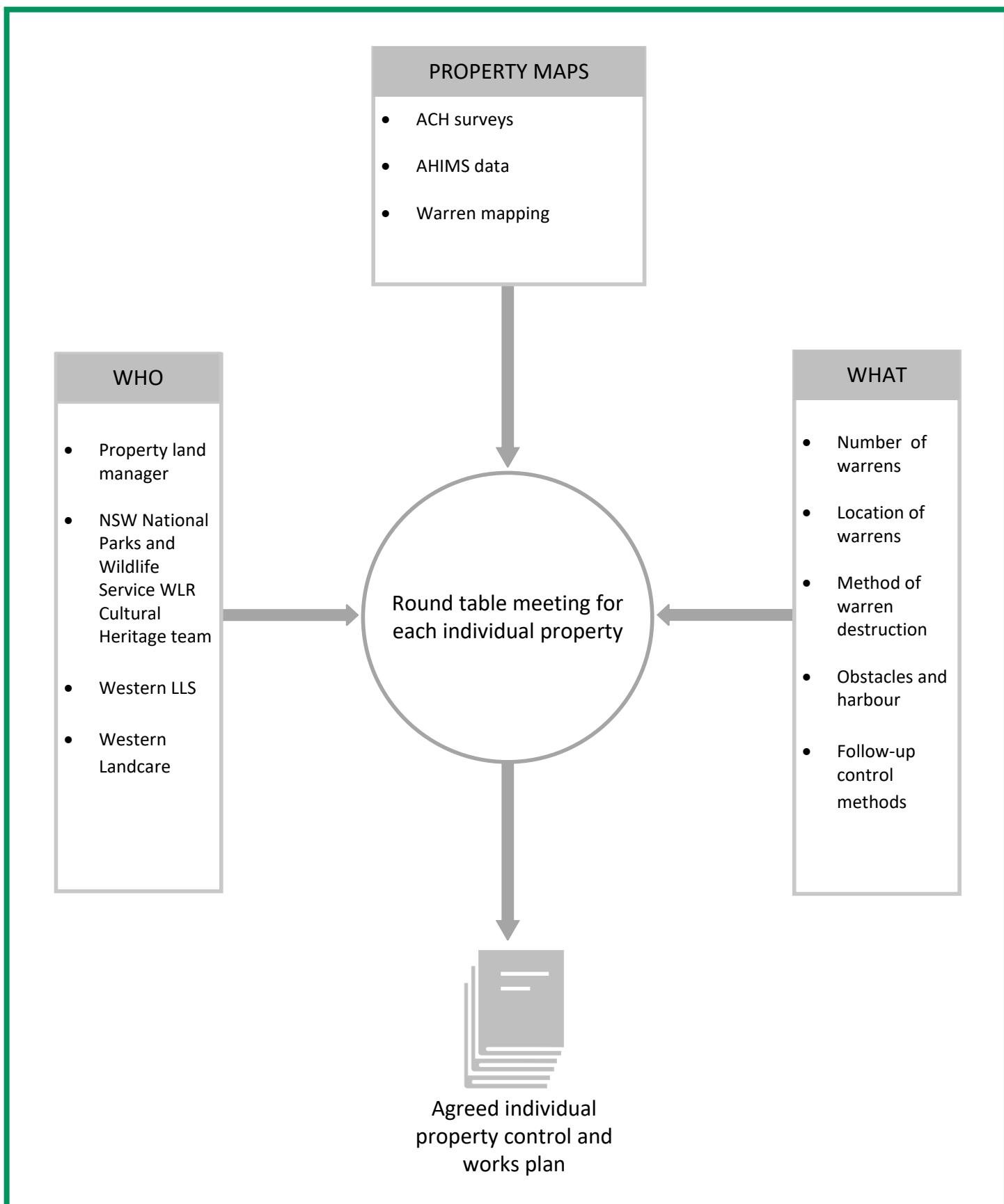


Figure 6 Development of negotiated individual property-level control and works plan





## 9. Limitations of control options and some responses

It is not always possible to implement rabbit management programs, despite being based on options for best practice management and monitoring. Key social, financial and broader technical barriers may exist at different times. General obstacles to implementing a control program which may arise for any group any location are described below, followed by solutions relevant to WLR property.

### 9.1 Social

**Limitation:** Seasonal unavailability of land managers, contractors or volunteers to undertake any or all phases of a rabbit control program: planning; primary, follow-up and ongoing maintenance control activities; and monitoring.

*Response:* The Willandra Lakes Region World Heritage Property Rabbit Management Plan (this document, the Plan) has provided WLR land managers with information to incorporate rabbit control as part of their yearly ongoing property management.

**Limitation:** Landholders may not realise their legal obligations under the Biosecurity Act to manage rabbits on their property and that it is not a government responsibility.

*Response:* The Plan makes this responsibility clear.

**Limitation:** Unwillingness by adjacent land managers to engage in coordinated rabbit control programs. Neighbouring properties may not control their rabbits through apathy or viewing rabbits as the government's or their neighbour's problem. There may be real or perceived differences in the relative amounts of control being undertaken by neighbours, particularly between private landholders and government land managers. Some land managers display a preference for a single method of control, rather than an integrated suite of options.

*Response:* The Plan is a broad scale; integrated approach to rabbit control, incorporating government and non-government managed lands and has the support of WLR land managers.

**Limitation:** Competing land manager commitments and values mean rabbit control programs are given low priority or goals cannot be agreed on, assessment and control activities are not undertaken in a timely manner or there is no control at all. Control is best undertaken in hot and dry conditions — even drought conditions — but funds for control activities may not be available or other activities may have a higher priority.

*Response:* The Plan is the result of collaboration between Western Local Land Services and WLR land managers, and clearly outlines the selection and timing of primary and secondary control actions. The current program is funded until 2021.

**Limitation:** Coordinated control programs may be successful in reducing rabbit populations to low numbers during the primary control phase but are particularly prone to failure in the follow-up and ongoing maintenance phases without strong program coordination and incentives to persist.

*Response:* The Plan is the result of collaboration between Western Local Land Services and WLR land managers, and clearly outlines the required skills, knowledge and responsibilities of participants, in addition to the selection and timing of primary and secondary control actions. Consequently, land managers undertaking a rabbit control program understand the requirement for follow-up and maintenance control measures.

**Limitation:** Participants' experience with rabbit management programs will vary, as will the level of technical knowledge of rabbit biology and behaviour, the types of damage caused by rabbits, and the appropriate monitoring, control and assessment techniques required to develop an effective management plan. Appropriate training courses are unavailable or are not accessible by land managers with responsibility for rabbit control.

*Response:* The Plan provides standardised information on these issues, in addition to a clear framework for undertaking integrated control measures. Western Local Land Services can provide training in chemical handling to meet regulatory requirements and in monitoring techniques.

## 9.2 Government agreements and funding

**Limitation:** Government fails to provide and promote appropriate support measures or support the networks that achieve broad-scale control of rabbits across land tenures. Government incentives for landholders to participate, such as the provision of prohibitively expensive equipment (e.g. ripping machinery), are absent.

*Response:* This is not the case within the WLR. Western Local Land Services has initiated the Sustaining the Willandra Rabbit Control Project to support broad-scale control of rabbits. Funding is confirmed from 2018–21.

**Limitation:** Governments have variable and unpredictable funding for rabbit control that is dictated by budget cycles and is often reduced by competing government priorities. An assured budget is critical for the delivery of long-term best practice rabbit management, particularly the capacity to undertake ongoing maintenance control and protect prior investment. There may be insufficient amounts in budgets to undertake expensive primary control activities, and no flexibility to initiate opportunistic control when the rabbit population is naturally low.

*Response:* The Sustaining the Willandra Rabbit Control Project has been funded from 2018–2021.

## 9.3 Other financial

**Limitation:** The cost to individual landholders of materials and equipment for rabbit control can be prohibitive, or adequate finance is unavailable to individual landholders at optimal times for rabbit control. This can be especially true during drought conditions.

*Response:* The Western Local Land Services has initiated the Sustaining the Willandra Rabbit Control Project in direct response to this limitation and to provide the capacity for integrated control across the wider region. Cost to individual land managers is limited to in-kind support, such as time spent mapping warrens on their property.

**Limitation:** Land managers have insufficient knowledge of the costs associated with different control techniques, either alone or in combination and in relation to the area being managed, to inform the development of a cost-efficient management approach.

*Response:* The WLR land managers have an appreciation of costs associated with different control techniques on their properties and are aware of the amount of funding available across the whole WLRWHA. Western Local Land Services has developed the Willandra Lakes Region World Heritage Property Rabbit Control Program in collaboration with these land managers.

**Limitation:** Financial uncertainty discourages potential rabbit contractors from undertaking appropriate training and establishing viable businesses and the availability of contractors becomes a limiting factor to undertaking control.

*Response:* Historically, contractors have been available to WLR land managers for ripping works and relationships have been established over a long period. Alternatively, land managers with appropriate equipment can conduct their own ripping activities.

## 9.4 Technical

**Limitation:** None of the techniques for rabbit control developed to date reliably provide complete mortality, so the use of multiple techniques and follow-up and ongoing maintenance control remains necessary, with its associated risks to success.

*Response:* The Plan has identified the suite of measures applicable to the WLR. Participation is voluntary but participating WLR land managers have committed to following their integrated individual property work plans.

**Limitation:** Some techniques require specific weather conditions to work effectively, for example, fumigation and biological control require wetter or moist conditions. Increasing climatic uncertainty in the WLR means timing of these follow-up operations can be affected, compromising previous actions and the entire program.

*Response:* WLR land managers must act decisively when conditions are suitable.

**Limitation:** Weather conditions at the time of mapping warrens can affect the correct determination of an active burrow (wind-blown sand may obscure signs at the burrow entrance). Similarly, weather conditions subsequent to the mapping may hinder re-locating the warren (wind-blown sand may bury the warren).

*Response:* Minimal delay between warren mapping and enacting control measures and GPS coordinates to assist with re-locating warrens.

**Limitation:** Recorder uncertainty or subjectivity in determining if a burrow is active or in detecting a rabbit during spotlight counts.

*Response:* Western Local Land Services to supply training in identification of active warrens.

**Limitation:** The development of resistance in rabbits to RHDV is widespread.

*Response:* Do not rely on biological control as a primary control measure. It is only one technique amongst a suite of measures in the integrated control plan.

**Limitation:** Cost of purchasing drones and of training.

*Response:* If drones are deemed a suitable monitoring technique, seek external funding sources for the purchase of equipment and training.

**Limitation:** Limitations which exclude the use of 1080 poison.

*Response:* Primary control measures will consist of warren destruction only, and implosion only in culturally sensitive areas.





Ernest and Richard Mitchell investigating a hearth. Photo credit: NPWS World Heritage team

## 9.5 Cultural

**Limitation:** Lack of certainty regarding the locations of cultural heritage material or of culturally sensitive areas can restrict or inhibit a land manager undertaking actions or implementing a control program.

*Response:* NSW National Parks and Wildlife World Heritage Team to work with WLR land managers, where required. Western Local Land Services to supply maps to land managers identifying known point locations of cultural material and culturally sensitive areas. These maps are indicative only and are not to be interpreted that no other cultural items occur on their property; due diligence still applies.

**Limitation:** Lack of knowledge of the management objectives under the intergovernmental agreement for WLR can similarly inhibit a land manager implementing a control program. These objectives are to identify, protect, conserve, present and transmit to future generations Australia's cultural and natural heritage of outstanding universal value.

*Response:* Ensure WLR land managers are aware of their responsibilities through confirmation or education.

**Limitation:** Weather conditions subsequent to the cultural heritage mapping may hinder re-locating the warrens or items, and items may be inadvertently damaged during control actions or while accessing the warren. As rain and wind can expose or rebury sites or items, it is important that the dozer operator has current site data on their GPS.

*Response:* Conduct control actions as soon as practical after the cultural assessments have been completed. Avoid long periods between the mapping and control activities. The dozer operator must have the most recent GPS data for cultural heritage records, including AHIMS data, in order to avoid sensitive areas and those warrens designated not to be ripped. The units should be returned to the NSW National Parks and Wildlife World Heritage Team or other designated officer for regular synchronising of mapping and control activities.

## 10. Adaptive Management

Adaptive management allows control activities to be critically analysed and adapted to ensure continued effectiveness. In order to analyse efforts, land managers of the WLR need to monitor and record abundances of rabbits (see Monitoring in section 7).

If particular control activities do not appear to affect rabbit abundance, land managers should evaluate these activities and determine why they have not achieved the desired outcomes (e.g. whether it was the timing of activities, the procedures employed, the amount of dedicated resources, or simply those activities are ineffective in that area).

This Plan is due for annual review and WLR land managers will need to reconsider activities and remove any risks/failures to ensure that new operations are more likely to achieve the desired outcomes.

Communicating outcomes of actions at the property level with other WLR land managers will allow each to effectively adapt their control programs without having to experience similar failures (Commonwealth of Australia 2016b).

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## Useful links

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There are many useful resources on the internet; a small selection is included below:

<http://www.pestsmart.org.au/pest-animal-species/european-rabbit/>

[https://www.pestsmart.org.au/wp-content/uploads/2017/11/RabbitRHDVK5\\_infopack-web-1.pdf](https://www.pestsmart.org.au/wp-content/uploads/2017/11/RabbitRHDVK5_infopack-web-1.pdf)

<https://www.pestsmart.org.au/tag/rabbit-sop/>

<http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-animals/invasive-animal-management/established-invasive-animals/integrated-rabbit-control-for-rural-and-natural-landscapes>

<http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-animals/a-z-of-pest-animals/european-rabbit>

<https://www.dpi.nsw.gov.au/biosecurity/vertebrate-pests/pest-animals-in-nsw/rabbits/rabbit-control>

<http://www.rabbitfreeaustralia.com.au/rabbits/controlling-rabbits/>

[https://www.ils.nsw.gov.au/\\_data/assets/pdf\\_file/0005/1186268/Managing-native-vegetation-on-a-rural-property.pdf](https://www.ils.nsw.gov.au/_data/assets/pdf_file/0005/1186268/Managing-native-vegetation-on-a-rural-property.pdf)

[https://www.ils.nsw.gov.au/\\_data/assets/pdf\\_file/0008/734507/Allowable-activities-for-landholders.pdf](https://www.ils.nsw.gov.au/_data/assets/pdf_file/0008/734507/Allowable-activities-for-landholders.pdf)

<https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap>

[https://www.ils.nsw.gov.au/\\_data/assets/pdf\\_file/0008/735254/Allowable-activities-relating-to-rural-infrastructure.pdf](https://www.ils.nsw.gov.au/_data/assets/pdf_file/0008/735254/Allowable-activities-relating-to-rural-infrastructure.pdf)

[https://www.ils.nsw.gov.au/\\_data/assets/pdf\\_file/0008/734516/Land-Management-Code-Overview.pdf](https://www.ils.nsw.gov.au/_data/assets/pdf_file/0008/734516/Land-Management-Code-Overview.pdf)

[https://www.ils.nsw.gov.au/\\_data/assets/pdf\\_file/0010/734518/Obtaining-other-approvals-managing-native-vegetation.pdf](https://www.ils.nsw.gov.au/_data/assets/pdf_file/0010/734518/Obtaining-other-approvals-managing-native-vegetation.pdf)

## Appendix 1 Program-level roles and responsibilities

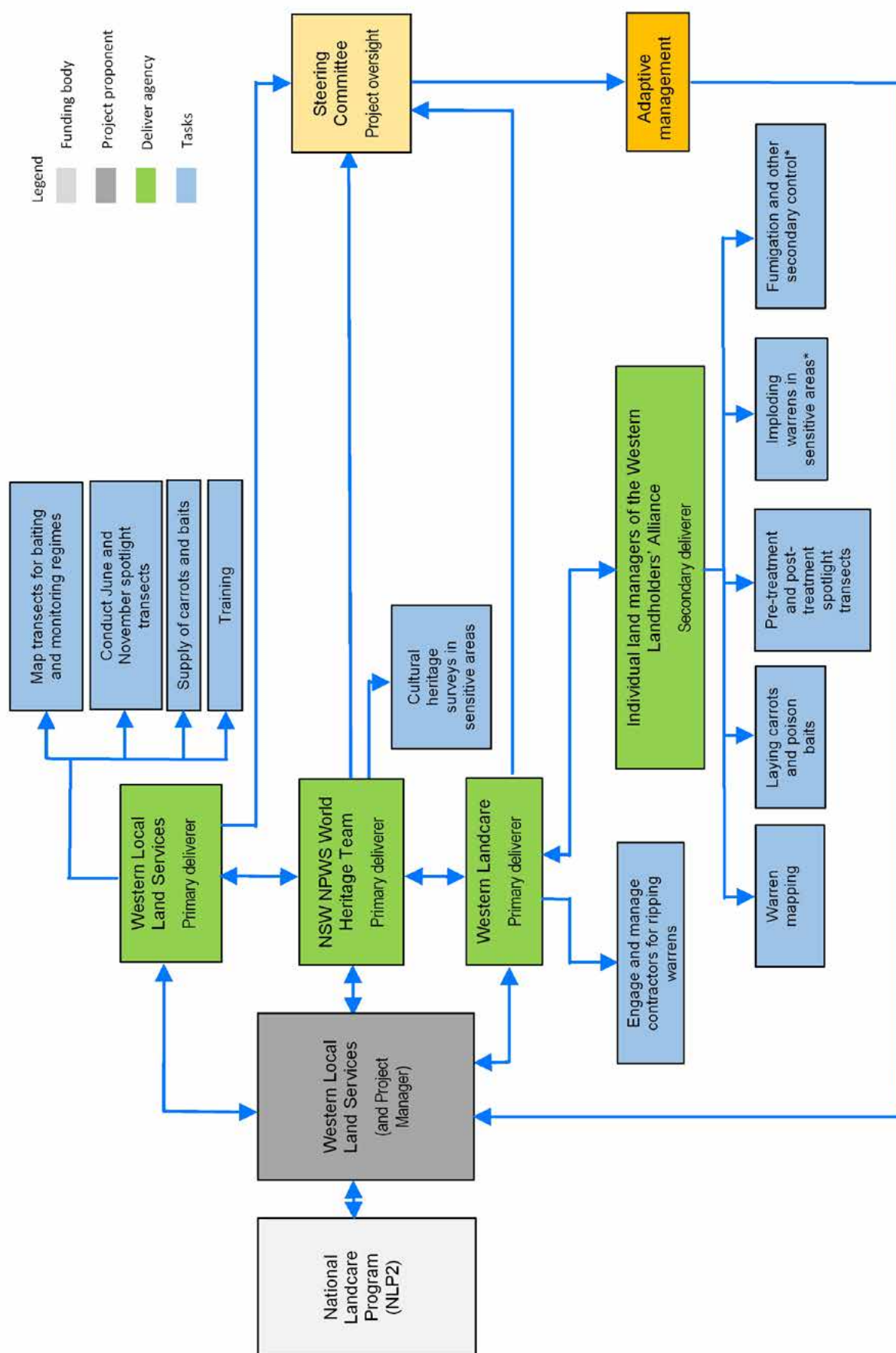


Figure A1 Willandra Lakes Region World Heritage Property Rabbit Management project stakeholders and roles — program level

\* See Figure 6 Development of negotiated individual property-level control and works plan.



Table A1 Willandra Lakes Region World Heritage Property Rabbit Management stakeholder roles – program level

Stakeholder	Role
<b>National Landcare Program (NLP2)</b>	<ul style="list-style-type: none"> <li>Provides funding to undertake rabbit control actions aimed at protecting cultural heritage values of WLRWHA</li> </ul>
<b>Western Local Land Services</b>	<ul style="list-style-type: none"> <li>Project proponent and project manager</li> <li>In consultation with NPWS World Heritage Team, determines areas to be surveyed for cultural heritage</li> <li>Reports to Commonwealth</li> <li>Coordinates Steering Committee meetings</li> </ul>
<b>Steering committee</b>	<ul style="list-style-type: none"> <li>Provides oversight on the progress of the project</li> <li>Evaluates the need and direction of any adaptive responses to management program</li> <li>Membership made of one representative from Western Local Land Services, NPWS World Heritage team, Western Landcare, Willandra Landholders Alliance</li> </ul>
<b>NSW NPWS World Heritage Team</b>	<ul style="list-style-type: none"> <li>Communicates with Western Local Land Services Project Manager</li> <li>Conducts cultural heritage surveys on and around each mapped warren and AHIMS record</li> <li>Maintains a track log on GPS</li> <li>Communicates with Western Landcare officer, as required</li> <li>Communicates with Western Local Land Services officer, as required</li> <li>Submits the new cultural heritage records to AHIMS</li> </ul>
<b>Western Landcare</b>	<ul style="list-style-type: none"> <li>Reports to Western Local Land Services Project Manager</li> <li>Engaged under contract with Western Local Land Services to undertake agreed on-ground outputs <ul style="list-style-type: none"> <li>Engage and coordinate operator to rip warrens</li> <li>Coordinate and liaise with Willandra Landholders' Alliance to fulfil their role</li> </ul> </li> <li>Communicates with NPWS World Heritage Team, as required</li> <li>Shares electronic data from participating landholders with Western Local Land Services</li> </ul>
<b>Willandra Landholders' Alliance – individual land manager</b>	<ul style="list-style-type: none"> <li>Reports to Western Landcare Officer</li> <li>Collaborate with Western Local Land Services on establishing monitoring transects</li> <li>Participating landholders will report on progress of agreed tasks within their property work plan, i.e. <ul style="list-style-type: none"> <li>Undertaking pre-treatment abundance surveys, as per monitoring protocol</li> <li>Laying of carrot baits, according to standard protocol</li> <li>Implosion of warrens, where required</li> <li>Fumigation and shooting follow-up operations, as required</li> <li>Undertaking post-treatment abundance surveys as per monitoring protocol to determine follow-up actions</li> <li>Applying due diligence as required</li> </ul> </li> </ul>
<b>Ripping contractor(s)</b>	<ul style="list-style-type: none"> <li>Reports to Western Landcare officer</li> <li>Undertakes ripping of mapped warrens that have been assessed clear of cultural heritage material</li> <li>Maintains a track log on GPS</li> <li>Any new warrens seen by the bulldozer operator are marked on GPS but not ripped</li> <li>Applies due diligence, as required</li> <li>Submits GPS to Western Landcare</li> </ul>

## Appendix 2 Government-assisted previous control efforts in WLRWHA and their evaluation

### 2002

Ripping activities are known to have occurred but spatial data, or information on the program under which it occurred, is not known (Sunraysia Environmental 2014).

### 2007

Ripping activities are known to have occurred on Arumpo, Banoon, Baymore, Turlee, Gol Gol, Prungle and Top Hut, but information on the program under which it occurred is not known (Sunraysia Environmental 2014).

### 2008 - 2009

A ripping program was undertaken on Joulmi prior to its incorporation into the national park by the then Land and Property Management Authority with funding from the then Lower Murray Darling Catchment Management Authority. The program was completed in 2009 and ripped 1,799 warrens (some covering 1 ha) in culturally non-sensitive. Post-treatment surveys revealed few re-opening of burrows. Overall, 22% of property was treated but funding was not sufficient to cover the all suitable areas. Vegetation monitoring sites were established and some follow-up shooting was conducted. During the same period, baiting was conducted over 262 km (David Gee, pers comm).

### 2010 - 2012

Ripping activities are known to have occurred on Arumpo, Banoon, Baymore, Chibnalwood, Prungle, Spring Hill, Top Hut and a few warrens on Gol Gol but information on the program under which it occurred is not known (Sunraysia Environmental 2014).

### 2013

Ripping activities are known to have occurred only on Gulthul but information on the program under which it occurred is not known (Sunraysia Environmental 2014).

### 2014

1. Sunraysia Environmental (2014) Assessment of Effectiveness of the Rabbit Warren Ripping Program—Willandra Lakes Region World Heritage Area. Report prepared for Office of Environment and Heritage, Buronga, NSW.
  - Aimed to assess the effectiveness of past programs over the previous 10 years and guide future rabbit control actions.
  - Twenty, randomly selected 1 ha plots for each property involved in previous control works were assessed for active and inactive warrens.
  - Many areas not treated and many warrens missed, creating hotspots on most properties.
  - Only 26% of ripped warrens were not re-infested, i.e. 74% of warrens re-opened.
  - Concluded future programs needed to be more strategic using integrated methods in planning and implementation stages.
  - Recommended the development of a rabbit management strategy.

2. Kelly I and Kelly MW (2014) Willandra Lakes World Heritage Area treatment of rabbit warrens within sensitive areas: WLRWHA (Hot Spots) Project. Prepared for Western Local Land Services, Buronga.
  - A follow-up assessment of the hotspots identified by Sunraysia Environmental (2014).
  - Found many more warrens than were previously mapped, recording active and non-active warrens.
  - Conducted mapping in culturally sensitive areas.
  - Recorded previous ripping activity in culturally sensitive areas.
  - Undertook warren destruction using a Rodenator in culturally sensitive areas.
  - Report contains maps of warrens and maps of treated warrens in culturally sensitive areas for the northern properties of WHA.
  - Produced spatial data for warrens treated.
  - Recommended integrated control measures (baiting and warren destruction) and better warren mapping.

### 2015

1. Booth S, Barrett, T, Ridges M, Simpson G, Goggin L, Bye D, Green R, Leys J and Heidenreich S (2015) Sustaining Willandra – Integrated Land Management Framework. Final report to Western Local Land Services for contract MU9057 (unpublished report).
  - This project constituted part 1 of Willandra Spatial Prioritisation Program (see below in 2016). Its focus was not specifically on rabbit control but in developing a framework and spatial prioritisation tool to guide the way in which scientists should work alongside stakeholders to conserve agree values in the landscape. It illustrated the use of the tool through a hypothetical rabbit control project and demonstrated how the project manager could record how the project connects with all elements of the Willandra Plan of Management (2014).
2. Kelly L and Kelly MW (2015) Willandra Lakes World Heritage Area field survey to locate and record rabbit warrens. Prepared for Western Local Land Services, Buronga.
  - Follow-up to the 2014 work on hotspots but no control measures implemented.
  - Mapping rabbit warrens across the property and in culturally sensitive areas for the southern properties of WHA.
  - Ripping done prior to this assessment project was more successful than on northern properties.
  - Recommends a suite of control methods (baiting 2 weeks prior to using Rodenator in culturally sensitive areas) and cultural heritage surveys prior to works.
  - Landholders to use their map products.



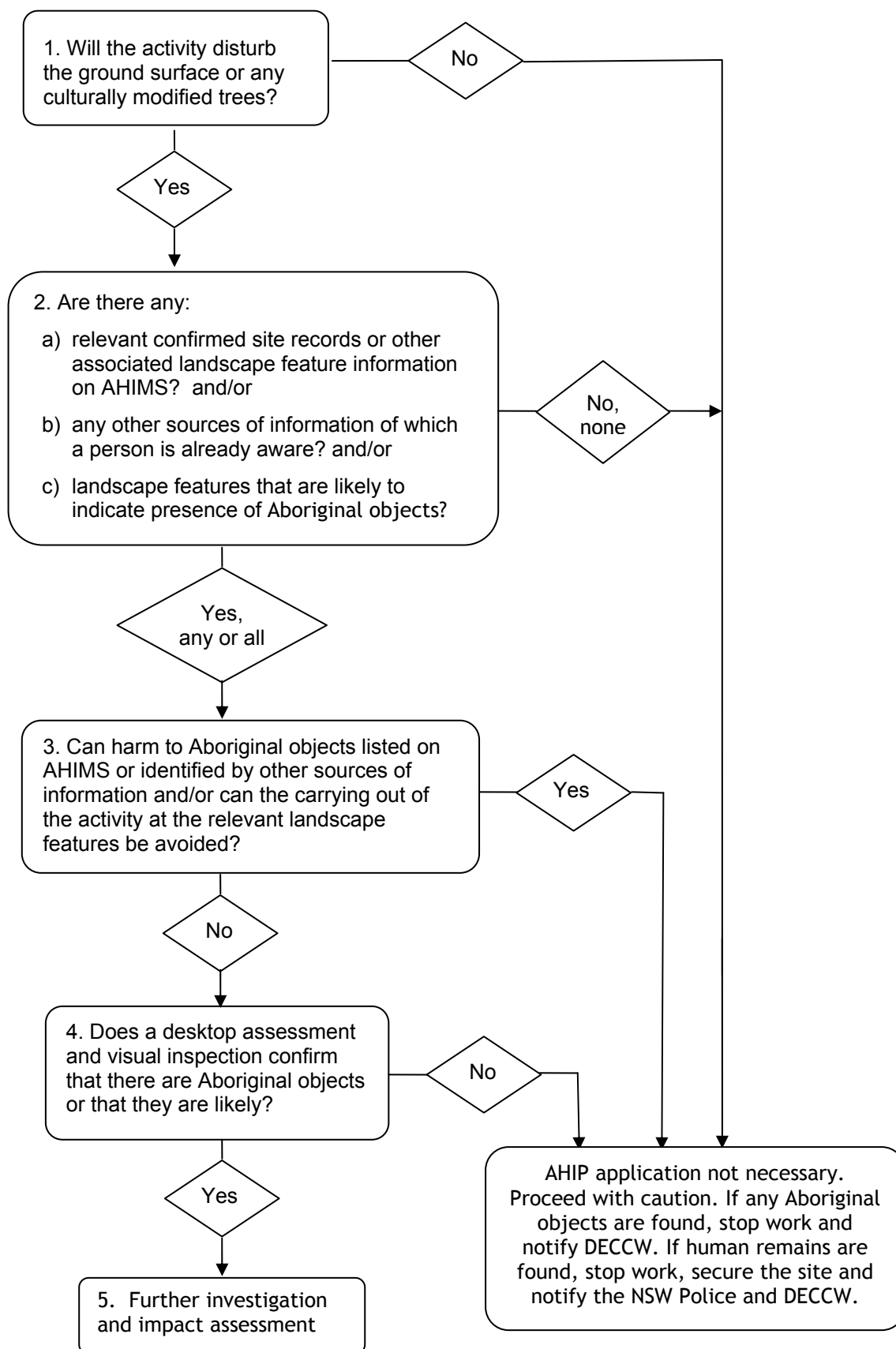
## 2016

1. Barrett T, Bye D, Booth S and Leys J (2016) Sustaining Willandra: Phase II of the Willandra Spatial Prioritisation Program: Project Report to Western Local Land Services. Knowledge Services Team, Science Division, NSW Office of Environment and Heritage.
    - Demonstrates a ground-cover modelling tool for prioritising rabbit control locations and methods.
    - The approach identifies priority areas for treatment based on the warren density, archaeological sites, archaeological potential and total ground cover.
    - Used on the southern properties of WHA
    - Ground cover monitoring methodology developed can be successfully used to monitor grazing pressure and evaluate works to control grazing pressure. These investments were designed to manage total grazing pressure and protect the outstanding universal values of the Willandra
    - Recommended new Landsat imagery is regularly imported into the software to allow on-going monitoring of investment sites.
  2. Willandra Lakes Region World Heritage Area (2016) Willandra Lakes Region World Heritage Area Rabbit Control Program Southern Properties.
    - WLRWHA entered into a contract with Western Local Land Services to control rabbits in the northern and southern properties, which later changed to the southern properties only
    - The aim was to develop joint action through integrated landscape management to counter the historical sporadic and opportunistic programs.
    - Northern properties run as organic enterprises could not use 1080 poison.
    - The failure to achieve normal control rates of rabbits (up to 95% reductions from ripping and baiting programs) in the WLRWHA was principally due to the inability to effectively plan and undertake a landscape approach and the lack of follow-up treatments.
    - Mechanical control was a major concern. Destructive forms of control such as ripping, should not be used where there are known archaeological sites, on land-units that archaeological sites are known, or have potential, to occur, or on sensitive, eroding landscapes. To reduce the impact on such areas, 1080 was proposed as it is less invasive.
    - Twelve rabbit warren clusters in the WLRWHA were identified, in addition to approximate warren densities using Western Local Land Services data collected in 2014.
    - Local observations identified inactive, as well as active warrens, need to be treated to make an impact on rabbit populations.
- Monitoring sites to be set up to monitor the results of the 2016 control program on Banoon and Marma Stations. Monitoring to be done using number of active entrances and 2 km spotlight transects.
  - Discussed the possibility of being included in a K5 Calici virus release.
  - Control works were carried out in February 2016 during predicted high temperatures and low rainfall to maximise the effects of the baiting and ripping program. All 423 previously recorded warrens within the 1080 zone were treated and 881 warrens were ripped on Banoon. Follow-up spotlighting planned.
  - Program was considered a success in creating a stronger partnership with the WLRWHA Landcare Group. In the absence of funding, the program provides each landholder with a plan that breaks the ad hoc nature of previous rabbit control.
  - The organic certification leaves limited options to controlling warrens where World Heritage Values are present. The options include shooting and implosion. Both involve huge time and cost commitments, and neither are actively pursued by the landholders as they are unaffordable in large-scale programs.
  - New landholders in the WLRWHA Landcare Group are amenable to co-contribution plans and are aware that it is their responsibility to control pest animals; several still have a strong belief that it is the government's responsibility to control pest animals on their properties. This is in part because of the legacy of past control programs that sort little contribution from the landholders. This program has succeeded in changing that understanding with all landholders, reaffirming that if there are no contribution on future programs, there will be limited support from government agencies.

## 2017

- Trial release of Rabbit Hemorrhagic Disease (RHDV1 K5) on four WHA properties (Mungo NP, Baymore, Mulurulu and Banoon) as part of an Australia-wide trial. Forty hot-spot warrens (ten per property) were chosen for the release.
- Post-release monitoring revealed rabbit abundance was reduced by an average of 40% compared to benchmark figures.
- Follow-up control treatments were recommended but not undertaken.

## Appendix 3 Generic Aboriginal cultural heritage due diligence process





## Appendix 4 Aboriginal cultural heritage and undertaking projects with Western Local Land Services

### Aboriginal cultural heritage and undertaking projects with Western Local Land Services

Western Local Land Services acknowledges the Traditional Owners of the land within the Western region, and pays respect to past, present and future Elders of that land. The protection and enhancement of Aboriginal culture, heritage and spiritual beliefs is an issue of great importance to the traditional owners of these lands and waters and is of benefit to the whole community.

#### Overview

Aboriginal cultural heritage is intrinsically linked to the landscape, traditions and culture of Western NSW. Western Local Land Services acknowledges its responsibility to work with the broader community to understand, value and protect important cultural assets, and believes there is a great opportunity for landholders and Aboriginal people to work together to share knowledge of country and protect the rich heritage of Western NSW.

#### Projects and assessing for Aboriginal cultural heritage values

Western Local Land Services staff must ensure landholders participating in a project are aware of their responsibilities under the NSW Government's *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*.

This code explains what due diligence means in terms of steps that Local Land Services employees (and landholders implementing Local Land Services programs and projects) must take as part of the ongoing risk management process in order to identify, prevent and mitigate harm to Aboriginal cultural heritage. Following due diligence to determine that project activities will not harm Aboriginal objects and cultural values helps provide a defence against prosecution if an object or value is later unknowingly harmed without an Aboriginal Heritage Impact Permit.

Western Local Land Services encourages landholders to participate in the assessment process and ask questions along the way. See overleaf for more information on what is involved in the assessment process.



#### Role of your project officer

Your Western Local Land Services project case officer will remain the key contact for the landholder and will liaise with them to make arrangements for an Aboriginal Communities staff member, accompanied by the relevant Traditional Owner, to access the project site to conduct an Aboriginal cultural heritage assessment, should it be a requirement for your project.

#### Role of Aboriginal Communities staff

Western Local Land Services employs three dedicated Aboriginal Communities staff members. It is the role of these staff members to ensure that cultural values in or near the project area are clearly identified, recorded and protected from disturbance. The Aboriginal Communities staff members will also engage a relevant Traditional Owner or knowledge holder to accompany them to assess your project area. All staff and experts engaged by Local Land Services will be expected to comply with all on-farm WHS, biosecurity measures and access and notification arrangements requested by the landholder. A detailed report will be provided on completion of the assessment.



Local Land  
Services

*Images from the Willandra Lakes  
World Heritage Area: A scarred  
tree, a hearth site and a stone  
artefact. Images: L Mitchell*

## What's in scope

For landholders successful in securing funding to implement or participate in a Western Local Land Services project or initiative on their property, the following process will apply.

Your Local Land Services case officer will discuss with you whether your project activities will disturb the ground surface or risk impacting culturally modified trees. If your project activities do not, you can proceed with caution.

If any of your project activities will disturb the ground surface or are at risk of disturbing culturally modified trees, this will trigger a more detailed assessment process.

- Your case officer will conduct a desktop assessment of your project which includes a search of the Aboriginal Heritage Information Management System (AHIMS) database, producing a map of current records in or near your project area.
- Your case officer will liaise with you to arrange an on-ground assessment of the project area prior to any work occurring. The assessment will be conducted by a specialist Western Local Land Services staff member who will also engage the relevant Traditional knowledge holder, Community Elder or Traditional Custodian to attend.
- During the on-ground assessment, any Aboriginal objects or landscape features likely to hold Aboriginal objects will be clearly identified, photographed, GPS located and recorded.
- A report will be provided that identifies any risks of disturbance that your project poses to the Aboriginal objects or landscape features, along with recommended modifications to avoid their disturbance, should this be the case.
- It is also important to note that any Aboriginal objects or culturally modified trees identified during the assessment, that are not currently, will be registered in the AHIMS database as per legislative requirements under section 89A of the *National Parks and Wildlife Act 1974* (NPWS Act).
- If for any reason you are unable to modify your project to avoid impacting on Aboriginal objects and landscape features, you must apply for an Aboriginal Heritage Impact Permit (AHIP) under the NPWS Act. This must be approved by the relevant agency before commencing any project works.

- If human skeletal remains are located (and they are not part of a registered burial site in AHIMS) then the Police (000) must be called and the immediate location cordoned off as a crime scene, until advised otherwise.
- If at any point during works you think you have identified an Aboriginal object at risk of being disturbed, you must stop work and notify your Western Local Land Services case officer who will coordinate a specialist staff member to assist you as soon as possible.

## What's not in scope

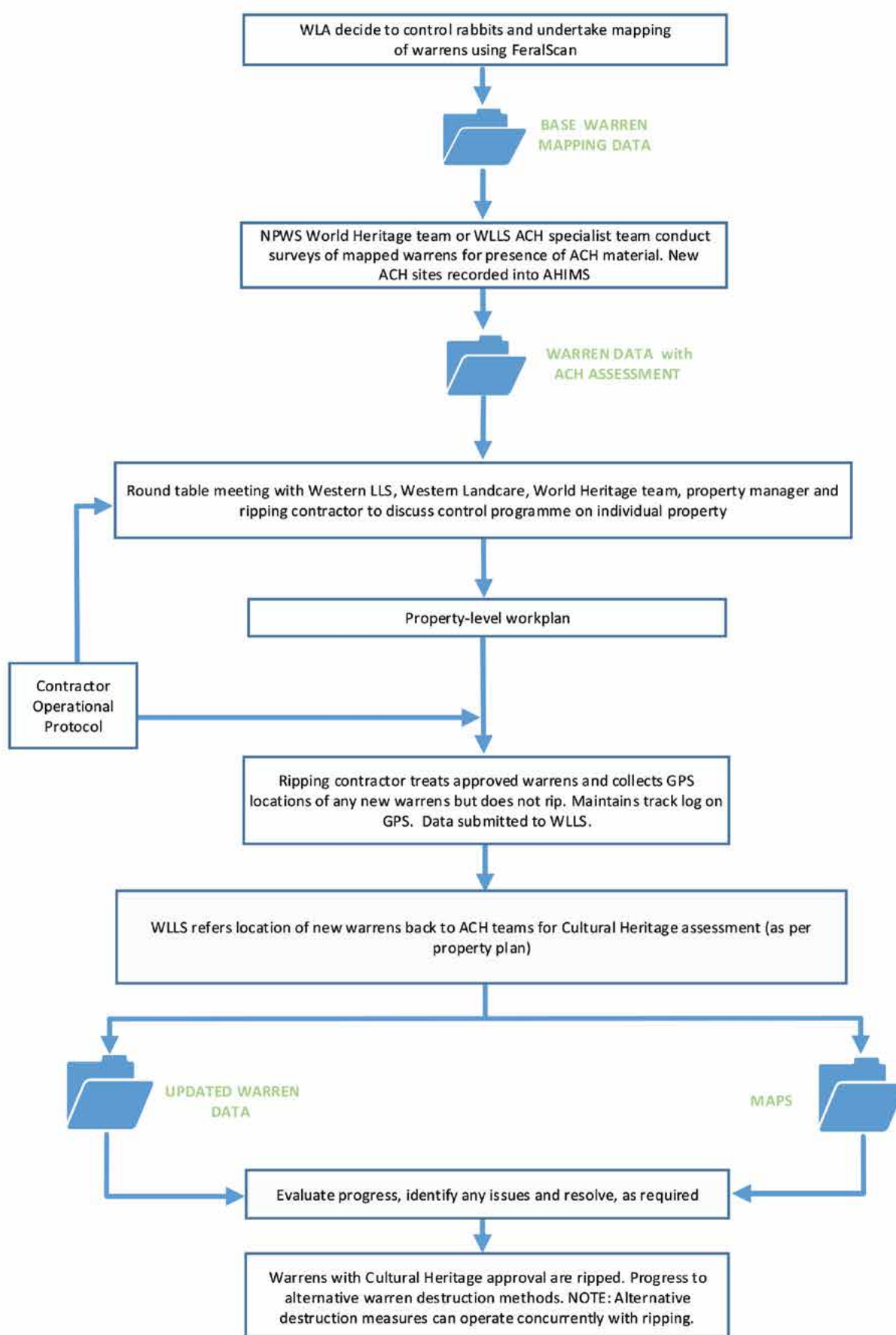
It is important to understand that Aboriginal communities are primarily interested in sharing cultural knowledge with landowners and protecting cultural values together. If you identify cultural values on your property through this process, or have on a previous occasion, you should know:

- It will not lead to land claims against lawfully occupied crown or freehold land, there is currently no legislation in NSW that allows the acquisition of land because cultural values are present.
- No person will be granted automatic access to sites without your permission. All members of the public need the landowner's permission to enter your property.
- It will not automatically lead to locking up portions of country or management changes. In a very small number of cases, specific localised protection works may be recommended. Any project modifications, management options or recommendations will be discussed with you as the landholder to find the best possible solution.








## Appendix 5 Summary cultural heritage data management process



## Appendix 6 Operational procedure for contractor ripping rabbit warrens

1. The property has been divided into sections and your GPS will hold waypoint information only for the section(s) that you are working on. You will cover the property section by section.
  2. Do not rip any warrens not held in the GPS (but see points 6).
  3. The waypoint information in the GPS is of three kinds:
    - Warrens suitable to rip indicated by 
    - Warrens not to be ripped (they will be treated with alternative methods), indicated by 
    - Recorded Cultural Heritage items which are to be avoided, while travelling to the next warren and indicated by 
  4. Please use track log on your GPS to record where you have been. If you do not know how to use track log, a Western Local Land Services officer will assist.
  5. Please use the GPS to mark each warren as they are ripped (this will enable an accurate count of the number of warrens ripped; a track log does not give this information).
  6. Please use the GPS to mark any new warrens you may encounter which are within the bounds of the waypoints in your GPS. That is, if you find a new warren while travelling to the next, please mark it and give it the name NW (indicating a new warren). This name will differentiate this waypoint from other waypoints for ripped warrens. If you do not know how to give a waypoint a name, a Western Local Land Services officer will assist.
  7. Do not rip the new warrens you have marked. Report back to the Western Local Land Services or the World Heritage Team so a Cultural Heritage survey can be conducted.
  8. All warrens held in your GPS have been assessed for the presence of Aboriginal Cultural Heritage artefacts. However, under the *National Parks and Wildlife Act 1974*, due diligence for Aboriginal Cultural Heritage is the responsibility of the land manager. If Aboriginal artefacts and/or human remains are found in the course of your work, you should stop work immediately and notify the land manager. Please also notify the Western Local Land Services.
  9. If you are in doubt over the presence of cultural material or if a burial has been discovered, stop work immediately and notify the land manager, who must contact the World Heritage Team for further advice. Please also notify the Western Local Land Services.
  10. In the event there is accidental disturbance to Aboriginal Cultural Heritage as a result of your activities, stop work immediately and notify the land manager, who should then notify World Heritage Team. Please also notify the Western Local Land Services.
  11. Some warrens where ripping is permitted, i.e. no Cultural Heritage material was found, may be situated near trees or within a clump of trees, such as belah or mallee. You may decide that clearing the trees is required in order to access the warren, i.e. push over the trees. In line with the Land Management (Native Vegetation) Code, any clearing must be to the minimum extent necessary and only if no alternative methods of destruction are available.
- The landholder must consider whether the activity is an 'allowable activity' under the code or is 'broad-scale land clearing' where they need a clearing approval and an offset. This will need to be finalised **before** work commences. The amount of clearing is to be considered across the **entire** property.
- If landholders use an allowable activity as part of rabbit control, it is always best practice to keep records of all activities undertaken. These records can include:
- Photographs of the native vegetation before and after clearing.
  - The number of trees and species cleared.
  - GPS points of the trees.
- The main considerations when conducting an allowable activity include:
- It is the responsibility of the land manager — and contractor who is removing the native vegetation — to be fully aware of the legal requirements (ignorance is no excuse).
  - It is the responsibility of the land manager to keep records of any native vegetation cleared or removed.
  - **Clearing native vegetation under an allowable activity is always to minimum extent necessary.**
  - Other approvals may also be required, e.g. Council or Western Lands.
  - Clearing activities on vulnerable and sensitive category 2 land is restricted as per the fact sheet.
12. Once a week (e.g. Friday afternoons or other mutually agreed time), visit the office of the Western Local Land Services for the GPS data to be downloaded and to discuss progress or any issues.
  13. If you engage a subcontractor, you must notify the Western Local Land Services prior to their engagement.
- I have read and understood these protocols.**
- Signed \_\_\_\_\_
- Print name \_\_\_\_\_
- Date \_\_\_\_\_





## Appendix 7 How to do a spotlight count from a vehicle

(Adapted from PestScan Rollout of RHDV1 K5 in Australia: Information Guide; and Mitchell and Balogh 2007)

When undertaking a spotlight count from a vehicle, be sure to drive the transect during the day before undertaking the spotlight count to ensure you are familiar with the transect.

Transect length should be 10 km and located where control measures have been undertaken.

Two people are required to undertake a spotlight count — one person to drive and one person to spotlight and record rabbits.

Spotlight counts should be undertaken both before and after control actions to determine any change in abundance.

### Equipment

- 4WD vehicle
- 100W 12-V (narrow beam) spotlight, either roof-mounted or hand-held
- Pen, paper and monitoring sheet to record rabbit numbers

### Procedure for one driver and one or more observers

- Start approximately 30 minutes after sunset from an established starting point
- Drive at a constant slow speed (10–15km/hr)
- Scan in a 180° arc either in front of the vehicle (if counting from the back of a ute) or out of the side of the vehicle (if counting from the cab) for a distance of 50 to 100 m
- every 1 km, record the tally on a standardised spotlight count sheet
- Be careful not to count individual rabbits more than once
- Repeat the count over 3 or 4 consecutive nights of similar weather
- Start all counts as close as practicable to the same time, using the same driver and observer each time
- At the completion of the final night, average the counts obtained over all survey nights and divide the count by the length of the transect to get a simple index of abundance (rabbits/km)
- Enter in to FeralScan as shown in Appendix 9.

### Health and safety considerations

Driver and observer must be familiar with the track in daylight conditions, having driven it before starting the survey to make sure it is readily navigable.

Ensure that the spotlight is well maintained, with leads connected securely to the battery terminals and insulated from other components. Always disconnect the spotlight from the power source before changing the globe or making repairs. Switch the spotlight off when not surveying (i.e. do not leave the spotlight switched on face-down on the seat or on heat-sensitive material). Do not run the spotlight for long periods without the motor running.

All occupants should carry drinking water, a torch and sufficient clothing for warmth in the event of the vehicle becoming stranded. Avoid shining the spotlight beam into other people's eyes.

Check previous rainfall and surface conditions before the survey. The driver and observer must not be fatigued at the time they do the spotlight survey. The observer should wear adequate clothing during cold weather.

Drive at the correct speed and continually watch the surface ahead on the track.

Record observations only when the vehicle is stationary.

## Appendix 8 Example of a spotlight count sheet (from Mitchell and Balogh 2007)

[illegible]

Comments:

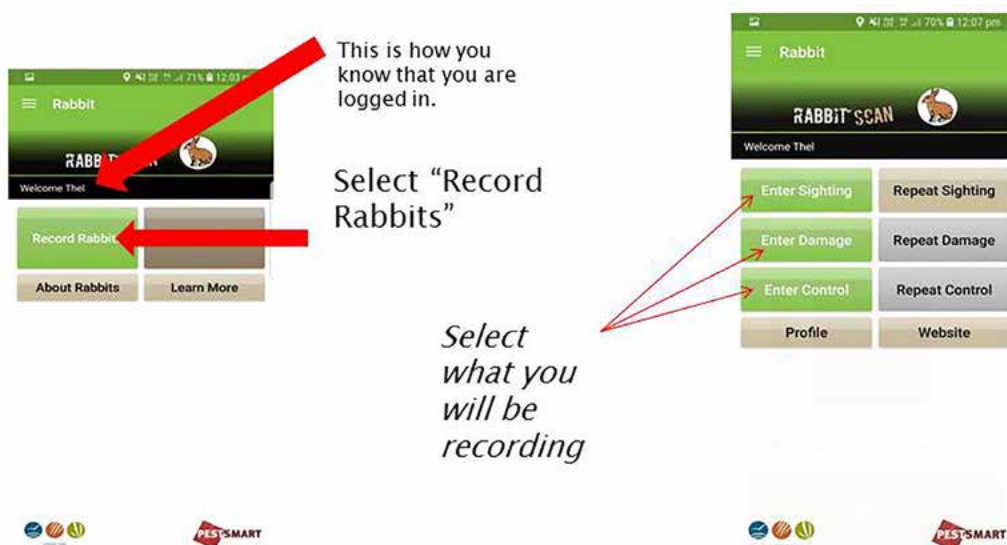
## Appendix 9 How to submit a rabbit warren sighting and spotlight count data using RabbitScan

### Logging on

- ▶ Go to your App store and download FeralScan



### Getting started





# Opening Screen – GPS Location

1. Date observed: 18/02/2019

2. Your location: Latitude, Longitude

3. Number seen?

- ☐ None seen
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6 - 10
- ☐ 11 - 20
- ☐ 21 - 30
- ☐ 30 - 50
- ☐ More than 50
- ☐ Not Applicable

4. Add spotlight data ☐

5. Rabbit warren at this location?

Leave your phone location on and this will fill automatically

*The first recording screen*

Getting location...

Cancel

# Form Completion & Submission

As you select the options other options may open up.

*Write anything you think is worth noting, e.g. culturally sensitive area, previous control undertaken.*

Please take photos of sightings, damage and control measures being undertaken.

*Choose how you would like your data shared.*

Once you have filled in all the data required – **SUBMIT!!**

4. Add spotlight data ☒

- ☐ None seen
- ☐ 1 per km
- ☐ 2 per km
- ☐ 3 per km
- ☐ 4 per km
- ☐ 5 per km
- ☐ 6 - 10 per km
- ☐ 11 - 20 per km
- ☐ 21 - 30 per km
- ☐ 31 - 50 per km
- ☐ Greater than 50 per km
- ☐ Not Applicable

5. Rabbit warren at this location?

- ☐ Yes
- ☐ No

6. Rabbit dung at this location?

- ☐ Yes
- ☐ No

7. Notes

9. Upload a photograph

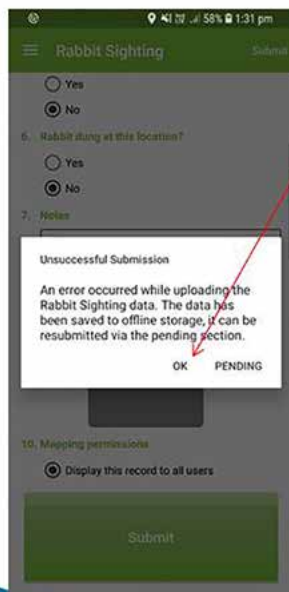
No photo chosen

10. Mapping permissions

- ☒ Display this record to all users
- ☐ Restrict this record my group(s) (private)

Submit

# With NO Internet Service

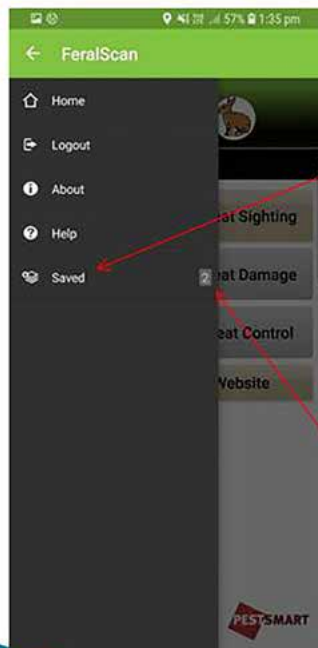


*With no internet service you will see this ERROR message – Select OK!!!*

**Select the Menu tab (Android)**



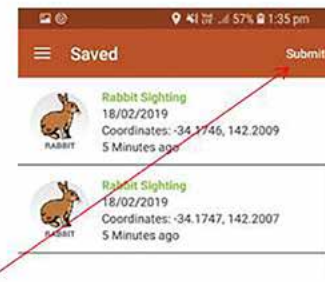
## Saved Entries



*Your data that has not been submitted is located in the Saved tab.*

*This shows you the entries that have not been submitted. – Select “Submit”.*

*It also tells you how many entries have not been submitted.*



# Submitting Saved Entries

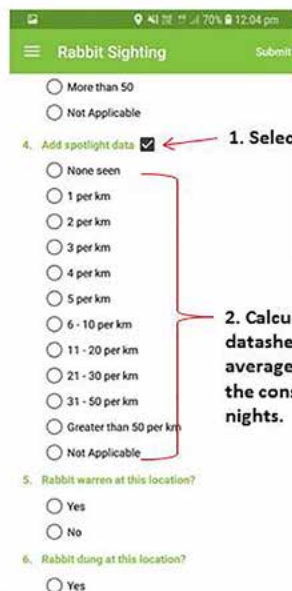


Make sure you have good service when you submit the saved entries.

Once submitted it goes back to the main menu screen.

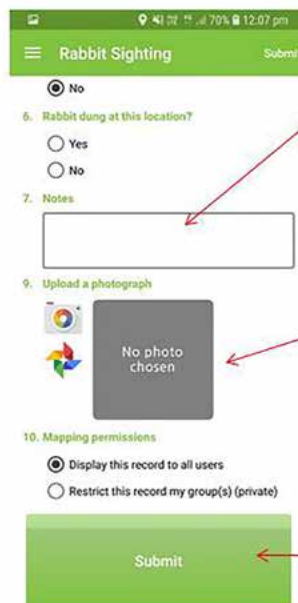


# Spotlight Transect Procedure



1. Select Spotlight Data.

2. Calculated from your datasheets. This is the average number from the consecutive transect nights.



3. Note that you are on a repeatable and marked transect. If the route has a name, note it here.

4. Take a picture & upload of a map indicating the route that you have taken.

5. Submit your data



## Appendix 10 Standard operating procedure for diffusion fumigation of rabbit warrens



### Standard Operating Procedure RAB005: Diffusion fumigation of rabbit warrens

Prepared by Trudy Sharp

#### Background

Fumigation of rabbit warrens is used to minimise the impact of the introduced European rabbit (*Oryctolagus cuniculus*) on agricultural production and the environment. Other rabbit control methods include poisoning, warren and harbour destruction, shooting, trapping, exclusion fencing and biological control with rabbit haemorrhagic disease (RHD) and myxomatosis.

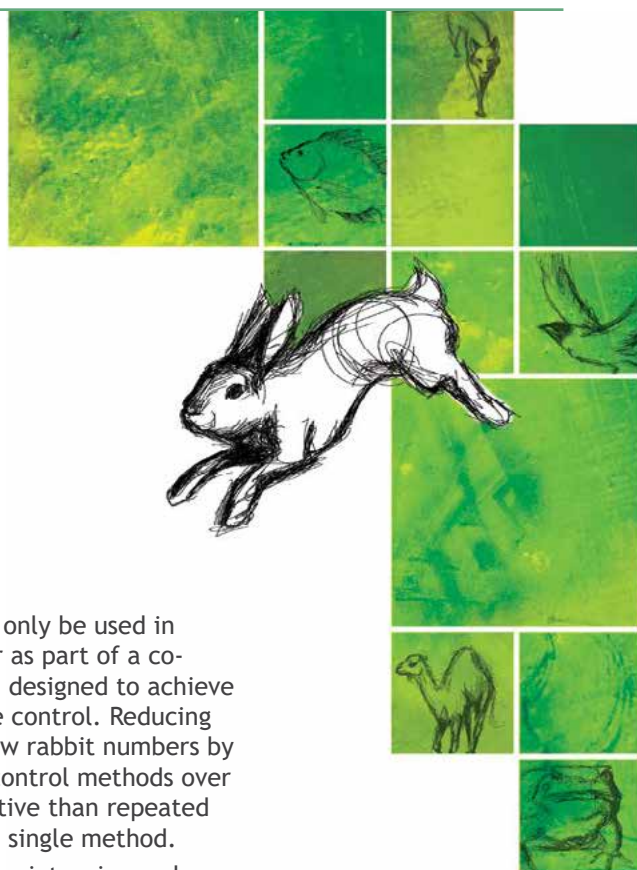
Fumigation involves the introduction of toxic fumes into a warren where it is inhaled by rabbits leading to their death. There are two types of fumigation: pressure fumigation, in which the fumigant gases or vapours are generated outside the warren and forced into the warren under pressure, usually from a pump and; diffusion fumigation, where tablets are placed in active burrows and the gas generated is allowed to diffuse through the warren.

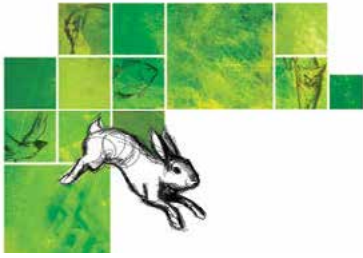
Diffusion fumigation is commonly carried out using phosphine gas. Warrens are treated with aluminium phosphide tablets which liberate phosphine gas on exposure to atmospheric or soil moisture. Phosphine is a systemic poison which depresses the central nervous system and respiratory function. It is highly toxic to humans; therefore operators performing warren fumigation must take adequate precautions to safeguard against accidental exposure.

This standard operating procedure (SOP) is a guide only; it does not replace or override the legislation that applies in the relevant state or territory jurisdiction. The SOP should only be used subject to the applicable legal requirements (including WH&S) operating in the relevant jurisdiction.

#### Application

- Fumigation should only be used in a strategic manner as part of a co-ordinated program designed to achieve sustained effective control. Reducing and maintaining low rabbit numbers by a combination of control methods over time is more effective than repeated (seasonal) use of a single method.
- Fumigation is labour intensive and costly. It is best used as a follow-up technique to warren ripping and poisoning (ie when rabbit density is low) but may also be effective in the following situations:
  - where ripping cannot be done due to inaccessible location (eg near rocky outcrops, along fences or riverbanks, around trees) or when there is a risk of soil erosion or damage to conservation areas
  - as an alternative to poisons in situations where 1080 and pindone cannot be used (eg when the risk of non-target poisoning is unacceptably high, distance restrictions cannot be adhered to etc)
  - when treating small areas or isolated rabbit populations.
- Fumigation can only be used for warren dwelling rabbits. It is not effective against surface dwelling rabbits.
- Fumigation can be carried out at any time of year but it has the greatest long-term effect if done shortly before the commencement of the rabbit breeding season.
- Fumigation with aluminum phosphide is most effective in non-porous soils through which the gas will not diffuse eg compacted heavy or wet soils rather than dry sand or cracked clay.





## RAB005: Diffusion fumigation of rabbit warrens



*Rabbit warren with multiple openings. Image: Alf*

- As phosphine gas is released from the tablets when wet, do not fumigate in weather conditions where the tablets cannot be protected from wetting prior to placement in the warren. Avoid fumigating in small sheltered gullies where the operator may be exposed to the toxic fumes. It is best to fumigate on windy days so that fumes are dispersed rather than building up in the air around the warren.
- Trained dogs can be used to drive rabbits underground prior to warren fumigation. However, it is unacceptable, and in some jurisdictions illegal, to set a dog onto a rabbit with the intention of catching or killing.
- Aluminium phosphide is listed as a Schedule 7 substance, a restricted chemical product which requires special precautions in manufacture, handling, storage and use, along with individual regulations regarding labelling or availability. In some States, fumigants can only be obtained by persons with appropriate training in their use (eg in Victoria an Agricultural Chemical Users Permit is required) or used by competent operators working in accordance with the relevant State and Territory legislation (see Table 1).
- Fumigants must be used according to instructions on approved labels and guidelines issued by relevant State authorities for vertebrate pest control.
- Phosphine is currently the preferred toxin for diffusion fumigation until more humane methods are developed. Chloropicrin (trichloronitromethane) is

considered to be highly inhumane and its use is not recommended. It causes intense irritation of the respiratory tract and profuse watering of the eyes for a considerable period before death. Exhaust from idling internal combustion engines is also not acceptable as adequate CO concentrations cannot be achieved (particularly with modern car engines) and exhaust contaminants such as hydrocarbons, ozone, nitrogen dioxide and nitric oxides cause severe irritation before death. Also, the exhaust gases produced may be unacceptably hot.

### Animal welfare considerations

#### Impact on target animals

- The toxicity of phosphine is due to inhibition of cytochrome oxidase - an enzyme essential for the use of oxygen for energy production. Inhalation of the gas causes a reduction in the activity of the central nervous system and breathing activity. The precise nature and extent of suffering of rabbits after inhalation of phosphine is unknown. Symptoms of phosphine toxicity in humans often include nausea, abdominal pain, headache and convulsions followed by coma. It is not known whether other mammals experience similar symptoms.
- Time to death can be highly variable depending on the concentration of gas in the burrow. For example, at concentrations of 400 ppm phosphine can kill rabbits in 30 minutes whereas at 25 ppm death will take 4 hours. The time taken to reach high concentrations throughout the warren largely depends on the amount of moisture in the soil and air, or on the tablets. In low humidity, complete release of phosphine gas from the tablets may take hours or even days. Higher humidity will cause a rapid rate of diffusion and therefore result in higher concentrations of gas so that the rabbit will be exposed to a lethal dose in a shorter time and will have less chance to dig out of the burrow.
- Failure to reach lethal levels of phosphine in some parts of the warren because of inadequate diffusion will result in ineffective killing but will not necessarily cause long-term suffering. Studies in other species (i.e. cats, guinea pigs and brown rats) have produced no evidence to suggest that exposure to sub-lethal levels of phosphine gas causes sub-acute or chronic poisoning. Therefore, rabbits that escape from fumigated warrens or those that are exposed to sub-lethal concentrations in deeper parts of the warren may only experience transient illness, not permanent debilitation.
- Fumigation is considered to be less humane than poisoning with 1080. Therefore, it is desirable to



fumigate only after a poisoning program when the density of rabbits is low. This minimises the number of rabbits that need to be killed by a less humane technique.

### Impact on non-target animals

- Fumigation of rabbit warrens is one of the most target-specific means of rabbit destruction and will have little impact on non-target species if used correctly.
- Fumigation must only be used in active, occupied warrens. If a warren appears to be empty or possibly occupied by a non-target species (eg wombats, dingoes, lizards, snakes), fumigation must not be performed.
- There appears to be no significant risk of secondary poisoning if carcasses of gassed animals are consumed by non-target predatory or scavenger species.
- If using dogs to work an area prior to warren fumigation, the following should be observed:
  - Dog handlers must be experienced and the dogs well trained, ie they must be easily controlled by a whistle or call, obey the handlers' commands and will not chase or attack non-target animals including livestock. Dogs that are deliberately bred or trained to attack without provocation must not be used. Suitable breeds would include terriers, labradors and others that are keen to chase but unlikely to catch a rabbit.
  - Handlers must not encourage dogs to attack and kill rabbits. Rabbits trapped in hollow logs etc. (where they are visible but the dogs can't access them), should be shot (refer to [RAB009 Ground shooting of rabbits](#)).
  - Rabbits inadvertently caught by dogs should be killed by a shot to the brain or by cervical dislocation. Rabbits should never be left to die a slow death after being maimed.
  - To ensure that dogs are not exposed to phosphine gas or allowed access to treated warrens, handlers must ensure that dogs are well restrained during and after fumigation.
  - For more details refer to [GEN002 The care and management of dogs used for pest animal control](#).

### Health and safety considerations

- Operators must strictly follow the directions on the approved label when using and storing aluminium phosphide tablets. They must not be used for any

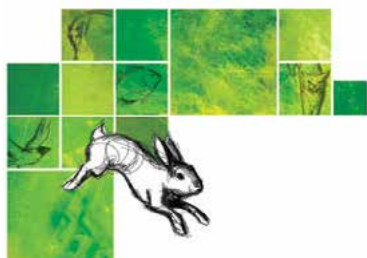
other purpose than the destruction of rabbits in active warrens.

- Fumigation must always be carried out by two trained persons and must not be carried out in wet conditions when it is likely that the tablets will become wet before insertion in the burrows.
- Phosphine is highly toxic to humans and can kill if the tablets are swallowed or the liberated gas is inhaled. Avoid contacting the skin with aluminium phosphide or breathing phosphine gas.
- If poisoning occurs go straight to a hospital or doctor **WITHOUT DELAY** and contact the Poisons Information Centre (Ph 13 11 26).
- Symptoms of overexposure to phosphine gas include headache, dizziness, nausea, and difficulty breathing. Severe exposure may damage liver, kidneys, lungs, and nervous and circulatory systems, and may cause death. If a person is exposed to phosphine gas, get them to fresh air immediately. If they are experiencing breathing difficulties give oxygen. If they have ceased breathing, apply artificial respiration using a one-way mask, air-viva or oxy-viva. Do not give direct mouth-to-mouth resuscitation if aluminium phosphide tablets have been swallowed.
- Appropriate personal protective equipment should be worn when using fumigant. This includes:
  - overalls
  - eye protection (eg chemical goggles or safety glasses)



Correct PPE should be worn when using fumigation tablets. Image: Invasive Animals CRC





## RAB005: Diffusion fumigation of rabbit warrens



*An active warren entrance. Image: Peter West*

- elbow length PVC or rubber gloves
- full-face respirator with combined dust and gas cartridge (canister) or breathing apparatus with air supply.
- If aluminium phosphide gets on skin, immediately wash area with soap and water.
- After use and before eating drinking or smoking, wash hands, arms and face with soap and water.
- After use, wash contaminated clothing and gloves.
- For further information refer to the Material Safety Data Sheet (MSDS), available from the supplier.

### Equipment Required

#### *Fumigation tablets*

***Fumigants must be stored in the closed original container in a cool, dry, well ventilated, locked area out of the reach of children and unauthorised persons and away from buildings inhabited by humans, pets or live-stock. Keep away from water and liquids which may cause immediate release of phosphine gas.***

- Fumigation tablets contain 560 to 570 g/kg of aluminium phosphide which produces 330 g/kg phosphine gas. Each 3 g tablet releases 1 g of phosphine gas when exposed to moisture in the air or soil. The evolution of gas can be increased by

adding extra water when the tablets are placed in the burrow.

- Phosphine gas is slightly heavier than air, colourless, and smells slightly of garlic.
- Phosphine generating fumigation tablets are produced under several brand names (eg Gastion®, Pestex® etc) and are available from rural merchandise suppliers.

#### *Other Equipment*

- personal protective equipment
- towel, soap, dish or bucket
- first aid kit
- warning signs
- newspaper or paper towel
- water for moistening paper
- a long handled device (at least 1 m long) for placing fumigant down the warren
- shovel or mattock for digging back and sealing burrows

### Procedures

- To maximise effect on rabbit populations, a careful on-site risk assessment to confirm the need for fumigation and assess the suitability of the area should be undertaken before fumigation is commenced.
- Fumigation must only be applied to active, occupied rabbit warrens to be effective and safe. Evidence of active warrens may include fresh rabbit droppings, tracks, mounds, or diggings.
- If it is suspected that native wildlife are using the warren, their presence can be determined by using sand pads - a 1 m<sup>2</sup> area of raked earth or sand outside of the warren entrance - to detect and identify footprints.
- The density of rabbits on the site should be estimated using spotlight counts and warren monitoring. The location and numbers of rabbits on neighbouring properties should also be approximated.
- Contact your vertebrate pest control local authority for more information and advice on site assessment and monitoring of rabbit numbers.

#### *Fumigation procedure*

***Always read the product label for specific directions on use.***

***Do not carry fumigants inside an enclosed vehicle, especially after the seals on the containers have been broken.***

- Fumigate when the weather is hot to ensure most rabbits are underground and the survival of rabbits above ground is low. Rabbits can be driven underground before fumigation by making loud noises or using dogs to work the area, chasing the rabbits into the warrens.
- Dig back the opening of the burrow so there is a 30 cm lip between the surface and the burrow. This exposes any branching tunnels and provides a solid shelf against which to back-fill soil.
- Place two aluminium phosphide tablets at least 60 cm into the burrow. Wrap the tablets in damp newspaper or paper towel to start the release of gas. To facilitate the easy placement of the tablet into the hole, a length of wire or piece of polythene pipe containing a push-rod can be used.
- The hole should then be filled, digging back the sides of the entrance and tamping down the soil. The ground should end up relatively flat to discourage opening up from the outside.
- The entire procedure, with two tablets and backfilling, should be repeated for each hole. Always work toward the windward side of the warren.
- It is essential that all entrances to the warren are sealed. Check under nearby scrub and fallen timber for any missed burrows.
- Complete decomposition of the tablets may take up to 72 hours if the humidity in the warren is low.
- Check for re-openings around one week after fumigating and treat again as necessary.

#### Assessing effectiveness

- The effectiveness of a fumigation operation should be monitored by recording the number of burrow entrances treated and then recording the number of re-opened entrances that need re-treated at subsequent visits. A follow-up visit and re-treatment should not be performed until at least 48 hours after the previous treatment. Repeat the procedure until no new burrows are found.

#### Procedural notes

- More detailed information on diffusion fumigation using phosphine can be found on approved labels, from various state guidelines (eg vertebrate pest control manuals, Landcare Notes, Farmnotes etc) and relevant federal, state and territory legislation.

#### Further information

Contact the relevant federal, state or territory government agency from the following list of websites:

- Australian Department of the Environment and Energy  
<http://www.environment.gov.au/>
- Australian Department of Agriculture and Water Resources  
<http://www.agriculture.gov.au/>
- ACT Transport Canberra and City Services  
<http://www.tccs.act.gov.au/city-living>
- NSW Department of Primary Industries  
<http://www.dpi.nsw.gov.au>
- NT Department of Land Resource Management  
<https://landresources.nt.gov.au/>
- QLD Department of Agriculture and Fisheries  
<https://www.daf.qld.gov.au/>
- SA Department of Primary Industries and Regions  
<http://www.pir.sa.gov.au/biosecurity>
- TAS Department of Primary Industries, Parks, Water and Environment  
<http://dpiw.tas.gov.au/>
- VIC Department of Economic Development, Jobs, Transport and Resources  
<http://economicdevelopment.vic.gov.au/>
- WA Department of Agriculture and Food  
<https://www.agric.wa.gov.au/>

Also refer to:

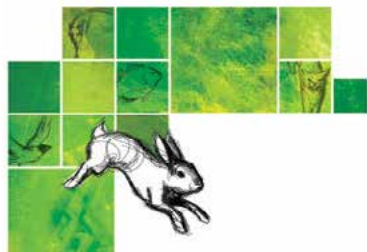
The Centre for Invasive Species Solutions

<https://invasives.com.au/>

or <http://www.pestsmart.org.au>



Image: Tarnya Cox



## RAB005: Diffusion fumigation of rabbit warrens

Table 1: Relevant federal, state and territory legislation for the use of pindone

State/territory	Legislation
Federal	<u>Environment Protection and Biodiversity Conservation Act 1999</u> Information available from the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) website: <a href="http://www.environment.gov.au/epbc/">http://www.environment.gov.au/epbc/</a>
New South Wales	<u>Pesticides Act 1999</u>
Queensland	<u>Health (Drugs and Poisons) Regulations 1996</u>
Australian Capital Territory	<u>Environment Protection Act 1997</u>
Northern Territory	<u>Poison and Dangerous Drugs Act 1999</u> <u>Territory Parks and Wildlife Conservation Act 1998</u>
Tasmania	<u>Poisons Act 1971</u> <u>Agricultural and Veterinary Chemicals (Control of Use) Act 1995</u>
South Australia	<u>Controlled Substances Act 1984</u> <u>Controlled Substances (Poison) Regulations 2011</u>
Victoria	<u>Agricultural and Veterinary Chemical (Control of Use) Act 1992</u>
Western Australia	<u>Poisons Act 1964</u> <u>Poisons Regulations 1965</u>

### References

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- Lowe T and Twigg L (2007). *Fumigation for Rabbit Control*. Farmnote 279. Department of Agriculture and Food, Western Australia.
- Department of Primary Industries, Water and Environment (2003). *Rabbit Control - Fumigation*. Agdex 671, Number 236. Department of Primary Industries, Water and Environment, Tasmania.
- NSW Department of Primary Industries (2012). *Vertebrate Pest Control Manual*. NSW Department of Primary Industries, Orange, NSW.
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- Coman B (1994). *District Rabbit Control: A Guide for Co-ordinators and Leaders*. Landcare Australia and Bureau of Rural Sciences.
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- Gigliotti F, Marks CA and Busana F (2009). Performance and humaneness of chloropicrin, phosphine and carbon monoxide as rabbit-warren fumigants. *Wildlife Research* 36:333-341.
- Marks CA (1996). Research directions for humane burrow fumigation and 1080 predator baiting. In: Fisher PM and Marks CA (Eds). *Humaneness and Vertebrate Pest Control*. Ropet Printing, Tynong North. Pp 50-57.
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## Appendix 11 Chemical handling qualifications required for rabbit control

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### To operate a Rodenator for warren destruction:

- No licence requirements for handling LPG or oxygen
- Accreditation AHCMON 305 – Operate Specialist Machinery

### To use 1080 poison for baiting activities:

- AQF3 Chemical Accreditation course (also known as “Chemical Handling Certificate” or “Chemical ticket”) but 1080 training is minimal (<https://www.chemcert.com.au/new-south-wales-legislation>)
- You must read the [Pesticide Control \(1080 Bait Products\) Order 2017](https://www.epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/pesticide-control-orders/guidance-for-using-1080), including the relevant schedule for the pest animal you need to control (<https://www.epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/pesticide-control-orders/guidance-for-using-1080>)
- Read the pesticide factsheet on vertebrate baiting <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/pesticides/pesticide-factsheets-vetebrate-baiting-160656.pdf?la=en&hash=D8C0152F7D38EF954B210CF0EBA289795F8F1492>

### To use phosphine tablets for fumigation activities:

- No restriction in NSW on purchase of aluminium phosphide tablets
- Contact Western Local Land Services for access to training opportunities in warren fumigation.





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[www.ils.nsw.gov.au](http://www.ils.nsw.gov.au)