Context Pest Control Scenarios

D. **An Alternative Option to 1080**

In order to complete a risk/cost benefit analysis of the use of 1080, a future with 1080 and a future without 1080 must be clearly described so that the relative benefits and costs of each scenario can be compared. Section B has described the suite of pest control methods currently in use for vertebrate pests, of which 1080 is an important component. If 1080 was no longer available pest control would most likely have to rely on a mix of traps and alternative toxins, with cyanide the most likely to be widely used.In other words, the alternative option would be a combination of a non-poison and a poison method.There would be no aerial control operations on mainland New Zealand. It should be noted that in some areas the terrain or dense nature of the bush would dictate that without aerial application of 1080 no control at all would be possible – for either Tb eradication or conservation purposes.

The mix of traps and cyanide is proposed as a most likely alternative option for comparative purposes for the following reasons:

- There is a range of traps commercially available now that are effective as leg-hold or kill traps and could probably be used more extensively than at present.
- Traps are acceptable to most of the public and eliminate the secondary poisoning risks associated with most poisons, especially for farm animals and dogs. A range of ground-feeding native birds, including kiwi species and weka, would be at increased risk however. Traps could be used more extensively around farm margins.
- Leaving aside the much higher costs of ground control, the logistics of covering large areas would require that an effective, inexpensive poison was also used as well as traps. Operators can lay cyanide baits over much larger areas than can be covered using traps, which would probably make cyanide the primary control tool for large-scale operations.
- Cyanide has been the poison of choice for commercial operators for decades, is cheaper than other poisons, has low environmental persistence and poses low secondary poisoning risks. (This can be considered as a disadvantage by reducing the by-kill of rodents and mustelids.) The paste formulations can be a risk to kiwi and encapsulated cyanide formulations are hazardous to weka. Cyanide is not used extensively where there are high rat numbers because of rat interference with the baits.
- Cyanide is the only poison that kills possums rapidly and therefore makes carcases available for collecting fur or pelts. It can also be used for Tb survey purposes by leaving carcases available for recovery and inspection.
- Baits based on biotechnology techniques are not yet advanced enough to be considered an option and would not be available for ongoing operations within the next decade.

The likely consequences of using this ‘combined alternative’ if 1080 was not available are explored next. These future scenarios are necessarily based on a number of assumptions derived from the alternative pest control option outlined above. The alternative option has been carefully developed and is considered to be the most realistic option based on criteria of cost, efficiency and effectiveness.

E. **Summary of Pest Control Scenarios**

This section summarises the outcomes of the pest control scenarios should 1080 be available or not available for future use. The supporting arguments are presented in more detail in the following sections: Section F describes the current situation within which agencies are operating; Section G describes the Future With 1080; and Section H describes the Future Without 1080.

E.1 **Current situation**

An examination of the current patterns of 1080 use shows that it is an integral part of pest management, mostly of possums, undertaken by all agencies, but especially by AHB and DOC. There are distinct differences in relative use of 1080 by the agencies and in the amounts they apply each year. While the AHB uses the most 1080, about 900-950 tonnes of 1080 bait/year, this is used on only about 8% of the total area treated in annual AHB operations. Nonetheless, the 1080 bait applied by AHB (99% from the air) is used to control possums over some 400,000 ha per annum, which is double the area treated annually by DOC and regional councils combined from the air (about 190,000 ha).

The AHB uses 1080 for a specific and crucial purpose in its overall Tb control strategy. Reducing and eliminating Tb in wild animal populations requires that infected possum populations in forested areas that are often remote from infected cattle and deer herds are:

- uniformly reduced to low densities
- over very large areas within a short time, and
- effectively reduced for extended periods of time.

Only if these conditions are achieved are Tb rates likely to decline since they eliminate and then suppress high density 'population pockets'– the necessary condition that enables possums to act as a *maintenance host* of Tb (Tb survives without re-infection from any other source). As long as Tb has an active maintenance host, independent of cattle or deer herds, it will survive in New Zealand. While the AHB can use traps, cyanide and other poisons over the much larger areas it treats around infected herds and on forest margins, it can only achieve rapid, uniform and sustained reductions of possums in remote and rugged forested areas by aerial 1080 operations. Often these areas cannot be treated from the ground given their difficult or impassable nature. The 8% of AHB's total operational area treated with aerial 1080 therefore represents a key element in the AHB strategy for reducing and containing Tb in wild animal populations, specifically by sustaining (for a minimum of 5 years) the low density conditions that prevent possums from acting as maintenance hosts. In addition, 'containment' is central to current AHB initiatives to keep Tb infections from spreading through wildlife into new areas, such as East Cape and eastern Bay of Plenty.

The current DOC use of 1080 has a wider focus than that of AHB. Like regional councils, DOC has statutory responsibilities for conserving biodiversity values (at genetic, species and ecosystem levels) throughout much of New Zealand. 1080 is used in targeted priority areas where it is the cheapest, most effective and often the only practical tool for controlling pests, particularly possums. A major use of 1080 by DOC and regional councils continues to be for the protection of high value forest ecosystems by reducing possum browse pressure and aiding the retention or recovery of forest canopy. Large areas of these forests are able to be treated by air, whereas ground control would be several times more expensive per

hectare, or not possible because of terrain difficulties. Although the area treated annually by DOC using 1080 is about 133,000 ha, representing half the total area DOC treats each year, this under-estimates the overall role of 1080 in DOC's approach to pest control. A much larger area is under sustained management on a rotational basis. DOC now has about one million hectares under sustained management, about 25% of which is actively managed each year. In this longer-term context DOC relies on 1080 for treating 80% of the one million hectares, compared with its 50% contribution to the annual control effort. This difference is due to the longer control cycle (4-6 years) that is possible with aerial 1080 operations compared with more frequent treatments using traps and poisons. By the same argument, AHB and regional councils also have larger areas under sustained management (AUSM) than they treat annually and 1080 plays a similarly more influential role in the longer term. For AHB, its AUSM area is over eight million ha, and for the regional councils about two million ha.

But in addition to killing possums, aerial 1080 operations also have an additional positive outcome for conservation which is not achieved by ground pest control methods. Aerial operations can produce a high by-kill of rodents (particularly ship rats) and mustelids (mostly stoats), both significant predators of native birds, reptiles and invertebrates. If timed correctly, aerial 1080 operations provide a respite from these predators (as well as from possum predation on eggs and chicks) during the breeding season. Threatened species that benefit include kiwi species, kaka, kokako, kakariki, mohua and *Powelliphanta* (land snails). Aerial 1080 operations have also been used at the initial stages of establishing "mainland islands" where subsequent ground control is able to keep pest numbers at low enough numbers to enable birds and other species to recover and build up population numbers. Other important uses of 1080 are for wallaby, rabbit and hare control, protecting plantation forests, and for pest control on private and Maori land. 1080 was the major tool for rabbit control before Rabbit Haemorrhagic Disease (RHD) decimated rabbit populations. But as rabbit resistance to RHD grows, 1080 has re-emerged as the only practical rabbit control method on large scale operations.

With steady improvements in baits and in delivery, the amount of bait spread during aerial operations is now between 2-5 kg per hectare, the average being between 2-3 kg. This amount of bait, at a typical concentration of 0.15% of active 1080 ingredient (1.5 g/kg), contains about 4.5 g of 1080 – the equivalent of spreading about a teaspoon of 1080 over a hectare.

E.2 **Outcomes for Tb control**

The AHB has the single objective of achieving "Official Freedom" from bovine tuberculosis. For the national effort to control Tb in cattle and deer herds the differences between the future outcomes with or without the use of 1080 are clear and stark, as will be the different likelihoods of achieving AHB's objective.

WITH 1080 use there is a high probability that current successes at reducing herd infection rates and eliminating Tb from wild animal populations will continue. With 1080 use, epidemiological modelling predicts the following outcome (Figure 1). By 2015, the current vector risk areas will have been substantially reduced throughout the North Island and in Otago and Southland. Important, but smaller infection areas will remain in the West Coast, around Kahurangi National Park and in Nelson/Marlborough. As of April 2006, there were a total of 190 deer and cattle herds infected with Tb in New Zealand, with the West Coast, Canterbury and Otago suffering the largest number of Tb infected herds. Two regions are

presently considered to be Tb-free. By 2015, with 1080, AHB predicts there will be a drop to a total of 59 Tb infected cattle and deer herds. Four regions should have no infected herds while the remaining regions should have much reduced numbers of infected herds compared with the present. In some regions the capacity to finally eradicate Tb from residual pockets of infected wildlife should then be feasible.

WITHOUT 1080, the likely outcomes for Tb control by 2015 are shown in Figure 2**.** The likely outcome is for an *increase* from the April 2006 total of 190 infected herds to 239 Tb-infected herds. Three regions should have no infected herds, but the number of infected herds will have increased in all other regions. The present containment in the North Island is predicted to have failed and infected possum populations will have spread out from the central North Island to infect wildlife, as well as deer and cattle herds, in East Cape and eastern Bay of Plenty. While Tb-infected possum populations should still show further reductions in Otago and Southland, there will be little or no gains in the rest of the South Island without 1080. The proportion of possum populations infected with Tb will increase markedly in Kahurangi National Park/Nelson and the West Coast, and will also increase in Marlborough.

The inability to effectively reduce possum populations from the air in forested areas will have set back current gains. This would be despite a *rise* in the annual expenditure for TB-vector control should there be no further use of 1080. Also, despite the rise in expenditure, there would be about an 8% decline in the areas under active control by AHB using ground methods only compared with the current situation. These crucial differences reflect the central role of aerial 1080 operations in enabling possums and other wildlife vectors to be controlled – efficiently, effectively, quickly and uniformly – over large areas, regardless of terrain. Ground trapping is much less effective at eradicating the small Tb foci that are more likely to succumb to large (10,000+ ha) aerial operations. As described earlier in this summary, a future without 1080 is most likely to create the situation where possums continue to act as a maintenance host of Tb. Hence Tb is sustained in wild animal populations, regardless of any on-farm controls and controls over herd movements, and possums can provide an ongoing source of infection for cattle and deer herds.

Figure 1 | **Areas forecast to be occupied by Tb-infected wildlife WITH continued 1080 use**

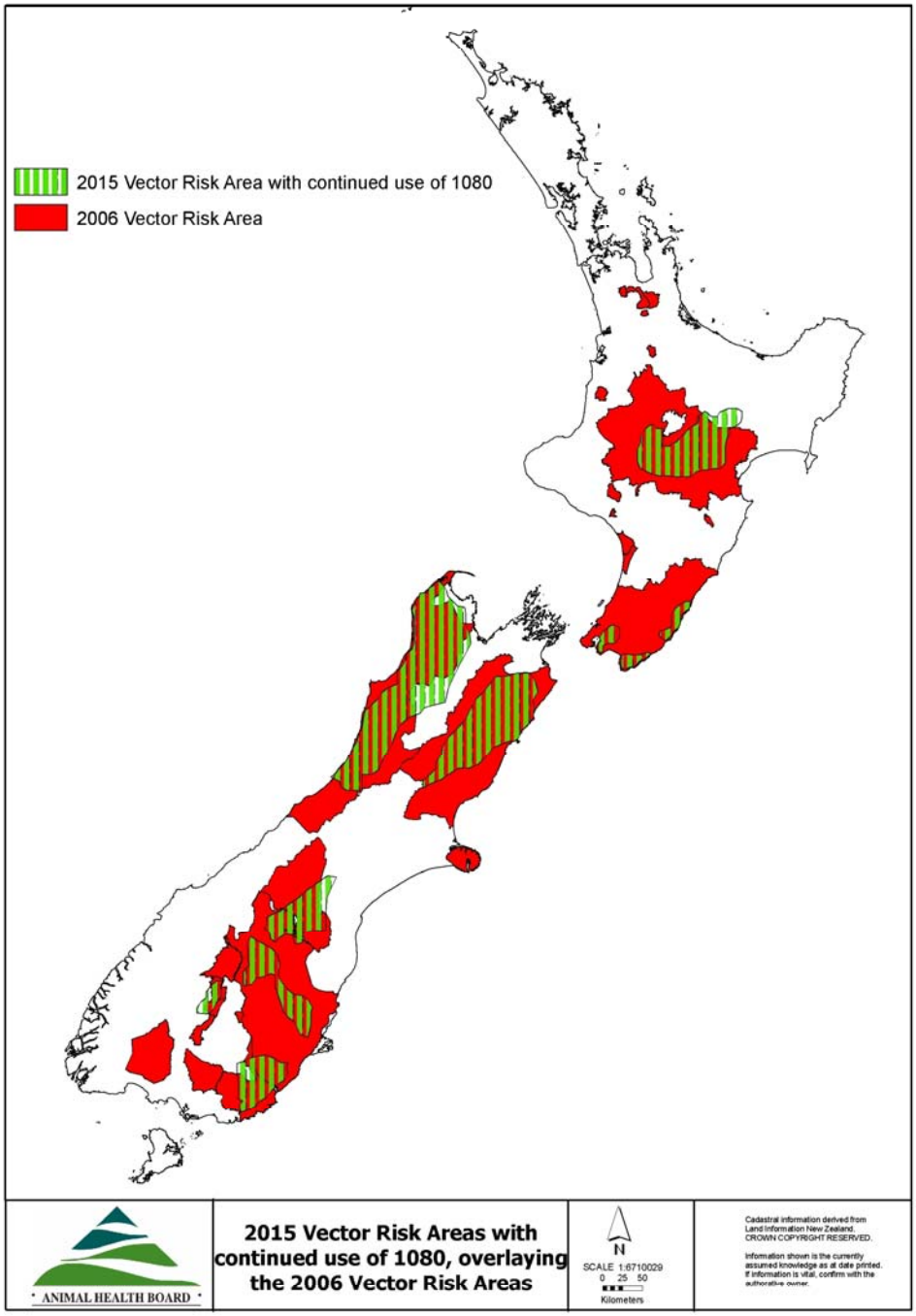
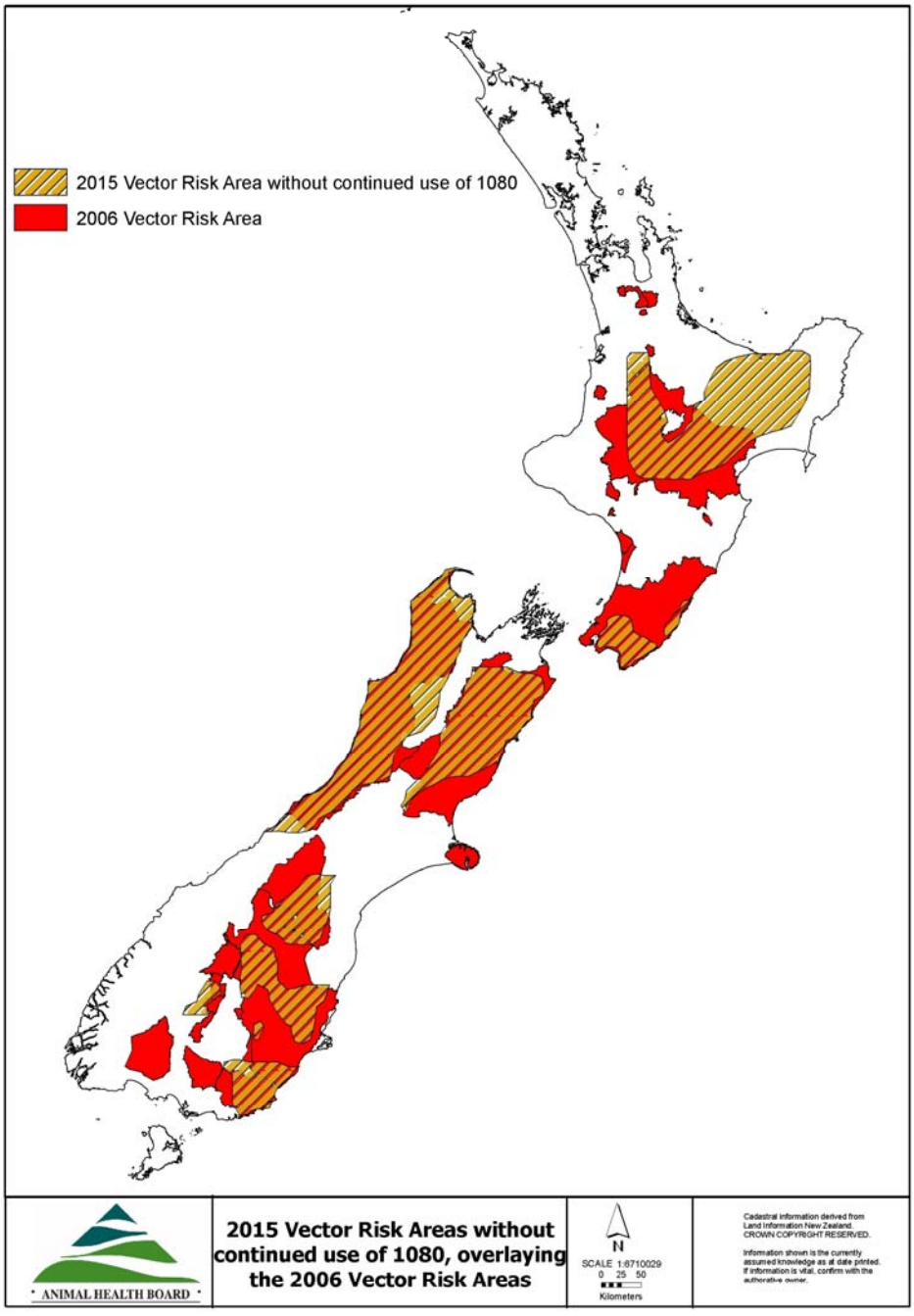
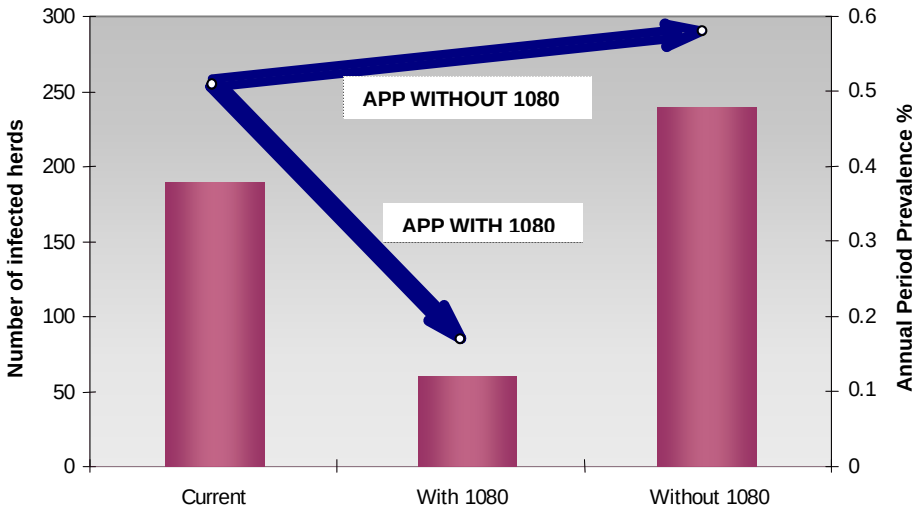


Figure 2 | **Areas forecast to be occupied by Tb-infected wildlife WITHOUT further use of 1080**



How would these two different outcomes affect the objective of achieving “Official Freedom” from bovine Tb? The established international benchmark for a country to be considered free of Tb is called the Annual Period Prevalence (APP), a measure of the occurrence of Tb expressed as a percentage of total herd number (see Glossary, Section 6.2 for a full explanation of the APP). A figure of 0.2% APP is the international benchmark for a country to be recognised as officially free of bovine Tb, providing this level (or below) is maintained for 3 years. In April 2006, the APP value for New Zealand was 0.51%. Based on AHB modelling, the two outcomes for the APP, with and without 1080 use, are shown in Figure 3.

Figure 3 | **Summary of Tb scenario outcomes for 2015**



WITH 1080 use, and based on an estimated total of 75,000 herds, the APP is predicted to fall from 0.51% to 0.17% by 2015. This would meet the target of the National Possum Management Strategy and would enable New Zealand to be officially recognised as free of bovine Tb – as long as it was kept below the 0.2% figure for 3 consecutive years. This would have been achieved with *decreasing* expenditure for Tb eradication from wildlife populations.

WITHOUT ongoing use of 1080 the current situation will deteriorate and the APP is predicted to rise from 0.51% to 0.58%. New Zealand would be further away from achieving the international benchmark of 0.20% than it is at present and is most unlikely to achieve the target in the foreseeable future. This would be despite *rises* in costs of control as ground control efforts endeavour to keep infection rates from rising in forested populations. Instead of aerial control reducing possum numbers in inaccessible forests, the management strategy will have switched to creating and maintaining buffer zones along the margins of these forests to try and keep infected possums away from farm edges.

WITHOUT 1080, New Zealand will be faced with the need to control possums for Tb purposes alone on up to five million ha/year for as far into the future as we can see.

Alternatively, by retaining the use of 1080 the total area that will need to be targeted for ongoing Tb control will steadily reduce, possibly to less than one million ha/year after 2020. There are significant cost differences attached to these two scenarios. WITH 1080 use, costs will be declining by 2015 as infection rates drop and as the campaign strategy moves towards possible eradication of Tb in wildlife in remaining infected areas. WITHOUT 1080, costs will continue to rise into the future, along with infection rates, until an alternative control methodology is developed which can provide the benefits currently available from 1080. The estimated cost differences between the two scenarios by 2020 could be $40M per year and likely to continue for an indefinite period.

E.3 Outcomes for conservation

Conservation outcomes are more difficult to summarise, given the multiple uses of 1080 by DOC and regional councils to help with meeting a wide range of conservation and natural heritage objectives. The timeframes over which effects become apparent are also more complicated when compared to monitoring changes in Tb rates. For example, some forest ecosystems may not show the consequences of possum control for many years, whereas the by-kill of predators may benefit bird populations during the next breeding season.

WITH ongoing 1080 use DOC and regional councils expect to be able to maintain and expand their many programmes aimed at sustaining indigenous biodiversity. Priority forest ecosystems covering about one million hectares will continue to be treated by DOC on a sustainable basis, mostly by aerial 1080 operations. These areas represent that fraction of the DOC-managed lands where habitat protection is targeted to meet objectives in the New Zealand Biodiversity Strategy. Possum damage in these areas is having negative effects on biodiversity values, such as increasing the risk of canopy collapse and further losses of threatened species, both plant and animal. The locations of the one million ha under sustainable management by DOC are shown in Figure 4. They are widely dispersed throughout New Zealand and some overlap with areas of Tb-infected wildlife (compare Figure 1 and Figure 4). These overlap regions in the central North Island, Wellington and Nelson/ Marlborough are the areas where AHB operations, combined with DOC or regional council operations, can provide additional key gains for conservation (Section F.7).

While habitat protection is one of the major, nationally important uses of aerial 1080 operations, another nationally important use of 1080 is for the by-kill of predators – mostly ship rats and stoats. It has become increasingly apparent that if aerial 1080 operations occur at the right time of the year and by-kill rates are high, then forest birds that breed in the spring and summer benefit from the reduced numbers of predators.Since possums also feed on birds (as well as on *Powelliphanta* snails and many invertebrates), possum control at these times also provides a window of opportunity to increase nesting success. Research is underway to improve the effectiveness of rat by-kill from aerial operations.

The early indications are that improvements in application methods will increase the reliability and effectiveness rat control. Research results for some bird species and partial studies on others indicate that the species in Table 1 benefit from well-timed, successful aerial 1080 operations.

Figure 4 | **DOC areas under sustained management for possums**

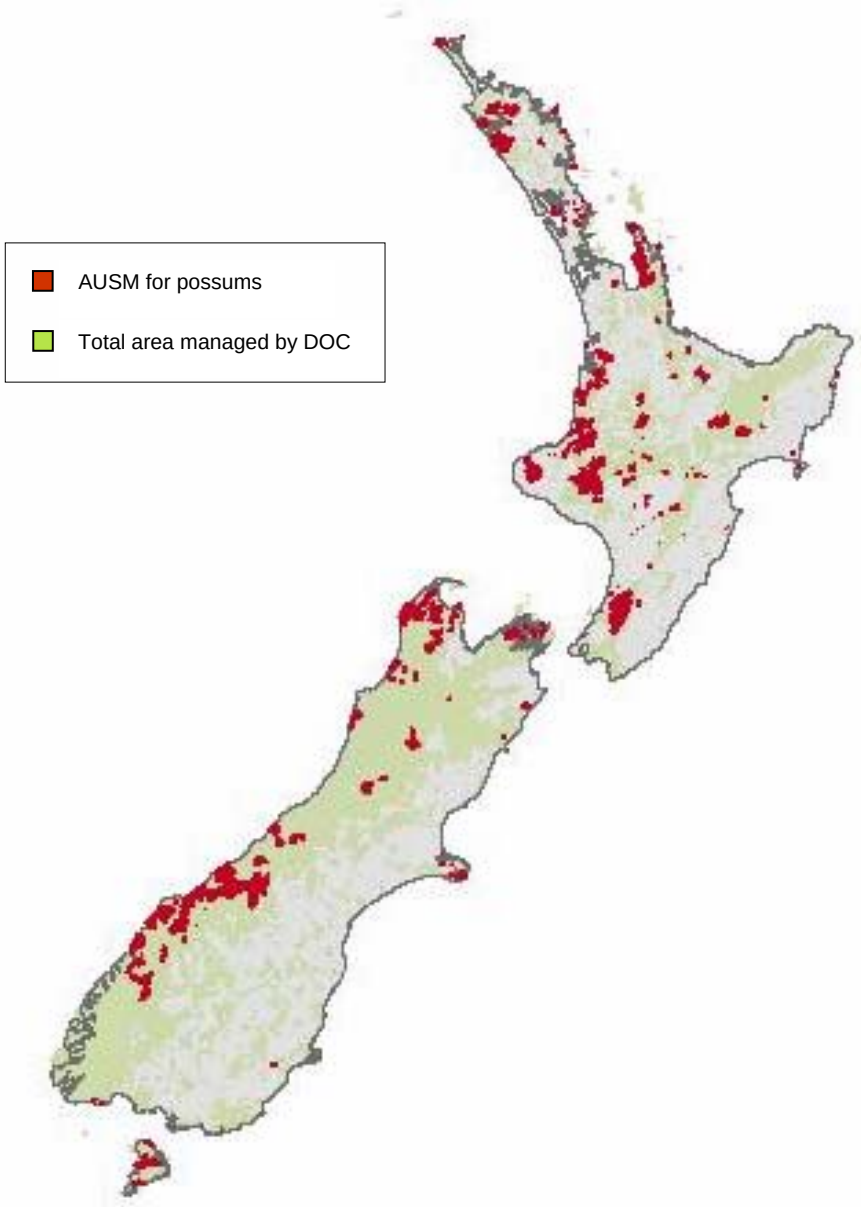


Table 1 | **Forest birds known or expected to benefit from aerial 1080 operations**

Acutely threatened species	**Not threatened, but benefit from predator control**
Kokako	Tui
North Island kaka	Bellbird
South Island kaka	Fantail
Rowi (Okarito brown kiwi)	Whitehead
Mohua (yellowhead)	North Island robin
Kakariki (orange-fronted parakeet)	Tomtit
Chronically threatened species	
North Island brown kiwi	
South Island brown kiwi	
Great spotted kiwi	
Kereru/kukepa (pigeon)	

Access to 1080 will enable DOC to use aerial 1080 operations to suppress predator numbers, via by-kill, in high 'mast years' of beech seeding. In mast years rodent numbers increase dramatically, followed by increases in predator numbers which, in turn, can threaten species such as mohua. 1080 provides the ability to cover the large areas involved quickly and effectively via aerial operations, something that is not possible from the ground.

Other pests such as wallabies would continue to be targeted by DOC and councils using 1080 and their numbers should be significantly reduced in vulnerable habitats over the next decade. Rabbits would continue to be controlled using 1080, which becomes an increasingly important consideration as the resistance of rabbits to RHD grows.Conservation outcomes will also benefit from the synergies that are currently possible from all agencies combining operations that reduce Tb levels while benefiting biodiversity (see Section F.7). This is possible in many areas where extensive forests meet farmland, such as the boundaries around Kahurangi National Park and Tongariro National Park. These operations involve a mix of aerial 1080 and ground operations.They are often timed to also reduce other pests (rats and mustelids) to assist birds during their breeding season as well as reducing possum numbers over forests and farmland.

WITHOUT the use of 1080, the capacity for protecting conservation values into the future will be severely reduced. Even if current resources were increased to compensate for the much higher costs of ground control over aerial (which can be up to seven-times higher), about half of the one million hectares currently under sustained management by DOC, mostly for possum control, would not be able to be treated. This area is that portion of the total DOC-managed lands that have already been identified as priority areas warranting protection for their biodiversity values. Half a million hectares is a sizable area. It would represent the combined area of the following, largely forested, national parks – Egmont, Whanganui, Te Uruwera, Abel Tasman, Westland and Paparoa.

Some of the forests that currently are included in DOC's one million ha for sustained control would be highly likely to face cuts to their current possum control programmes. The areas where those reductions would occur would be selected on the basis of a complex set of priorities. However it is likely that reductions would affect areas where broad-scale landscape features such as canopy density, extensive mistletoe and other possum-preferred

species populations or general forest health values are protected at present. It is also likely that reductions would apply to remote and rugged areas where the cost of alternative treatments would be prohibitive or too difficult. Such potentially non-treatable areas are located in:

- parts of Wanganui National Park
- the eastern Taranaki hill country and parts of Egmont National Park
- parts of Tararua Forest Park
- some of the Coromandel peninsular
- parts of Kahurangi National Park
- large areas of northern and central Westland
- the Cascade area of South Westland
- the Pembroke mountains, Arthur and Eglington regions in Fiordland National Park.

Without 1080, the birds listed in Table 1 could only be treated by ground control at a local-level scale. Cyanide and traps for possum control would not provide by-kill of rat or stoat numbers. Only priority populations would be targeted for the more expensive ground control operations and the option of providing widespread benefits for a wide range of important species (including invertebrates) over large areas would effectively disappear. The potential to slow or reverse the current contractions in the populations of kiwi species over important areas of their range would be reduced or removed. It is important to stress that only aerially-delivered 1080 provides a toxic bait to virtually all possums. For ground control operators to be as effective would mean they needed to set traps or lay cyanide baits on a 50 x 50 metre grid. This is rarely possible. Re-invasion of possums (as well as rats and stoats) from these patchily treated areas then reduces the effectiveness of the control which has to be repeated more frequently – whether for Tb or conservation purposes.

To summarise, the likely outcomes for conservation WITHOUT 1080 use would therefore include:

- Progressive loss of some forest canopies with increased mortality rates for forest trees leading to ‘patchy’ forests.
- Little possibility of controlling predators such as rats and stoats through by-kill methods. This would place severe pressures to develop other methods for predator control, without which there are several bird species whose ranges will contract and local extinction rates would be likely to rise. This includes kiwi species, kaka, kokako and probably kereru/kukupa.
- Inability to control predators during ‘mast years’ of beech seeding, currently done via aerial 1080 operations. The outcome is most likely to be further decline and possible extinction of mohua (yellowhead) and kakariki (orange-fronted parakeet).
- Current efforts to provide gains for other bird species such as tomtit, whitehead and kereru though 1080 operations would not be realised.
- Control of wallabies in key habitats (central North Island and Canterbury) would be more difficult and current control objectives are unlikely to be realised. Expansion of wallaby

populations into new areas would be likely with damage to agricultural lands and native habitats.

- Rabbit numbers, which are already rising in Otago as populations become resistant to RHD, will increase and may well become a major threat again to inland South Island regions as 1080 is the only practical control technique for large-scale operations.
- There is likely to be a consequential decline in the ecosystem services provided by areas that are no longer under sustained management.
- The synergistic benefits of combined Tb and conservation operations would be much less likely, or impossible to achieve.

In short, the ability of management agencies to meet several key targets in the New Zealand Biodiversity Strategy would be severely compromised. Current gains may well lose ground for both valued species and ecosystems.

F. **Current Situation**

This section describes how AHB, DOC and regional councils currently use 1080. The relative importance of 1080 for annual control operations and longer term objectives covering areas under sustained management are discussed. It will also explain how, despite their different objectives, the agencies sometimes combine their 1080 operations to achieve additional gains for conservation and control of Tb vectors. This section sets a baseline against which future scenarios, with and without 1080 use, can be compared, in Sections G and H.

F.1 **Current patterns of 1080 use**

All agencies use 1080 for pest control, mostly against possums, but its use by each agency varies markedly, relative to other methods. This reflects differences in objectives and in circumstances where 1080 is used.

- AHB uses 1080 exclusively for possum control. Regional councils and DOC use 1080 principally for controlling possums, although by-kill can also be very important with respect to rat and stoat control. 1080 also plays an important role in controlling other pests, such as rabbits, wallabies and even feral cats (see the case study on Southern NZ Dotterel, Section I).
- The average amounts of 1080 bait used per year are as follows[1]:
  - between 900-950 tonnes in AHB operations
  - approximately 430 tonnes in DOC operations

[1] These figures are averaged over the last 3 years from Animal Control Products information.

  - an estimated 50-100 tonnes in regional council operations.

- The active 1080 ingredient usually makes up 0.15% of this total weight of bait. Hence the amount of active ingredient currently used per year is about 2,140 kilograms for all agencies combined.
- Current efficiencies in aerial 1080 operations mean that the amount of 1080 active ingredient used to treat the total 1080 areas (Table 1) by air or ground averages out at 3.5 grams of 1080 active ingredient per hectare – approximately half a teaspoonful.
- Most 1080 is used in aerial operations. The proportions vary by agency, but aerial application is by far the most important method.
- The total land area under active control for possums in any one year varies between and within agencies, as does the relative use of different methods (refer Table 2).
- The relative importance of 1080 is most accurately assessed by looking at the total areas under sustained management, rather than at the areas that are treated with 1080 in the average year (see Section F.4).

F.2 **Pest control strategies**

Animal Health Board

For the AHB the approach to possum control reflects a sequential set of objectives.The first objective is containment, followed by control to reduce the transmission of infection to cattle and deer herds. The final objective is eradication of Tb from wild animal populations. This final objective requires the suppression of vector populations over wide enough areas and for sufficiently long enough time to prevent geographic expansion of wildlife infection and then achieve localised eradication of Tb in wildlife. Vector control at this scale will lead to containment and eventual reduction in the geographic area harbouring wildlife infection. *The final outcome of this strategy will be long-term gains for sustainable disease control.*

This means, primarily, control of possums by a variety of methods and some ferret control, which is mostly by trapping. Control operations need to cover extensive areas of both farmland and adjacent areas that may be harbouring infected wildlife vectors. Past experience and epidemiological studies have shown that these control areas need to be large (10,000 ha or more) to reduce or eradicate Tb in cattle and deer herds. There are three reasons why operations need to be done at this scale. First, it is not economic to try and detect the small areas where Tb-possums actually occur (the Tb foci). Secondly, control over large areas kills infected juvenile possums that can move several kilometres to establish new Tb foci. Third, it minimises the immigration of non-tuberculous juvenile possums into the (unknown) infected area. If these Tb foci are repopulated quickly, then the Tb infection can be maintained.

Areas adjacent to infected herds may include other agricultural lands, private land and DOC-managed lands, which are often forested. In comparison with DOC, control operations are more likely to be over relatively ‘easy country’ where ground control using traps and cyanide is straight-forward and effective. In fact, traps and cyanide are the methods used for possum control on over 80% of the average annual areas treated for the AHB (Table 2). But many areas of AHB operations are not ‘easy’ and ground control is difficult and expensive.

However it is important to stress the strategic benefits which aerial 1080 operations bring to the Tb control programme. Without aerial operations on steep, forested lands bordering

farming country (such as on the West Coast of the South Island, the Tararua Ranges in Wairarapa and the Hauhungaroa Range west of Lake Taupo) ground control efforts alone on adjacent farmland would not be enough to protect herds from infection. Furthermore, aerial 1080 operations are essential to prevent the disease spreading in wildlife through large forested or mountainous areas to areas which are still free of infection. A good example of this is the extensive AHB operations in Whirinaki Forest Park and Te Urewera National Park which are designed to prevent expansion of wildlife infection into East Cape and eastern Bay of Plenty. The extent of the Tb problem in New Zealand is discussed further in Section F.5.

Table 2 | **Current situation – annual area treated by pest control method**

Control method	**Annual treatment area, hectares**		
	DOC	**Regional Councils**	**AHB**
Aerial 1080	127,000 (48.3%)	61,000 (7.6%)	396,000 (7.3%)
Ground 1080	5,800 (2.2%)	25,500 (3.2%)	4,000 (0.1%)
Traps & CN	129,800 (49.3%)	485,500 (60.7%)	4,500,000 (83.3%)
Other poisons	500 (0.2%)	228,000 (28.5%)	500,000 (9.3%)
Total hectares	263, 100	800,000 *	5,400,000
*Note: The regional council areas do not include operations managed by regional councils on behalf of AHB.			

Department of Conservation and regional councils

DOC and regional councils have statutory responsibilities for conserving biodiversity values over much of New Zealand. Consequently they have a mix of management objectives that include – conserving threatened plant and animal species, protecting and restoring forest ecosystems, eradication projects (often on islands) and multiple-pest management initiatives ('mainland islands' and sanctuaries). Where these objectives involve possum control the choices of method and the intensity and periodicity of control reflect the most efficient means of achieving the objectives. For example, DOC treats forest canopies in Whanganui National Park by aerial 1080 operations every 7 years to reduce the impacts of possum browse. By comparison, protecting the threatened plant *Dactylanthus taylorii* requires local ground-control every 2-3 years and keeping possums at low densities (below a Residual Trap Catch Index of 2%).

Regional councils control possums and other pests based on Regional Pest Management Strategies (RPMS –Biosecurity Act 1993) to protect production, water and soil, human health, recreational, Maori, and biodiversity values. DOC also manages for biodiversity values, but with significant differences in the types of areas it manages and the use of methods. Regional councils are generally controlling possums on land that is closer to urban areas and rural settlements, land that is easier to work in and is often more 'patchy' than lands treated by DOC. DOC focus much more on sustaining key forest ecosystems and protecting particular habitats of threatened species. Many of these forests cover large areas, as in national parks, and are often in remote and rugged places. Such places suit aerial 1080 operations, for three reasons:

- cost
- effectiveness

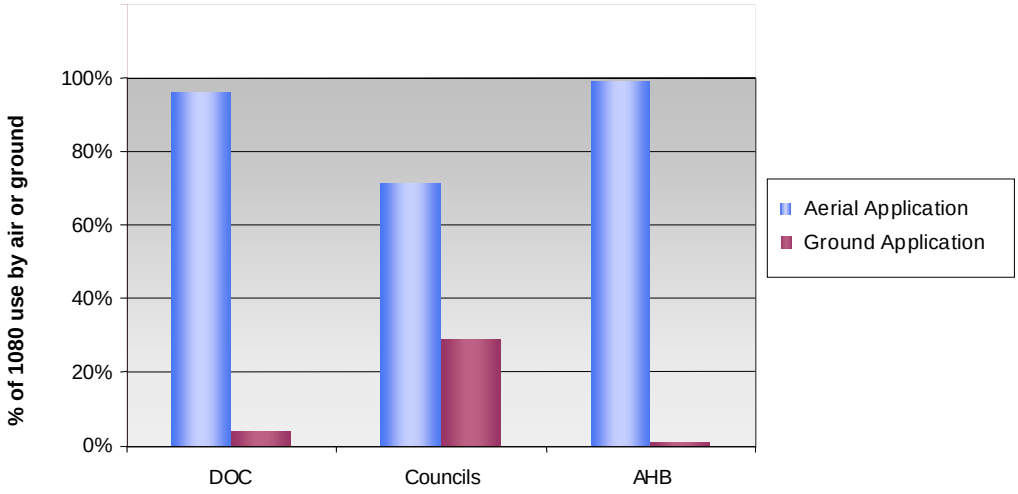
- inability to use ground control in many places.

As a consequence of these inter-agency differences, about half of the area DOC treats annually is by aerial 1080, whereas the use of traps and cyanide dominate regional council operations (about 60% of the area treated annually). Councils use aerial 1080 operations for about 8% of the area they treat annually, a very similar percentage to that for AHB operations.

F.3 Annual use of 1080 and aerial 1080 operations

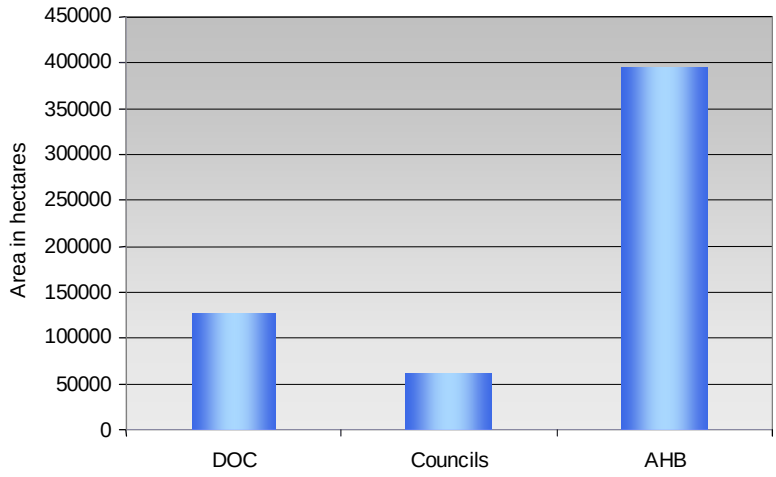
Although the relative use of 1080 varies considerably between agencies (Table 2), most of the 1080 they apply is via aerial operations (Figure 5). The balance is used in ground-control methods.

Figure 5 | **Proportion of 1080 applied by air or ground by different agencies**



Section F.2 described the types of places where 1080 is primarily used – large forested areas where access and terrain make ground control expensive, difficult or impossible. Although the regional councils also use 1080 from the air to treat areas of plantation forestry, private and Maori indigenous forests, most of the areas councils treat from the air are indigenous forests with a range of biodiversity values. Also, the AHB aerial operations are mostly on forest lands or shrublands with Tb-infected wildlife, including large areas managed by DOC. The overall benefits to indigenous biodiversity of 1080 use can therefore be approximated by combining the areas treated using aerial 1080 by the different agencies (Figure 6). (This is not to overlook the 5,800 ha that DOC treats with 1080 on the ground).

Figure 6 | **Approximate areas of forest treated with aerial 1080 by different agencies**



There are three points to be made from Figure 6 in relation to 1080 use. First, a considerable area of indigenous forest ecosystems, probably over 580,000 ha, is being treated annually by all agencies combined through aerial 1080 operations. Secondly, the majority of this total area, some 68%, is treated by AHB to reduce infected possum populations. These operations are providing secondary and even primary benefits for biodiversity protection. Thirdly, while the size of area treated is relevant, so is the *particular value* of the biodiversity being protected – which cannot be shown on a graph. This is where the area of 760,000 ha **under sustained possum management** (see next section) by DOC using aerial 1080 operations is of crucial importance in a national conservation context. DOC's aerial 1080 operations are specifically protecting some of the nation's most threatened species and important indigenous ecosystems. For example, extensive 1080 aerial operations were vital in achieving initial possum knockdowns in successful efforts to reverse the decline of the North Island kokako (see the case study in Section I). Preventing further canopy collapse of native forests in places such as Egmont National Park, Westland and the Coromandel Peninsula are other examples. As is highlighted under "The Future without 1080" (Section H) there are many places where the rugged and inaccessible nature of the country means that if aerial treatment is not available to reduce possum numbers, *there is no treatment at all*. This is a major concern for these high value conservation areas, given that they are often in remote and rugged country where ground control is expensive, difficult, or simply not possible.

F.4 Area Under Sustained Management

Section C described how effective aerial control operations can lengthen the time interval before areas need to be re-visited for possum control, e.g. to 6-7 years. Areas that are ground- treated (with traps, 1080 baits or other poisons) require control at more frequent intervals (1-3 years). The result is that management agencies are managing large total areas for possum control, but only a percentage of the whole area under management will be treated in any one year. Agencies refer to the total area under possum management as the Area Under Sustained Management (AUSM).

The AUSMs for all agencies are shown in Table 3. The current figure for DOC is 1,050,000 ha and has averaged about 993,000 ha over the past 5 years. Of DOC's approximately one

million ha currently under sustained management about 25% is treated each year (Table 2). The regional councils manage possums over 800,000 ha each year, but information is difficult to gather on the total area under sustained possum management. An estimate is that the AUSM by regional councils is about two and half times larger than the area treated annually. This gives an estimated area of two million ha classified as AUSM for possums by regional councils (Table 3). This is roughly double the area managed by DOC for sustained possum management. The largest AUSM is managed by AHB at an average of over eight million ha for the 2003-2006 period.

Table 3 | **Current scenario – estimated areas under sustained management**

Control Method	**Areas under sustained management (AUSM), hectares**		
	DOC	**Regional Councils**	**AHB**
Aerial 1080	760,000 (77%)	242,000 (12%)	1,780,000 (22%)
Ground 1080	35,000 (3%)	101,000 (5%)	5,000 (0.1%)
Traps & CN	192,000 (20%)	1,127,000 (56%)	5,701,000 (70%)
Other	500 (0.1%)	530,000 (27%)	634,000 (8%)
Total, hectares	992,700	2,000,000	8,120,000

Note: For DOC areas treated with 1080, a cycle time of 6 years has been used to estimate the area treated by aerial or ground methodologies in the average year. The estimated annual treatment area using traps and cyanide is the residual area once these 1080 averages have been deducted. A similar approach was used to estimate 1080 areas treated by regional councils using a cycle time of 4 years for 1080-treated areas. AHB figures presume an average cycle time of 4.5 years for aerial operations and 1.5 years for ground-based methods.

Two points emerge from the data on areas under sustained management compared with the annual totals in Table 2. The first point is that the different agencies have different 'multipliers' between their annual and AUSM figures. These are as follows:

- AHB multiplier is 1.5 (the AUSM is one and a half times the area treated annually)
- Regional councils' multiplier is approximately 2.5
- DOC's multiplier is about 3.8

These differences are due to the different relative use of 1080 as a control tool by the agencies or, put another way, the extent to which agencies use traps and cyanide. AHB uses traps and cyanide for over 80% of its operations and these need to be repeated frequently to keep possum densities at low levels. By contrast, 1080 operations are less frequent and therefore larger areas can be managed with longer rotations of control operations.

The second point is that the use of 1080 is more important over the longer-term for the AUSM than is apparent by its use on an annual basis (comparing percentages between Tables 2 and 3). This is most relevant for DOC's use of 1080 since it is the agency with the greatest relative use of 1080. Table 3 shows that DOC is reliant on 1080 to sustainably manage possums over about 80% of the million hectares it manages long-term. On an annual basis, however, 1080 is used for only 50% of the area that is treated. Without 1080, especially aerial 1080 operations, DOC would be severely constrained in the areas it is able

to sustainably manage for possum control. The increased value of 1080 to AHB when looking at its total area under sustained management is also evident. While 1080 is used over about 7% of the area AHB treats annually, it is the method used over 22% of the lands treated by AHB on a sustained basis.

F.5 **Current Tb situation**

The current situation is represented in two maps showing the areas occupied by Tb infected possums, which are classified by AHB as Tb Vector Risk Areas (Figure 7) and the total number of infected cattle and deer herds in each region (Figure 8).

These two figures show that infected cattle and deer herds and infected possums occupy large, but discrete parts of New Zealand. By April 2006, there were 190 herds (153 cattle, 37 deer) classified as Tb infected. The five major Tb areas are the central North Island, Wairarapa, Westland to Tasman, North Canterbury and Otago. These areas are often characterised by farmlands in close proximity to extensive forest-pasture margins. This is most clearly shown by the dairy farms that extend up narrow Westland valleys, hemmed on either side by native forests. Expansion of these major Tb areas in the 1970s and 1980s may have been largely due to the dispersal of infected juvenile possums, assisted by inadequate control measures.

It is likely that infected possum populations currently have 1-5% of individuals infected with Tb. Analysis has shown that as the possum density in a region decreases the first observed change is a reduction in the number of individual tuberculous cattle and deer followed by a reduction in the number of infected herds. Historical information, supported by modelling, indicates there is about a 90% probability of eradicating Tb from the possum population if:

- the possum population can be held at a low density (2% or less of the Residual Trap Catch Index) for a minimum of 5 years, and
- there is no immigration of Tb-infected possums.

The ability of Tb to persist in wildlife vectors until the transmission rates can be reduced and held at low levels for at least 5 years requires vector control to be maintained *even when infection rates are low*. One of the salutary lessons from the easing of Tb control efforts through the 1980s, following initial success in reducing the number of infected cattle herds in the late ‘70s, was that any premature relaxation in the control effort will lead to the spread of Tb through wildlife, a subsequent rise in herd infection rates, and will require a much larger, more expensive control effort many years into the future. The rapid rise in infected herd numbers between 1980 and 1990 when vector control was minimal is shown in Figure 9.

Figure 7 | **Current areas of Tb-infected possums**

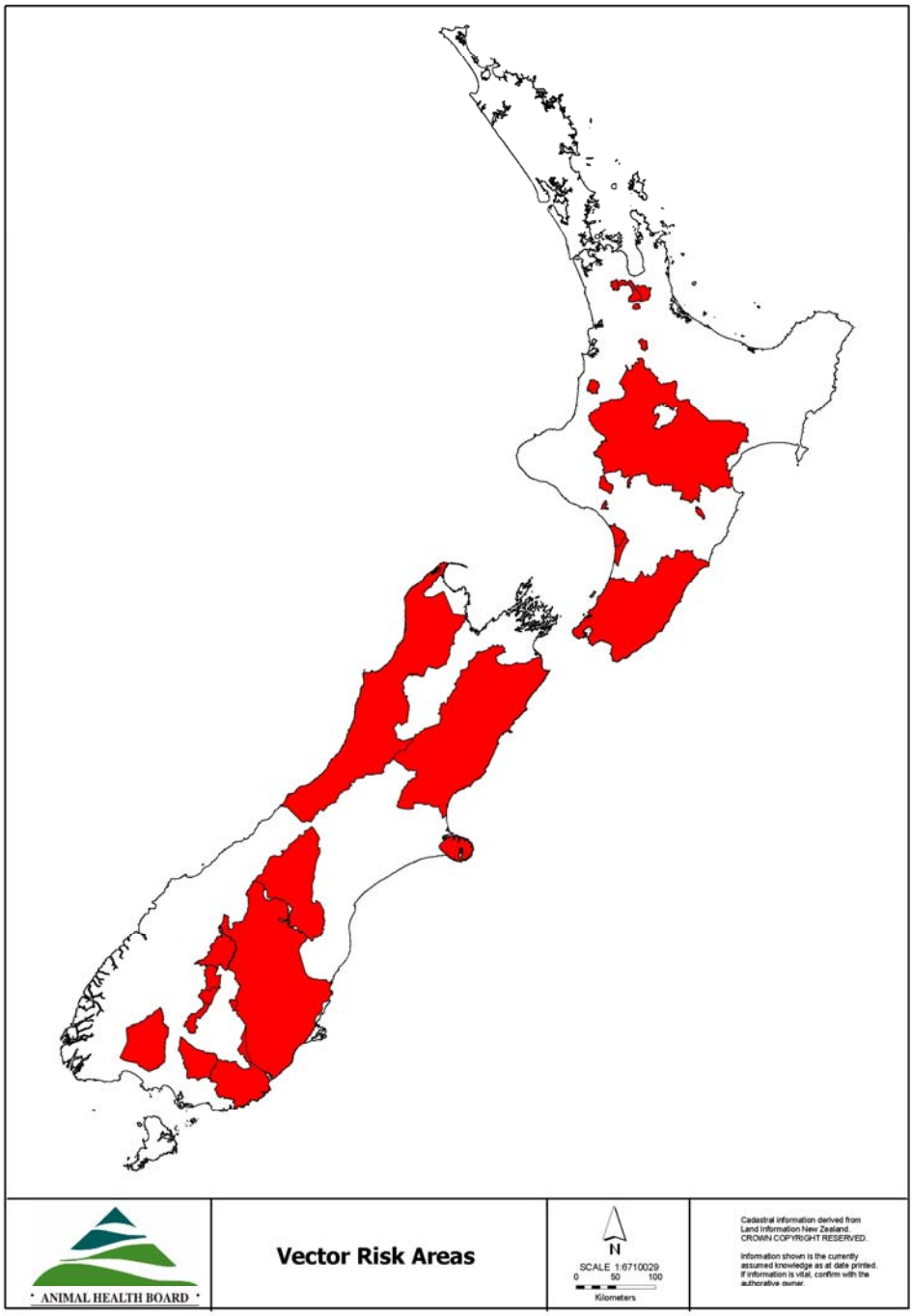


Figure 8 | **Current number of infected herds by region**

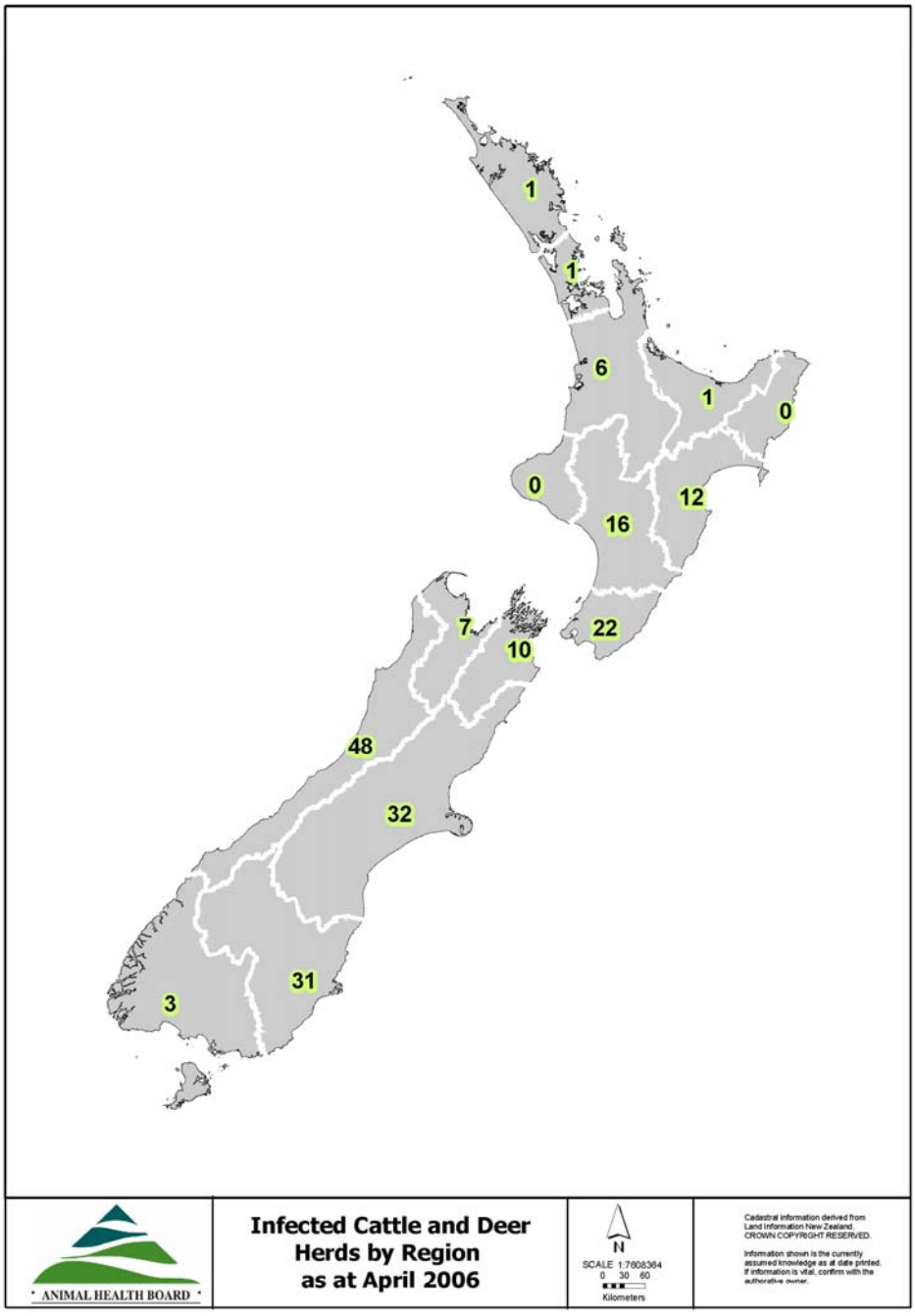
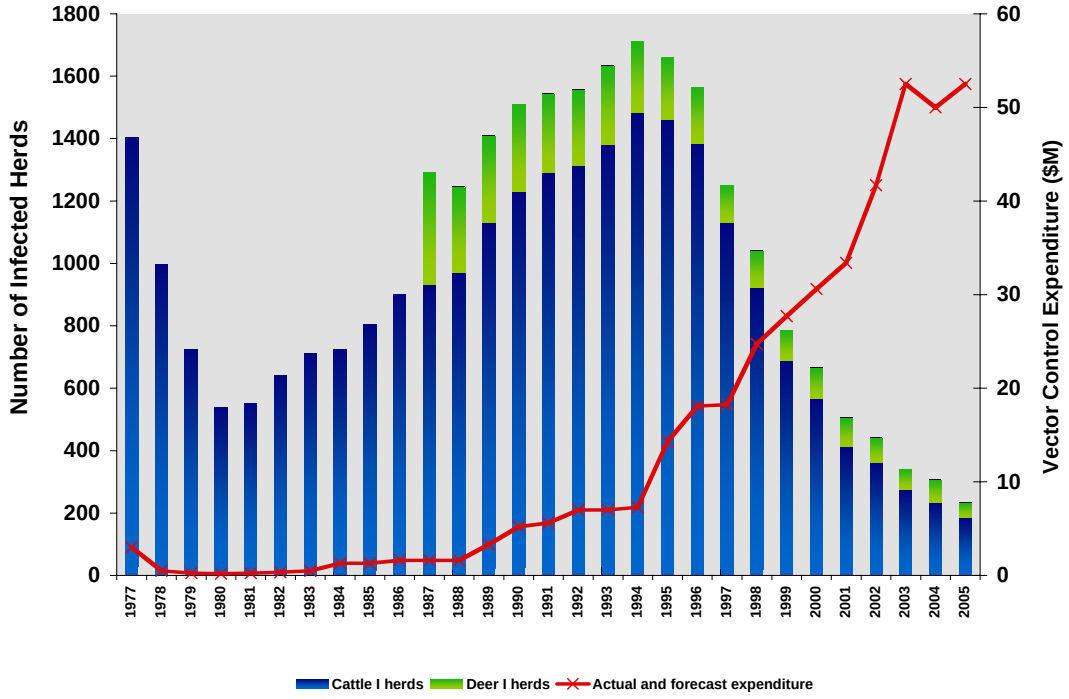


Figure 9 | **Number of Tb-infected cattle and deer herds and expenditure on Tb vector control**



F.6 Current conservation situation

The current conservation situation cannot be easily summarised on a map or in a large spreadsheet. Unlike the single focus goal of the AHB, regional councils and DOC have multiple objectives across marine, freshwater and terrestrial ecosystems to conserve our natural heritage and manage natural resources. Their goals and objectives are contained in numerous statutes and in the New Zealand Biodiversity Strategy (2000). Control of invasive pests is one of the major tasks for these agencies to improve the survival chances of the 400 native plant and animal species currently ranked as being most at risk.

DOC has been successful in controlling or eradicating pests in a number of high value areas such as offshore islands, sanctuaries (as for kiwi) and on 'mainland islands' but these represent less than 3% of the lands administered by DOC. Less intensive control of pests is undertaken on a further 32% of these lands but some 55% of the lands administered by DOC that might benefit from management receive limited management or none at all. Funding limitations, rather than a lack of control techniques, are responsible for the lack of pest management over such large areas. Despite the gains in understanding from research of the ecology and needs of threatened species, there have been no major breakthroughs in new pest control technologies. While similar figures for regional councils are not available, it is unlikely that councils would view their current efforts at biodiversity conservation as meeting all their needs.

In this current situation cost-effective methods and priority-setting for at-risk biodiversity – species, habitats and ecosystems – continue to drive management decisions. While intensive management of species, such as kiwi, has boosted the three North island kiwi

sanctuaries, kiwi ranges and densities are showing disturbing contractions elsewhere. A similar outlook applies for other threatened species, such as mohua (yellowhead) and kakariki (orange fronted parakeet), despite the efforts to control predators. Yet research has shown that where control is undertaken (ground and aerial), species can recover and populations increase. Given the extent of the land area over which DOC and regional councils are responsible for 'turning the tide' on biodiversity loss, the benefits of 1080 as a cost-effective tool for controlling major pests of many threatened indigenous species continue to be substantial.

F.7 **Conservation outcomes achieved collectively by agencies**

Key gains are also achieved for conservation in New Zealand by coordinating operations run by the various agencies – DOC, regional councils and AHB. Although AHB, DOC and regional councils have different objectives and use the various control methods in substantially different proportions, they can and do combine their respective objectives to achieve conservation gains that are greater than the sum of the parts.

Coordinated operations in the Tongariro area

In the Tongariro area the AHB, DOC, Environment Waikato and Horizons regional councils mount combined operations to reduce Tb rates in cattle and deer herds and also to reduce possum numbers in Tongariro National Park and other conservation areas. In this way large contiguous areas are treated (by air and ground methods) at the same time. This improves bird survival and reduces the impact of possum dispersal from untreated areas. The outcomes so far are reductions in Tb, substantial increases in kiwi chick survival and substantial improvements in other native bird populations in this area, such as for robins and tomtits (e.g. at Mt Pihanga, Lake Rotoaira and Lake Rotoponamu).

A southern example of cross-agency cooperation is in North-west Nelson where AHB has carried out extensive Tb control operations along the northern and eastern sides of Kahurangi National Park while DOC has completed a 'ring' of operations over several areas within the Park but close to its boundaries. The combined operations have created a much larger contiguous area of possum control which should benefit both Tb reduction and biodiversity values.

Aerial 1080 operations were crucial components of these combined operations in both regions.

There has been a trend to greater coordination of operations between agencies in recent years. Aerial 1080 operations have not been used systematically to control predators (primarily ship rats and stoats), partly because rat kills from aerial 1080 operations have been variable in the past. Research is currently underway to determine the operational parameters that maximise reductions of these crucial predators via aerial control. Research has shown, however, how devastating this predation pressure is for many bird species. This has increased the pressure to try and time aerial 1080 operations to benefit birds into the next spring/summer breeding season. Since possum also prey on eggs and birds, reducing their numbers also directly benefits populations of forest birds. There may well be increasing benefits to forest birds from these coordinated operations between agencies as research identifies the optimal operational approach.

G. The Future with 1080

In this section we look at the likely futures by 2015 for Tb and conservation outcomes **assuming the ongoing use of 1080, that is, WITH 1080**. First, the assumptions for all agencies under this scenario are given, followed by separate descriptions of what is likely to happen to Tb control efforts and conservation objectives.

G.1 Assumptions

The following assumptions are based on the experience of the various agencies with respect to the control costs and management priorities that are current and as well as projected. They take into account the past difficulties and time lags associated with developing and improving control methods and the extensive research needed to understand environmental effects and improve operational effectiveness.

- Funding for Tb vector control and for DOC possum control is unlikely to increase to any significant extent. Regional councils are more likely to increase their possum control budgets, to improve biodiversity condition, especially if there was a significant scaling back by AHB operations. This would likely be by increased funding from property rating and might face political or public constraints in some regions.
- The costs of aerial 1080 control for all agencies will continue to be cheaper than ground control. Control cost differences per hectare will continue as at present and the same cost multipliers will apply (see box ‘Costs of controlling pests’ in Section C).
- Cost advantages of 1080 for protecting biodiversity values are likely to be an important consideration since 1080 aerial operations also provide important biodiversity benefits through the by-kill of rodents and mustelids.
- As Tb eradication is achieved in certain areas and the control strategy moves to the next phase the use of aerial 1080 will become more important as more difficult country is targeted. Over these large areas ground operations are ‘patchy’ or are not possible due to terrain constraints.
- For DOC, the current strategic mix of operations is likely to continue, but could be affected by changes to the funding priorities for biodiversity protection, natural heritage protection, climate change adaptation and natural hazard responses.
- Aerial 1080 can be used to target rat population irruptions should they occur following “masting” years for fruiting or seeding and threaten species such as mohua.
- For regional councils the strategic mix will be significantly influenced by the rate at which Tb rates decline and the AHB operations are scaled back, although councils are taking on an increasing amount of pest control with respect to protecting natural heritage values.
- The use of 1080 ground control will remain minimal by AHB and DOC as the strategic focus continues to be on the benefits of large-scale operations.
- The use of “other” methods will remain largely unchanged by all agencies.
- Efficiencies and effectiveness of control methods are unlikely to improve significantly during this period.

- 1080 will continue to be an important toxin to retain in the toolbox for wallaby and rabbit control, particularly in areas such as Canterbury and Otago, where resistance levels to RCD in rabbits are already high and are likely to continue rising.

G.2 **Future for Tb control with 1080**

With the continued use of 1080 the next decade is most likely to see further important gains in vector control and reductions in Tb rates. It should be possible during this decade to move to the next phase of the Tb control strategy, the eradication of Tb from wild animal populations. This will involve new initiatives to control wildlife vector populations and eradicate Tb from vector populations at even greater distances from infected cattle and deer herds.

During this time 1080 will have been used in aerial 1080 operations in initiatives to stop Tb from spreading through large areas of contiguous forest which are presently free of infected possums. Consequently, AHB expects the actual areas treated with 1080 to rise significantly which means an increase in its overall reliance on the use of aerial 1080 (Table 4). The annual area treated using aerial 1080 operations is projected to increase two-and-a-half times to almost a million hectares while the area trapped and treated with cyanide would decrease by 300,000 ha as more difficult forested country is increasingly targeted from the air. An important regional objective will be to stop the expansion of wildlife infection into East Cape and eastern Bay of Plenty. A key to this strategy will be aerial 1080 operations, predicted to rise to represent almost 18% of the annual areas treated, up from the current 7%.

Table 4 | **Areas treated annually by AHB for Tb with future use of 1080**

Control method	**Current areas treated annually, ha**	**Future area treated annually, ha**
Aerial 1080	396,000 (7.3%)	996,000 (17.5%)
Ground 1080	4,000 (0.1%)	4,000 (0.1%)
Traps & cyanide	4,500,000 (83.3%)	4,200,000 (73.7%)
Other poisons	500,000 (9.3%)	500,000 (8.7%)
Total	5,400,000	5,700,000

There are projected gains for biodiversity values from these operations as well. Targeted areas will include Whirinaki Forest Park and Te Urewera National Park with populations of threatened species including kiwi and kokako. Coordinating AHB operations to assist with the birds' breeding seasons would reduce rat and stoat populations as well as possums.

G.3 **Future outcomes for Tb control with 1080**

The ability to continue to use 1080 will mean that, by 2015, it should be possible to contain, and in some cases eradicate, Tb from wild animal populations in major areas of forest where they are currently found. This will be as a direct consequence of the ability to target key infected populations with aerial 1080 operations in difficult country. Expenditure on vector control in 2015 is expected to be in the range of $35M - $40M per year compared with about $55M at present.

Figure 10 shows the forecast areas likely to still contain Tb possums. In most regions the ranges of infected possums would have contracted to a significant extent and the percentage of possums with Tb would have decreased. The estimated number of infected herds in 2015 for each region is forecast to show marked improvements over the current levels (Figure 11). This would mean a decline from 190 infected herds to 59. Details of the forecast outcomes and declines by region are given in Annex 1. A description of the national position with respect to infected wildlife and herds is given in Annex 2. As this national summary makes clear, these results represent a significant improvement over the current prevalence of Tb in wild animal populations and in cattle and deer herds.

The overall significance of these forecasts is best summarised in the predicted value in 2015 of the Annual Period Prevalence (APP) figure. A figure of 0.2% APP is the international benchmark for a country to be recognised as officially free of bovine Tb. The APP value in April 2006 was 0.51%. Under the forecasted outcomes the APP figure in 2015 would drop to 0.17%. New Zealand would then have met the target of the National Possum Management Strategy (NPMS). Although there would still be low levels of Tb, New Zealand could then be officially recognised as being free of bovine Tb, providing it was kept below the 0.2% level for 3 years. At that point the option of continuing control efforts to actually eradicate Tb would be considered from strategic and feasibility perspectives.

Figure 10 | **Areas forecast to be occupied by Tb-infected possums in 2015, WITH 1080 use**

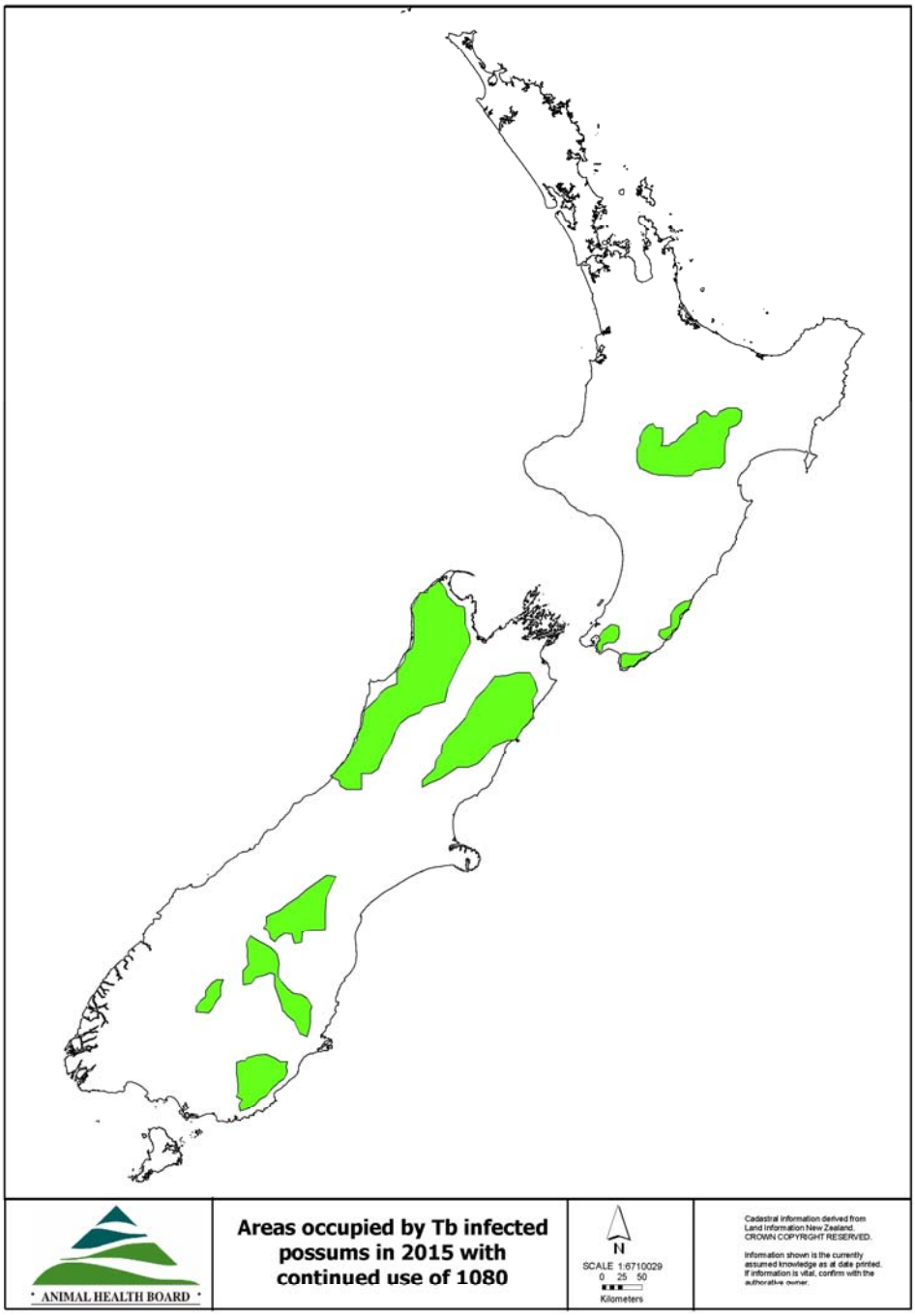
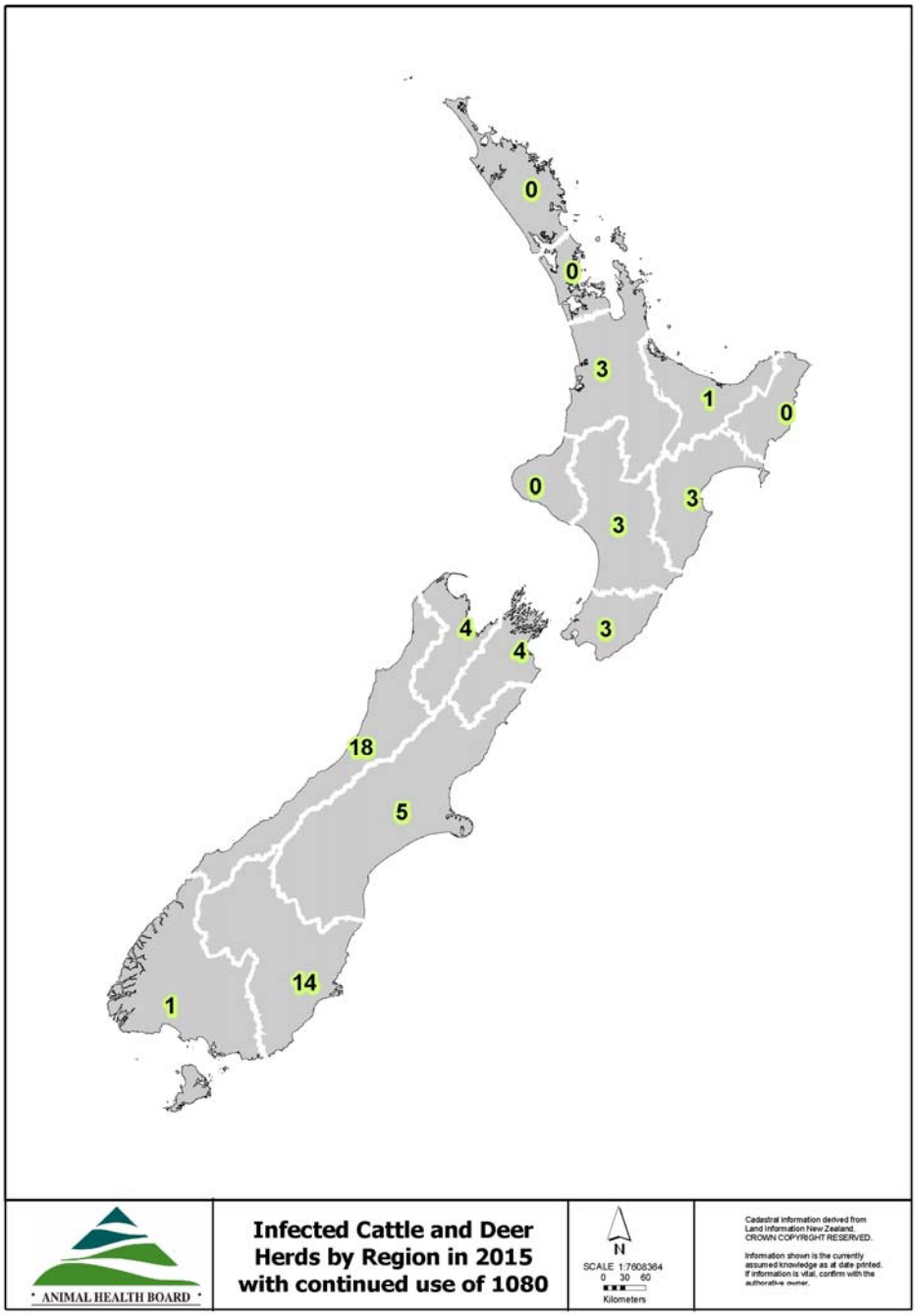


Figure 11 | **Forecast number of Tb-infected herds in 2015, WITH 1080 use**



G.4 **Future for conservation management with 1080**

The management for conservation and natural heritage projects would also benefit considerably from the continued use of 1080. From a DOC perspective, the projections are for an improvement in the condition of forest canopies across a wide range of protected natural areas, including national parks, state forest parks, reserves, regional parks and other areas of ecological significance. In particular, rugged, inaccessible areas could still be treated effectively and efficiently using aerial 1080. Such improvements would also apply to less visible aspects of forest biodiversity as well and would improve the habitat conditions for birdlife and many other native species, both plant and animal. Large-scale maintenance programmes using aerial 1080 would be undertaken, as required, to protect specially managed areas for threatened species (the 'mainland islands') and as a key initial step in helping to establish any new ones.

The ongoing decline of several currently threatened bird species could be targeted through the periodic use of aerial 1080 operations in combination with other control methods. Research is underway to identify the factors that maximise by-kill of rodents from aerial 1080 operations. This may well lead to operational changes and a consistently higher by-kill of rodents. As a consequence, 1080 may become a more deliberately used tool in ongoing efforts to halt and reverse the declines of forest bird species.

In the meantime, the DOC possum control programme is likely to be similar to that currently existing (Tables 2 and 3). DOC would continue to control about 260,000 ha annually out of a total area of around one million ha that it now has under sustained possum management. About 75% of that area, or three-quarters of a million ha, would be dependent on aerial 1080 operations for protecting its biodiversity values. Other pests, such as wallabies, would also be targeted using 1080. The objective will be to slow and stop their spread into new areas and reduce current damage they are causing in the central North Island as well as in South Canterbury.

There would be strategic flexibility to use 1080 to control possums should trends in climate change indicate the need to improve the resilience of large forest areas in particular regions. This may well include periodic treatment programmes to control predator irruptions associated with mast years in beech forests, again relying largely on aerial 1080 treatment.

With ongoing use of 1080, regional councils would have maintained and expanded pest control for biodiversity and natural heritage purposes. The extent of this expansion would have been strongly influenced by the rate and places where AHB has scaled back its operations. As described above, AHB expects to *increase* its use of 1080 over the next 10 years, but not necessarily over the same areas that it presently treats. In this respect its focus is quite different from those of councils and DOC, both of which have an ongoing focus with protecting the values of specific places. The AHB focus is on disease reduction, independent of place. As Tb is eliminated from certain areas and the focus moves to containing or controlling Tb elsewhere, important areas of biodiversity may no longer have the benefits of AHB control programmes. In these areas regional councils may well want to significantly increase their pest control operations and would be reliant on 1080 use in those areas where ground control is too expensive or too difficult. At this time it is not sensible to estimate what this may mean in terms of actual hectares treated for pest control by regional councils, given that it is premature to predict changes in the location of AHB's control effort.

Two other vertebrate pests for which 1080 is a key control method are wallabies and rabbits. As the only poison registered for wallaby control, 1080 will continue to be central to efforts to contain and reduce wallaby populations in both North and South Islands. Prior to the arrival and spread of RHD 1080 was used extensively in aerial operations to reduce rabbit numbers over large areas. In Otago, for example, approximately 320 kg of 1080 was applied each year. While 1080 use dropped sharply after RHD, its use is now increasing and is likely to be the key method of rabbit control as numbers increase.

H. The Future without 1080

This section considers the likely futures by 2015 for Tb and conservation management **assuming there has been no use of 1080 in the preceding 10 years, that is, WITHOUT 1080**. Again, the underlying assumptions are given first, followed by separate descriptions of the likely management response and outcomes for Tb control and conservation.

H.1 Assumptions

The following assumptions are based on the experience of the various agencies with respect to the costs and management priorities that are current and as well as projected. The starting point is the alternative option of using mainly traps and cyanide to replace 1080 as described in Context Section D. The assumptions also take into account the past difficulties and time lags associated with developing and improving control methods and the extensive research needed to understand environmental effects and improve operational effectiveness.

- Funding for Tb vector control and possum control by DOC is unlikely to increase to any significant extent.
- Funding for possum control by some regional councils will need to increase significantly to meet the extra costs given the absence of 1080 and an anticipated increase in biodiversity and natural heritage pest control projects. Additional council funding would likely be from property ratings and might be constrained by political and public opposition to the required level of increase in some regions.
- Cost differentials will continue as at present between ground control methods and aerial control (see box ‘Costs of controlling pests’ in Section C).
- Because of difficulties of trapping and higher costs of operations, AHB would only be able to “buffer” the forest margins of difficult country. For similar reasons those sites currently treated by DOC by aerial 1080 operations would reduce in size by at least 66%.
- DOC’s strategic mix of operations is likely to switch to a focus on localised treatment programmes for species protection and representative site protection.Broad-scale goals currently associated with natural heritage protection and, in the future with climate change, are likely to become a minor part of the Department’s possum control programme.
- The total area treated by regional councils may increase, finances permitting, but the size of these increases would be less, because of higher ground-control costs, than if 1080 had still been available.
- Regional councils will still be endeavouring to increase their pest control operations to meet regional pest management strategies and maintain AHB-funded Tb operations.
- Areas with rugged and very difficult terrain are most unlikely to be treated at all by DOC, regional councils or AHB. While control in “buffer zones” may be possible, this would not protect biodiversity values that may be at risk within these difficult areas.
- The use of “other” methods will remain largely unchanged by all agencies.

- Forestry companies will not have 1080 as a cost-effective tool for large-scale protection of plantation forests at either establishment or later for control of rabbits, hares, and possums.
- Ground control for rabbits over large areas will be inadequate, costly and inefficient.
- No broad-scale technique will be available for combating irruptions in predator populations.
- For the purpose of this assessment, the significant rise in demand for ground-trapping and baiting operations could be met by contractors and suppliers without a drop in quality control.

H.2 **Future for Tb control without 1080**

Expenditures would not decrease, but the area treated each year by traps and cyanide would decline by 50,000 ha due to higher costs for ground control and the absence of an aerial alternative to 1080 (Table 5). Higher ground costs would arise because there would be a shift to treating more difficult, and therefore more expensive, country from the ground that is presently treated from the air. Since ground-treated areas tend to be treated more frequently, the total area under sustained management for possums would also decline from current levels, by an unspecified amount. The areas forecasted to be treated annually by all methods by 2015 is given in Table 5 and compared with current efforts.

Table 5 | **Areas treated annually by AHB for Tb without use of 1080**

Control Method	**Current areas treated annually, ha**	**Future areas treated annually, ha**
Aerial 1080	396,000 (7.3%)	0
Ground 1080	4,000 (0.1%)	0
Traps & cyanide	4,500,000 (83.3%)	4,450,000 (90%)
Other poisons	500,000 (9.3%)	500,000 (10%)
Total, ha	**5,400,000**	**4,950,000**

The current plans for the next phase of the Tb control strategy are focused on containment and eradication of Tb from wildlife over large areas. This would not be possible with the loss of aerial-control techniques. Rather than reducing existing possum populations and stopping infected possums from spreading into new areas, modelling results forecast two major negative outcomes. First, a significant spread of infected possums into new areas towards East Cape and eastern Bay of Plenty. Secondly, currently infected areas in north-west Nelson and Marlborough/North Canterbury would expand and deepen as Tb became more common in the possum populations.

Preventing these disease outbreaks would be too difficult or expensive from the ground.Instead of aerial control over these forests, 500m wide, low-density possum buffers would be established along the bush pasture margin of these forests as a second-best option.Their purpose would be to reduce the risk of Tb possums moving out onto farmland, rather than elimination of the disease.The momentum towards Tb eradication would slow,

stop, and probably reverse with a likely increase in infection rates. Managing to contain Tb from spreading further would therefore require ongoing control of possums over some five million hectares, or more, each year into the indefinite future.

H.3 **Future outcomes for Tb control without 1080**

Without aerial 1080 operations, the forecast is that it will be impossible to eradicate Tb from certain possum populations and difficult to contain the spread of Tb infection. Consequently, Tb will persist in wild animal populations in major areas of forest where it is currently found. In the absence of aerial operations, ground control efforts will be targeted at maintaining low density possum buffers around priority areas. Historically, this option has been significantly more expensive than aerial control as it has to be repeated annually compared to 4-5 year cycles for aerial control. More importantly, ground control is not as effective as aerial control at restricting movements of Tb-possums onto farms. This is because of the greater scale, evenness and consistency of control achieved by aerial operations.

The expenditure on vector control by 2015 is expected to be in the range of $55M - $60M per year. This is the projected cost just to maintain low possum densities along all bush margins with extensive forest in order to minimise the risk of herds becoming infected by Tb possums from adjacent forests. This represents an increase of about $20M per year over the control costs if 1080 use had continued to 2015. But it also means, despite the increased costs, less success at controlling Tb rates than New Zealand presently enjoys. In addition, this expenditure will have to be maintained indefinitely until another cost effective means is identified for containing or eradicating infection from wild animal populations in these areas.

Figure 12 shows the areas forecast to be occupied by Tb-infected possums (and other wild animals) in 2015 if 1080 was banned from use. The probable outcomes would be significant ‘breakouts’ of Tb in wild animal populations in the central North Island and in the upper South Island. A comparison of Figs 10 and 12 shows this would be a consequence of not being able to successfully control and reduce Tb-infected possums over large, contiguous areas of native forest. In particular, Tb would not be contained in Te Urewera National Park and would be likely to spread northwards, threatening herds in the Bay of Plenty and Gisborne District. The consequential effect on the number of future infected herds in each region is shown in Figure 13. The number of infected herds is forecast to rise from 190 (April 2006) to 239 infected herds. Detailed information on the number of expected herds at risk, by region, together with expected breakdown rates and clearance rates are shown in Annex 3. A more detailed description of the forecasted national position with respect to infected wildlife and herds without 1080 use is given in Annex 4. While there should be progress in eradicating Tb within the Wellington region, most areas would show a decline over the current situation with increased infection in cattle and deer herds as well as in wildlife populations.

As a consequence, the forecast outcome for the Annual Period Prevalence (APP) figure is that it would rise from a value of 0.51% to about 0.58% in 2015 without the continued use of 1080. New Zealand would fail to achieve official Tb-free status.

Figure 12 | **Areas forecast to be occupied by Tb-infected possums in 2015, WITHOUT 1080 use**

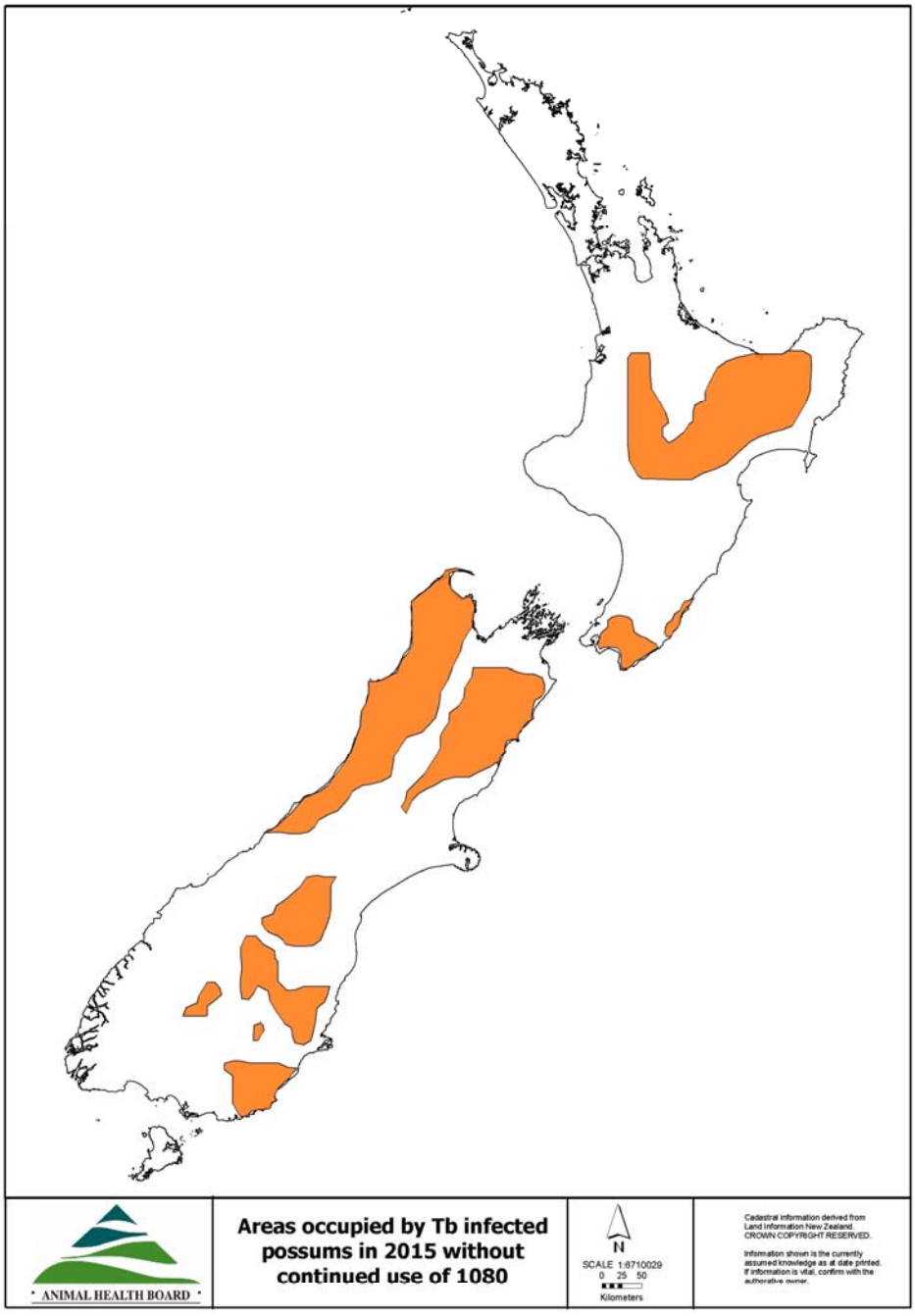
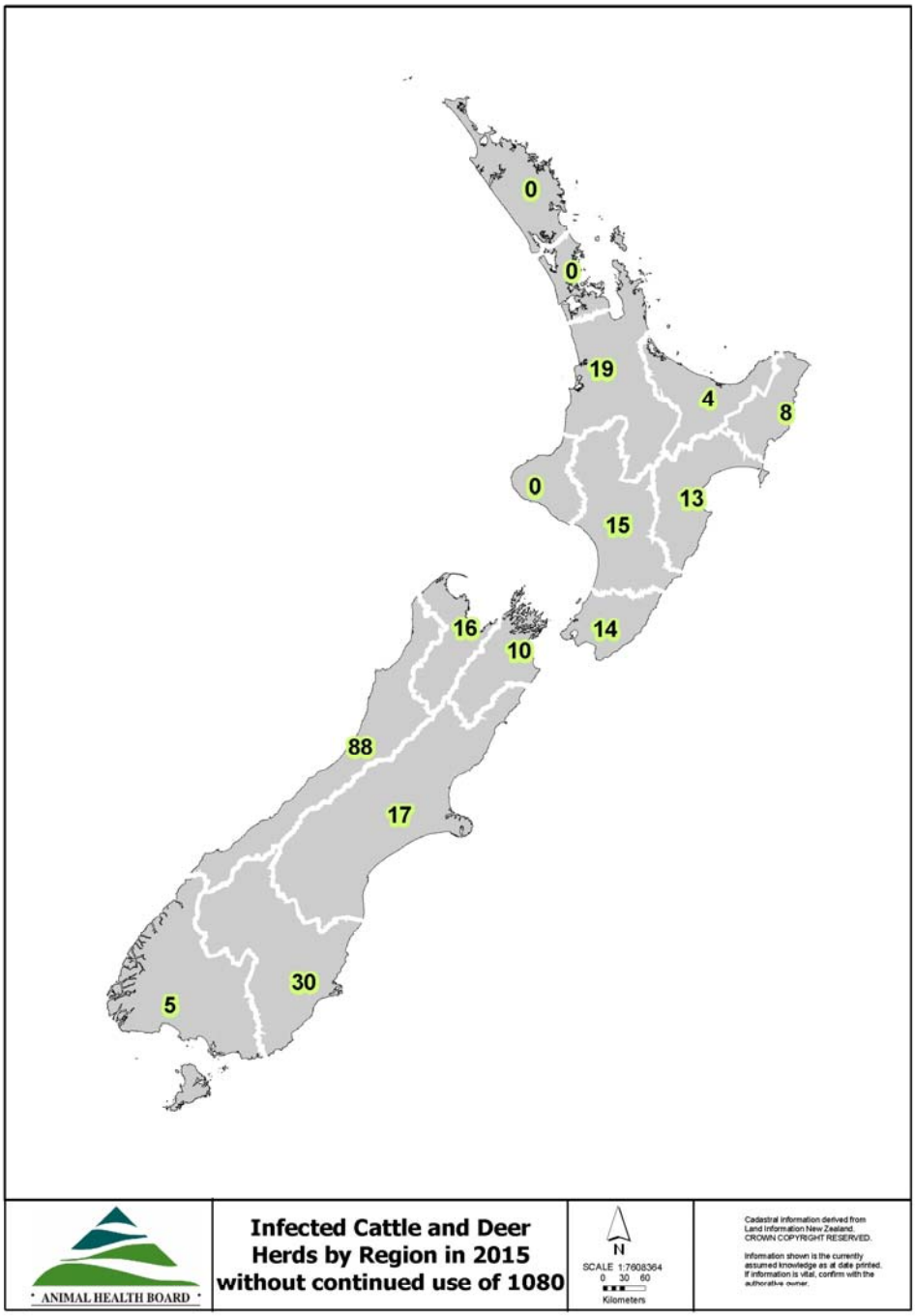


Figure 13 | **Forecast numbers of infected herds in 2015, WITHOUT 1080 use**



H.4 **Future for conservation management without 1080**

The key assumptions for the without-1080 scenario is that similar funding levels for DOC would need to be spent on more expensive ground control methods, usually at 3-4 times the cost per unit area. DOC would therefore have to cut the area currently treated each year for possum control from 263,000 ha to about 177,000 ha, which represents a 33% cut in priority areas currently managed. In the longer term, this would translate into about half million ha no longer being sustainably managed by DOC for possum impacts. The current area of one million ha under sustained management for possums would therefore be halved. This would be equivalent to stopping sustained management over an area equivalent to the combined area of six national parks – Egmont, Whanganui, Te Uruwera, Abel Tasman, Westland and Paparoa.

If regional councils were able to increase their funds (via rating rises) they may be able to compensate in some places for losing 1080 use by extending their ground-based control. What a funding increase would not be able to address is the lack of ground-based methods to control possums, rodents, mustelids and other vertebrate pests in remote and inaccessible terrain. It would, for all agencies, compromise current objectives by limiting managers to less effective methods. This would affect regional councils and DOC, but especially the latter, given its responsibilities for large remote forest areas many of which are in conservation and national parks. The benefits of large-scale control operations over short time periods would be lost.[2] DOC and regional councils would find it more difficult, or even impossible, to achieve many of their current objectives without 1080. There would also be the loss of biodiversity benefits that are currently provided by AHB's aerial operations and the combined operations between all agencies. An extensive re-prioritisation of the most important areas warranting ongoing control for habitat and species protection would be required.

Agencies would also lose the significant benefits of predator by-kill from 1080 use. All rodent and mustelid control would need to be specifically targeted as possum control using traps and cyanide would not provide any by-kill benefits. (Also, poorly set traps can increase risks of injury for ground-dwelling birds.) Control costs would therefore increase further and areas that could be controlled for predators would be much reduced. Even with extra funding there would be contractions in the areas and species that currently benefit from by-kill of predators via 1080 possum operations. It would be unlikely that any new 'mainland islands' would be established as these areas rely on initial large-scale aerial 1080 operations to reduce possum numbers and kill predators before the resulting lower densities are then sustained by ground control.

These management constraints and costs would significantly compromise DOC's ability to meet its projected targets for protecting biodiversity as identified in the New Zealand Biodiversity Strategy and in its Statement of Intent.

[2] For example – in 1996, 8,000 ha on Mt Pirongia were covered in 2 days of aerial 1080 operations while controlling possums over the remaining 6,000 ha of the same reserve took a further 2 years.

The management consequences for regional councils are more difficult to describe in quantitative terms. As discussed earlier, the extent to which councils expand or change their possum control programmes will be closely tied to future changes in AHB operations. If additional finances were available councils could be expected to expand beyond their current possum control. The key point is, however, that the problem of controlling possum in rugged and inaccessible would remain without 1080 aerial operations. Control of predators would also become more expensive and would be restricted to ground control over much smaller areas than currently benefit from by-kill results.

The control of other pests managed by councils and landowners, such as wallabies and rabbits, will be more expensive, ineffective and difficult. In the absence of RHD, aerial 1080 remains the most effective and efficient poison for rabbit control. Without 1080, and as rabbit resistance to RHD continues to rise, there is no other ground control technology with the same ability to reduce densities over large areas, quickly and effectively, or as cheaply.Pindone, shooting and trapping are suitable only for patch areas and low rabbit populations.

H.5 **Comparing Outcomes for Conservation**

The outcomes for conservation with or without the continued use of 1080 over this period are more multi-dimensional and harder to quantify than those for Tb control. They reflect the fact that 1080 is used against several different pests in many different environments. The outcomes may affect some species immediately (e.g. improved breeding success for birds), but for others the outcomes are only obvious many years later (e.g. sustaining forest canopies).

The aerial use of 1080 can be argued to provide the only tool that is *nationally important* for three outcomes: for habitat protection, primarily of forests; for improved survival rates of various threatened species; and thirdly for rabbit control. The large-scale extent of the positive outcomes for habitat protection and the widespread value of aerial 1080 in controlling rabbit and rodent populations justify this ranking as a nationally important tool for pest control. Threatened species are direct beneficiaries of the aerial control of possums and rodents (via by-kill effects) and the loss of aerial use of 1080 would have significant detrimental effects on conservation programmes throughout New Zealand. The ground application of 1080 helps achieve locally important outcomes for biodiversity, that is, at specific sites. Again, its unavailability for use in local situations would be a set-back in control programmes for several pests – possums, wallabies, mustelids and rodents.

DOC and regional councils are likely to fail to achieve crucial outcomes if 1080 is no longer available for use, especially in aerial operations. This will remain a crucial option for regional councils and DOC in their efforts to conserve indigenous biodiversity and meet the objectives of the New Zealand Biodiversity Strategy.

The predicted conservation outcomes for 2015, with and without ongoing use of 1080, are presented in Tables 6-9. Generic points regarding impacts on conservation objectives are as follows for the two scenarios.

WITH 1080 use:

- Forests which have been prioritised for aerial 1080 operations by DOC and regional councils will continue to be treated to sustain biodiversity values and new areas are likely to be added. Forest losses to possum damage will be slowed and reversed over about one million ha of prioritised conservation land.

- Efforts to more successfully ‘co-target’ possums and rats through aerial 1080 use should have led to improved operational outcomes. This will provide important options for improving bird breeding successes by large scale aerial control during the spring/summer breeding period.
- Many forest birds should consequently benefit from planned ‘co-target’ operations, including several threatened species.
- Other threatened species, such as mistletoe and giant snail species, would have also benefited from 1080 operations.
- Containing and reducing the present ranges of wallabies would be possible and a resurgence in rabbit numbers could be countered using aerial 1080 operations.

WITHOUT 1080 use:

- The forested areas that could be treated annually by DOC would drop by about 33%. The total area treated by DOC on a sustained basis, because of its reliance on aerial 1080 operations, would fall to about half of the present one million ha. Ground control over the remaining area would be less effective and patchier. Instead of holding or improving the current status of forest canopies and many threatened plant and animal species, there would be increased extinction risks and progressive damage with forest collapse possible over hundreds of thousands of hectares.
- Increases in biodiversity losses could lower the effectiveness of ecosystem services currently provided from DOC-managed lands. These include soil and water values, flood control capacity and carbon storage.
- Cultural and amenity values will diminish and may affect recreation and tourism opportunities.
- Control costs will rise substantially per unit area as possum control and predator control would no longer be achieved in single 1080 operations, but need to be targeted separately.
- As a consequence, range contractions would occur for several threatened species including kiwi, kokako and kaka. Potential gains for other species, such as tomtit, kereru and whitehead would not be realised by ground control only.
- Wallabies would be likely to continue their range expansion in the central North Island and in South Canterbury and increase the damage done to forest habitats.

Table 6 | **Outcomes of possum control for habitat protection**

Conservation objectives	Now	Future with 1080	Future without 1080
Area Under Sustained Management	Approx. 1 million ha of public conservation land treated (based on direct operational costs of about $16/ha).	Approx. 1 million ha of public conservation land treated (based on direct operational costs of about $16/ha)	Reduced to about 500,000 ha (based on about $45/ha) of ground operations only. Existing ground control plus 1080 funds transferred
General vegetation response (Canopy and subcanopy)	Up to 1 million ha. treated. Priority ecosystems targeted to arrest or reverse decline of forest health.	Up to 1 million ha. treated. Ongoing initiatives to improve forest health as priorities dictate. Potential to expand operations into other areas needing control.	About 500,000 ha treated. Many important areas no longer treatable from the ground and potential for progressive attrition or forest collapse over many thousands of ha.
General species benefits	Where decline is attributed to possums, maintain or increase security of threatened species e.g. mistletoes, land snails, forest birds in general, invertebrates.	Where decline is attributed to possums, maintain or increase security of threatened species e.g. mistletoes, land snails, forest birds, invertebrates.	Reduced diversity, decreasing security and an increase of local extinctions of threatened species. Loss of critically important habitat to particular threatened species and communities.
Ecosystem services	Maintenance of ecosystem processes over 1 million ha. Processes include: soil and water values, forest structure, resilience to flood, drought & storm events, vegetation succession processes and enhancement of carbon-oxygen cycle.	Maintenance of ecosystem processes over 1 million ha. Processes include: soil and water values, forest structure, resilience to flood, drought & storm events, vegetation succession processes and enhancement of carbon-oxygen cycle.	A potential decline in ecosystem services over thousands of ha no longer receiving treatment. Losses may include: reduced soil and water quality, lowered resilience to flood, drought & storm events, reduced carbon storage capacity.
Additional cultural objectives			
Mauri	I tenei wa tonu, ko nga mahi aukati i te paihamu me ona hoa kino hei whakaoho ake i te mauri e ngoikore ana i roto inga ngahere. Present possum and other pest eradication programmes rejuvenate the diminishing mauri, or life force, of threatened forest ecosystems.	Kia mau tonu ki te kaupapa aukati kia ora ai te ngahere me tona ake mauri. To maintain the processes which improve the health and life force of the forest.	Ka mate ngahere, ka mate ano ko tona ake mauri. The forest will weaken as will the forest's life force.
Landscape & amenity values and national identity	Maintenance of broad scale landscape, amenity, and intrinsic values to support recreation and tourism opportunities, & sustain New Zealand's national identity.	Ability to maintain broad scale landscape, amenity, and intrinsic values to support recreation and tourism opportunities & sustain New Zealand's national identity. Extend protection to additional priority areas.	Diminishment of landscape, amenity and intrinsic values resulting in loss of the quality of recreational and tourism opportunities, and loss of ability to include public expectations & national identity

Table 7 | **Outcomes of rat and possum control for species protection**

Conservation objectives	Now	Future with 1080	Future without 1080
Prevent functional extinction of acutely threatened species	Able to rapidly respond to large scale rat irruptions to protect vulnerable threatened species such as mohua and orange-fronted parakeets in South Island beech forest.	Mohua and orange-fronted parakeets and other threatened species continue to survive in South Island beech forest because there is the capability to rapidly respond to large-scale rat irruptions.	Risk of extinction is increased for mohua and orange-fronted parakeets in South Island beech forests because there is no capability to rapidly respond to large scale rat irruptions.
Enhance populations of acutely threatened species	Periodically use aerial control of rats & possums to enhance breeding success and range increase of species such as kokako and kaka. Okarito brown kiwi helped in breeding season. *Powelliphanta* snail spp protected from possum predation.	Kokako and kaka populations are more secure and re-establishing in areas where they had been locally extinct in 2005. Additional species included in similar protection programmes.Benefits to kiwi through improved targeting of predators via 1080 use. Operations to protect *Powelliphanta* snail spp continue in key habitats.	Kokako and kaka populations only secure in a smaller number of restricted sites. Where pest control is not undertaken, populations will continue to retract and local extinctions may result. Kiwi will be dependent solely on ground control and likely to continue declining outside sanctuaries. *Powelliphanta* at increased risk of extinction.
Enhance populations of chronically threatened species	Exploring potential of routine springtime control of rat populations over large areas, to increase breeding success of species such as brown kiwi, great spotted kiwi, and kereru/kukupa.	Declines of chronically threatened species can be reversed over very large areas.	Serious and gradual declines of chronically threatened species will continue over very large areas with implications for seed dispersal and forest health generally.
Enhance breeding success of populations of other forest birds	Wide range of species benefit from 1080 operations timed to assist breeding – tui, bellbird, fantail, whitehead, tomtit, North Island robin.	Improved effectiveness of 1080 use for rat control increases benefits to forest birds at breeding time.	No by-kill benefits of rat control from cyanide or use of traps. Lowered breeding success for many forest birds is likely.

Table 8 | **Outcomes of wallaby and rabbit control**

Conservation objectives	Now	Future with 1080	Future without 1080
Eradication and containment of wallabies	The eradication of dama wallabies from Kawau Island is being considered. Need to reduce densities and limit the range expansion of wallabies in the central North Island. 1080 is currently the only poison registered for wallaby control.	Wallabies possibly eradicated from Kawau Island. Reduction and containment in the central North Island. Further ability to target and contain incursions elsewhere, including South Canterbury	Wallabies not eradicated from Kawau Island and continue to expand their range in the central North Island and in South Canterbury.
Rabbit control	RHD continues to be effective in most regions. In parts of Otago, however, rabbit numbers are already high and aerial 1080 is being used to good effect. By killing almost all rabbits, it also removes almost all RHD- resistant rabbits, which then "resets" virus resistance to low levels. Hence 1080 seems to be extending the benefits of the virus.	As RHD loses its effectiveness, 1080 will be able to be used, once again, to reduce rabbit densities over large areas and protect the ecological and economic gains that have been made over the past decade.	As RHD loses its effectiveness, rabbit populations will increase, especially in Otago and other South Island inland areas. Ground control will be ineffective and expensive and there would be a high risk of major rabbit problems re-emerging.

Table 9 | **Regionally and locally important conservation outcomes**

Control technique	Now	Future with 1080	Future without 1080
Ground control of possums, rodents, mustelids and wallabies. **Aerial control of all the above.**	1080 one of a limited range of tools that can be applied to achieve conservation outcomes for species and habitats in regions and local areas. 1080 is the most cost effective and reliable poison to treat bush and non-grazed areas by aerial means to give overall coverage. As Tb vector control programmes decline, regional councils will be picking up these programmes under the umbrella of regional biodiversity projects to maintain the gains achieved from the Tb programme.	Agencies can choose the most cost effective and efficient method to achieve conservation outcomes, while minimising the environmental and human health risks. Regional councils will be expanding their work on the protection and enhancement of regional biodiversity and natural heritage values and sites over the next 10 years. The Long Term Council Community Plans are quite explicit on what values and objectives require protection and the common factor is animal and plant pest control. For these policies to be effective the ability to use 1080 is most important.	Many regionally and locally significant sites with substantial biodiversity and conservation values will not be able to be treated effectively because no other effective control tool is available The creation of mainland islands, protection of endangered and regionally threatened species will be compromised because only less effective methods will be available.

Annex 1. **Forecast outcomes of the distribution of infected herds by 2015 WITH 1080**

Region	**Estimated herds at risk of vector-related infection**	**Expected infected herds at June 2014**	**Expected breakdown rates per 1,000 herds**	**Expected new infected herds per year**	**Clearance rates percent**	Expected number of infected herds at June 2015
North Island						
Waikato -CNI	600	3	5	3	70	**3**
Manawatu/Wanganui - CNI	350	4	10	4	70	**3**
Bay of Plenty - CNI	150	1	5	1	70	**1**
Gisborne - CNI	100	0	0	0	0	**0**
Hawke's Bay - CNI	300	3	10	3	70	**3**
Southern Wellington	350	4	10	4	70	**3**
Total North Island	1850	15				**13**
South Island						
Kahurangi National Park	950	12	12	11	65	**12**
Balance of West Coast	950	11	10	10	65	**10**
Marlborough	300	4	10	3	50	**4**
North Canterbury	700	5	5	4	60	**4**
Sth Canterbury	200	1	5	1	70	**1**
Central & Coastal Otago	2200	11	5	11	70	**10**
Sth Eastern Otago	450	5	7	3	70	**4**
Eastern Southland	150	1	5	1	70	**1**
Total South Island	5900	50				**46**
New Zealand	7750	65				59

CNI = Central North Island

Annex 2. **The forecast national position by 2015 with respect to the status of infected wildlife and herds WITH 1080**

The forecast national position by 2015 WITH 1080, shown in Figures 10 and 11, may be summarised as follows:

North Island

Central North Island

Tb will be eradicated from wild animal populations in the Hauhungaroa Range. Major progress towards eradication in the Tongariro National Park. Tb wild animals may still remain in parts of inland Kaweka and Kaimanawa Ranges. Tb wild animal infection will have been contained and progress towards eradication will have occurred in Te Urewera National Park. Herds adjacent to areas where Tb has not been eradicated from wild animal populations will experience a low level of vector-related infection.

Southern North Island

Tb will be eradicated from the wild and domestic animal populations from most of the Wellington Region except for some pockets in the Aorangi and southern Rimutaka Ranges.

South Island

Tasman/ Northern West Coast

Tb wild animal infection will be contained well within the Kahurangi National Park, such that breakdowns in adjacent herds occur infrequently.

Marlborough

Tb wild animal infection will still be present in the upper reaches of the Awatere, Waihopi and Spray Rivers. Few herds will be affected.

North Canterbury

Tb will be eradicated from the wild animal populations in the southern part of North Canterbury, including Mt Grey and Mt Oxford. Tb wild animals are still likely to be present north of the Waiau River.It is expected that few herds will be infected.

South Canterbury

Infection is likely to remain in wild animals in the Benmore and Kirkliston Ranges and possibly in the Mackenzie Basin.Few herds will be involved.

Southern Westland/West Coast

The spread of Tb wild animal infection into south Westland will have been successfully contained. Further, Tb will have largely been eradicated from wild animal populations in south Westland up to the Hokitika River. There will be minimal risk to domestic herds. A small risk of vector-related infection of domestic herds will remain north of the Hokitika River, where Tb will not have been eradicated from the wild animal populations.

Otago

Tb will be eradicated from the northern and north eastern parts of Otago as well as the Blue Mountains. There will be a considerable reduction in the size of the Tb wild animal problem in the Catlins. Few herds will be affected.

Southland

Tb will have been eradicated from the wild and domestic animal populations in Southland.The infection in the adjacent Catlins will be contained and not spread into Southland.

Annex 3. **Forecast outcomes of the distribution of infected herds by 2015 WITHOUT 1080**

Region	**Estimated herds at risk of vector-related infection**	**Expected infected herds at June 2014**	**Expected breakdown rates per 1,000 herds**	**Expected new infected herds per year**	**Clearance rates percent**	Expected number of infected herds at June 2015
North Island						
Waikato -CNI	600	16	30	18	60	**19**
Manawatu/Wanganui - CNI	350	12	40	14	60	**15**
Bay of Plenty - CNI	150	3	25	4	60	**4**
Gisborne - CNI	250	7	30	8	60	**8**
Hawke's Bay - CNI	300	11	40	12	60	**13**
Southern Wellington	350	12	40	14	65	**14**
Total North Island	2000	61				**73**
South Island						
Kahurangi National Park	950	46	50	48	55	**55**
Balance of West Coast	950	41	45	43	55	**49**
Marlborough	300	7	30	9	55	**10**
North Canterbury	700	12	20	14	55	**16**
Sth Canterbury	200	1	7	1	55	**1**
Central & Coastal Otago	2200	13	7	15	60	**16**
Sth Eastern Otago	450	12	30	14	60	**14**
Eastern Southland	150	4	30	5	60	**5**
Total South Island	5900	136				**166**
New Zealand	7900	197				239

CNI = Central North Island

Annex 4. The forecast national position by 2015 with respect to the status of infected wildlife and herds WITHOUT 1080

The forecast national position on 2015 WITHOUT 1080, shown in Figures 12 and 13, may be summarised as follows:

North Island

Central North Island

Tb will not be eradicated from the wild animal populations in the Hauhungaroa and Rangitoto Ranges as well as Tongariro National Park.Tb wild animals will continue to pose threats to herds adjacent to these areas, despite implementing ground control buffers to reduce the risk of spread. Infection will still remain in parts of inland Kaweka and Kaimanawa Ranges, placing adjacent herds at occasional risk of infection.

Tb infected wild animals will not be able to be contained or eradicated in Te Urewera National Park. They are expected to continue to spread northwards with the potential to spread into Galatea and perhaps to Edgecumbe in the Bay of Plenty. There is a reasonable probability that they will place herds in the Gisborne District at risk. There is a potential that infection will spread to the Raukumara Ranges behind Gisborne putting more herds at risk in the future.Ground control in this country would be very expensive. Herds in northern Hawke's Bay will remain at risk.

Southern North Island

Tb will be eradicated from the wild and domestic animal populations from most of the Wellington Region. However, Tb will remain in the wild animal populations in a relatively extensive area of the Rimutuka Ranges as well as the Aorangi Ranges in southern Wellington. There is the potential for infection to spread along the Akatarawa Valley. The level of infection in the wild animals, despite low possum density buffers, will continue to contribute to a low grade infection of herds in this area as well as along parts of the Wairarapa east coast.

South Island

Tasman/ Northern West Coast

Tb-infected wild animal populations will expand to the outside fringes of the Kahurangi National Park. Despite intensive ground control buffers, Tb wild animals will continue to leak out of the Park. This will pose a risk of infection to the estimated 950 herds that graze around the Park boundaries.

Marlborough

Still likely to have Tb wild animal infection in the upper reaches of the Awatere River and possibly the upper Waihopi/Spray Rivers. Few herds will be infected.

North Canterbury

Unable to eradicate Tb infection from the southern parts of North Canterbury (Mt Grey and Mt Oxford, Ashley Forest). Infection will continue to move out from areas that are currently not controlled around North Canterbury high country stations.

South Canterbury

Infection likely to remain in wild animals in the Benmore and Kirkliston Ranges in south Mackenzie Basin. Few herds likely to be involved.

Balance of the West Coast

Tb-infected wild animals will not be able to be contained or eradicated from the balance of the West Coast. It is highly probable that infection will spread into Springs Junction and the Maruia Valley placing all herds at risk in these areas. It is possible that Tb wild animals may spread into north western Canterbury and further into South Westland. Herd infection levels are likely to be similar to what is currently observed in the balance of the West Coast.

Otago

May not be possible to eradicate infection from coastal Otago or the Blue Mountains leading to a consequent spillover into adjacent country. The Tb wild animal source in the Catlins will expand and place an increased area and number of herds at risk.

Southland

Due to the influence of infection expanding in the Catlins, herds in South eastern Southland will once again be placed at risk of infection from Tb wild animals.