TREASURY WORKING PAPER 00/24

Coughing up for Bovine Tb Control

Economic Review of the Proposed National Pest Management Strategy for Bovine Tuberculosis

Prepared at NZIER by Peter Clough and Chris Nixon, and reviewed by Stephen Gale

ABSTRACT

This report is a commissioned review of the Animal Health Board's (AHB's) discussion paper *Towards a Tb Free New Zealand*.

The key components of the proposed strategy are:

- the goal has shifted from one of management to eradication of bovine Tb;
- the annual expenditure requirement over the 10 year life of the proposed strategy doubles over that under the current strategy;
- the contribution sought from the Crown and industry more than doubles under the proposed allocation, while that from regional landowners reduces;
- the main benefit claimed for the strategy is an avoided risk of trade sanctions in premium markets, plus subsidiary public conservation benefit from possum control.

The report evaluates the assertions made by the AHB and concludes that the true risks are likely to be smaller and shorter in duration than the AHB analysis would suggest. Equally, a number of the assertions around the allocation of costs between funding partners are open to alternative interpretations. Consequently NZIER have concluded that the imperative for action in this case may be weaker than for some other biosecurity applications, such as threats of irreversible damage to indigenous biodiversity.

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Economic review of the proposed National Pest Management Strategy for Bovine Tuberculosis

Report to The Treasury

July 2000

NZ INSTITUTE OF ECONOMIC RESEARCH (INC.)

8 Halswell St. Thorndon

P O BOX 3479 WELLINGTON

Tel: (04) 472 1880

Fax: (04) 472 1211

Preface

The New Zealand Institute of Economic Research (NZIER), based in Wellington, was founded in 1958 as a non-profit making trust to provide economic research and consultancy services. Best known for its long-established *Quarterly Survey of Business Opinion* and forecasting publications, *Quarterly Predictions* and the annual *Industry Outlook* with five-yearly projections for 25 sectors, the Institute also undertakes a wide range of consultancy activities for government and private organisations. It obtains most of its income from research contracts obtained in a competitive market and trades on its reputation for delivering quality analysis in the right form, and at the right time, for its clients. Quality assurance is provided on the Institute's work :

- by the interaction of team members on individual projects;
- by exposure of the team's work to the critical review of a broader range of Institute staff members at internal seminars;
- by providing for peer review at various stages through a project by a senior staff member otherwise disinterested in the project;
- and sometimes by external peer reviewers at the request of a client, although this usually entails additional cost.

Authorship

This report has been prepared at NZIER by Peter Clough and Chris Nixon, and reviewed by Stephen Gale.

EXECUTIVE SUMMARY

This report provides an economic analysis and commentary of the proposed bovine tuberculosis national pest management strategy, as described in the Animal Health Board's discussion paper "*Towards a Tb free New Zealand*". It does not provide an alternative, but rather assesses the validity of the information, assumptions and frameworks used in support of the vector control aspects of the proposed strategy.

The key components of the proposed strategy for bovine Tb vectors are:

- The goal has shifted from one of management to eradication of bovine Tb;
- The annual expenditure requirement over the next 10 years doubles over that under the current strategy;
- The contribution sought from the Crown and industry more than doubles under the proposed allocation, while that from regional landowners contracts;
- The main benefit claimed for the strategy is avoided risk of trade sanctions in premium markets, plus subsidiary public conservation benefit from possum control.

Before a decision is made on the eradication proposal, more examination is required to demonstrate its feasibility and likely effect. The discussion paper contains insufficient explanation of the analysis used in formulating the strategy to be a reliable basis for assessing its economic worth. There are apparent inconsistencies in some of the figures and crucial details omitted from the reporting: for instance it is not explicit over how it handles progressive changes in the risks of trade ban over time. Neither is there any quantified analysis of alternative strategies to the current proposal for total eradication. This is important, for the cost of successive increments of vector control can be expected to rise the closer the strategy comes to achieving eradication, and it is likely that marginal costs will exceed marginal benefits before eradication is reached.

Piecing together the details which are reported in the discussion paper, it appears that the proposed strategy would only be worthwhile (in the sense of producing positive net benefits) if the costs being considered are simply those additional to the current level of expenditure. In other words this requires an implicit assumption that the resource use choice is between the current strategy being rolled over and renewed at current costs of around $30 million per year, or an extension to full eradication at a cost of around $60 million per year. On a more "zero-based" assessment the benefits identified for the strategy would not produce a positive net present value for decades to come. In all cases there is a risk that the strategy will not achieve its objective and the expected benefits will be smaller still.

The allocation of costs contains some inconsistencies in the treatment of private landowners and the Crown as exacerbators of the vector problem. This may create some disincentive for risk reduction at the herd and land management level, but this is primarily a distributional issue with little efficiency implication.

The principal benefit identified for the strategy, the avoided risk of trade ban, has a large potential economic impact, but since such a ban would be difficult to sustain under current international trade rules, the risk is probably very small and the expected value of this benefit is modest. A ban as described in the discussion paper is neither catastrophic nor irreversible: risks to human health are negligible and the trade ban impacts can be restored over time. Allowing for other potential uses of public funds, the imperative for action in this case is weaker than for some other biosecurity applications, such as threats of irreversible damage to indigenous biodiversity.

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1. INTRODUCTION AND OUTLINE

This report provides an economic analysis and commentary of the proposed bovine tuberculosis national pest management strategy described in the Animal Health Board's discussion paper "*Towards a Tb free New Zealand*". Its purpose is to identify the economic incentives and resource use implications of this strategy, highlighting issues which warrant further scrutiny in any review of the strategy.

The intention of this report is not to re-work the economic analysis in the AHB paper, but rather to provide informed assessment of the economic implications which emerge from the proposed strategy document, and the basis of the assumptions and analysis supporting that document. It outlines issues raised in carrying out the work, issues worth further examination, and conclusions in light of what is known about costs, benefits and risks, including:

- The appropriateness of the proposed strategy objective and its shift towards eradication.
- The robustness of assumptions about the threat of trade censure and consequent economic impacts.
- The optimal level of expenditure on bovine Tb vector control.
- The validity of assumptions underlying the distribution of costs between exacerbators and beneficiaries of the programme.
- The incentives created by the proposed and alternative cost allocation structures.

Determining the optimality of the proposed strategy is not possible without agreed values for risk probabilities, costs and benefits, many of which are indeterminate in biosecurity issues. To circumvent this problem, this report addresses two sets of questions: first, whether the proposed strategy applies a framework which is appropriate, reasonable and internally consistent in light of its legislation and government intentions; and second, whether the actual assumptions and estimates used are credible. Consideration of the first question alone may be sufficient to demonstrate the need for revision in the proposed strategy. Answers to the second fall largely outside the domain of economists, and it would require a larger exercise to verify conclusively the estimates in the proposed strategy, or replace them with something better. The report concentrates on the vector control aspects of the proposed national pest management strategy (NPMS), since the on-farm disease control is largely internalised within the productive sector.

The report starts with a brief background to the bovine Tb issue and how economics might approach it; reviews the AHB discussion paper with particular attention to the cost benefit analysis, the assumptions used, and the rationale for cost allocation; and concludes with a brief summary of the strengths and weaknesses of the paper and its utility in supporting policy decisions.

2. BACKGROUND TO THE BOVINE TB ISSUE

New Zealand has a high level of bovine Tb in farm herds of cattle and deer compared to other (but not all) trading partners in the OECD. The discussion paper on the proposed NPMS does not provide comparisons, but the 1995 draft paper of the strategy currently in force gave the examples in the table below.

	Incidence of Tb infected herds	Incidence of cattle with Tb
USA	0.0013%	0.0003%
Australia	0.0080%	0.0004%
United Kingdom	0.1200%	0.0040%
New Zealand	**1.0000%**	**0.0760%**
Republic of Ireland	1.4700%	0.5400%
Northern Ireland	7.6000%	0.3700%

This presents a risk because New Zealand's status and control programme does not conform to the guidelines of the Office International des Epizooties (OIE), which requires a level of 0.2% of herds or less with infection for a country to be regarded as Tb-free, and a set of demonstrated measures to control the problem if this level is not reached. Failure to comply could be raised in justification of non-tariff barriers against New Zealand exports.

Infection occurs through either movement of infected livestock around the country, or contact of livestock with wild vector species, prime amongst which is the possum. Under the Biosecurity Act 1993 Bovine Tb has a national control strategy administered by the Animal Health Board which acts in the following ways:

- Declaration of Disease Risk Areas around the country, within which movement of livestock is controlled by compulsory testing and certification of animals before movement off properties, and slaughtering of animals found to be infected. This is the Disease Control aspect of the strategy, and is funded by the owners of livestock potentially affected, by levies on slaughter and on dairy returns.
- Institution of a Vector Control strategy, which involves trapping and poisoning vector species (principally possums) in designated vector risk areas to reduce the probability of infecting cattle. The costs of vector control are shared between livestock owners, regional landowners and general taxpayers.

The current strategy was introduced in 1996 and is due for renewal next year. Under the current strategy there has been a reduction in the number of Tb-infected cattle and deer herds in NZ, which is the measure by which NZ is judged internationally. The AHB discussion paper notes that reduction in the number of infected herds has exceeded expectations [p 7] but areas at risk from Tb-infected wildlife have continued to expand [p2].

2.1 The proposed strategy in brief

The AHB discussion paper notes a new strategy is needed to ensure NPMS conforms with Biosecurity Act amendments in 1997, and because the risk of loss of key markets has increased. Apart from failure to conform to the OIE guidelines, it notes:

- the risk of consumer reaction to Tb as a perceived threat to health has increased;

- there have already been incidents of Tb being cited in opposition to access to New Zealand exports to some markets, the most obvious being Australia's restrictions on live animal exports from New Zealand.

The proposals in the discussion paper mark a significant shift from the first NPMS in claiming that eradication is not only achievable but should become the central goal. In 1995 the technical assessment of the feasibility of eradication was lukewarm, but detailed recent re-assessment has overturned this view. The paper further describes this change of objective as capitalising on better than expected results to date to propose "some challenging targets for the next ten years which, if achieved, would make eradication a definite possibility" [p 8].

The paper states there is no satisfactory alternative to the combination of test-and-slaughter, movement control and vector control if eradication is the goal. New technologies may come on stream, such as vaccination or biological control of wild animals, but there is no immediate prospect of this and no assumptions of new technology have been made in the new proposed strategy [p 8]. An adequate system of records to enable tracing the movements of animals, as required for compliance with OIE guidelines, may need to be established. But other farm management needs may require this as well. The most important move towards OIE compliance is adoption of pre-movement testing for animals moving into officially free areas [p 10].

The proposed objective for 2001-2011, in line with OIE standards, is to reduce the number of infected herds to 0.2% over the period 2010-2011. Maintaining the number of affected herds at this level for two years would allow official recognition of freedom from bovine Tb [p9]. Achieving this would require vector control of sufficient intensity over 7 million ha of Vector Risk Area (VRA) to achieve eradication from wild animals, and sustained vector control over a further 1.5 million ha to contain the spread of VRAs.

The discussion paper states that 90% of new infections are attributable to a vector source and the return from investment in vector control is eight times greater than corresponding investment in disease control (source unspecified). It also claims the devolved management of vector control that has emerged to date has been a success, and consultation with Regional Councils will be a critical part of the consultation process for the next NPMS.

The cost implications of the proposed NPMS are an additional $1.0-1.5 million per year in moving towards compliance with OIE guidelines for disease control; and increased vector control amounting to $600 million over the 10 years of the proposed NPMS [p 12]. Other increases in cost in line with inflation are likely. Based on assumed reductions in the risk of a trade shock in one or more premium markets, and on the public benefits of vector control to conservation, the return on investment in the vector control strategy is strongly positive. The NPV is very sensitive to assumptions made, but results are considered robust because relatively conservative values were used [p 12].

Farmers are the principal beneficiaries of increased vector control expenditure because of the value attributed to protection of market access. But the Biosecurity Act provides for costs to be assigned to beneficiaries and those who exacerbate the problem [p 12]. Crown funding is based on its two roles as exacerbator and as beneficiary, and following re-assessment of the Crown's role as exacerbator, in view of the number of infected possums on Crown land, the proposed strategy would require substantial increases in contribution from the Crown and industry sources, and a reduction from Regional Councils. Using a method similar to that under the Local Govt Act, the

appropriate shares of programme expenditure would be Crown 60%, owners of livestock 30% (industry levies) and landowners 10% (regional ratepayers) [p 14].

2.2 Economic perspectives on biosecurity

The incidence of disease lowers productivity of animals and inputs applied to them, and hence lowers benefits to society from food production processes. Disease losses arise from depressed output (either volume or price effects), loss of animals, reduced growth and so on. In addition, diseases give rise to defensive expenditures such as drugs, veterinary services, modifications in farm behaviour. A relevant objective for disease management is the minimisation of Total Disease Costs, where these comprise both disease losses and defensive expenditures. An added twist in the case of biosecurity is that many of the effects are uncertain, and a control strategy is largely an exercise in managing risks of potential damages.

Action to control disease is a resource using process which raises the same questions about efficiency and optimal allocation as in any other area of economic activity. Some economic principles which can be expected to apply to disease control are:

- Only the avoidable costs of disease can be saved;
- The law of diminishing returns suggests that the cost of abating risks are likely to rise the smaller the residual risk retained, and that eradicating the last million possums will be considerably more costly than eradicating the first million;
- Efficient expenditure on biosecurity activities can be expected to lie at the point where marginal costs of control equal marginal benefits obtained, such that an optimal level of Tb vector control could lie well short of eliminating Tb vectors;
- Given a specific standard to meet (such as the OIE guidelines), the issue is not so much one of cost benefit analysis to find an optimal level of biosecurity (it is already implied in the standard) but one of cost effectiveness, i.e. which of different options achieves the standard with most certainty and at least cost?;
- Transmissable diseases have an externality component;
- The risk and uncertainty surrounding biosecurity effects means that decisions will often be based on an expected value of the avoidable damage, given by the product of the potential damage times the probability of its occurrence, or on the basis of some other precautionary standard if the expected value approach is inappropriate to the nature of the risk involved.

Against this background, relevant questions to ask about the proposed bovine Tb NPMS, and its supporting analyses, are:

- Is it economically worthwhile, in the sense of yielding benefits likely to exceed its costs?
- Does it yield a return competitive with that from alternative uses of resources?
- Does it represent the most effective means of addressing the bovine Tb problem?

3. BOVINE TB VECTOR CONTROL STRATEGY – COST BENEFIT ANALYSIS

Cost benefit analysis is the name given to the process of assessing the merit, from the point of view of the community as a whole, of the allocation of investment funds to a particular project or between competing projects. It can also be used for assessing the impacts of government policy involving little explicit expenditure of public funds. The starting point for any cost benefit analysis is the compilation of a list of all extra costs and benefits foreseen as the result of the project or policy change. The stages then are:

- Converting all the effects into a commensurate set of monetary values, so that effects can be compared with each other;
- Allowing for comparison of effects occurring in different time periods, usually through some form of discounting to present values;
- Assessing the sensitivity of the analysis results to changes in assumptions made and values used for effects in the future, and more generally to allow for risk and uncertainty about the outcomes.

A fundamental part of cost benefit analysis is that it is comparing the proposed change against something else, which may be other proposals or a "do nothing" or "do minimum" option. If analysis shows a proposal results in positive net benefits or a benefit cost ratio greater than 1, it indicates the proposal is worthwhile in the sense of producing a return which more than covers its costs[1]. If there are other competing uses for the same investment funds from a constrained budget, it is necessary to look at the scale of return from competing uses, and select those with the highest return per unit invested so as to maximise the combined return from investments.

The cost benefit analysis in support of the proposed national pest management strategy for bovine Tb vector species is outlined in section 14 of the AHB discussion paper. The write-up is not particularly clear about how the analysis is put together, but some inferences can be made about the analysis.

3.1 The AHB analysis

The basic proposition for analysis in the discussion paper refers to the likelihood of targeted trade measures against New Zealand on the basis of its relatively high Tb rates and lack of full compliance with international standards [p.50]. The effect of such a ban would be primarily to reduce prices realised for New Zealand produce, as product is diverted from premium markets in Europe and North America to lower price markets such as Russia and Mexico. The main points that can be discerned from the discussion paper are as follows.

1. It is assumed that it takes two full years to convince trading partners to lift the ban, once initiated, with a three year "tail" with a 20% loss in value in each year while producers rebuild their customer links and positioning in affected markets [p 51].
2. Using 1998 volumes and prices, annual losses for the length of time the trade ban continues were calculated as $347 million for dairy, $396 million for beef and $73 million for venison [p 50].

[1] As discussed later, however, considerations of project risk and budget constraints often require a higher benefit cost ratio to signify a worthwhile project.

3. In addition, were a ban applied industry would move quickly to limit the damage and restore confidence in its products in these markets. This recovery plan would cost around $100 million, comprising $32 million in the first year to fully comply with OIE guidelines, $15 million to exclude milk from affected herds and $60 million to exclude meat.
4. Together these figures put the potential total cost of the trade loss at NZ$1.29 billion [p.51]. [This is presumably a present value cost in one year of an event lasting five, but is not described as such in the AHB paper.]
5. It is assumed that the risk of trade sanctions is 2% in any particular year over the next 10 years for the status quo situation, which would fall eventually to zero over the following 10 years under the proposed strategy [p 51].
6. An additional benefit to the public is the gain to biodiversity conservation from possum control, which has been valued as 25% of the average cost currently incurred by DOC ($13.65 per hectare) across the area under Tb vector control (2.876 million hectares), on the assumption that DOC's spending exactly equates to the public benefit received, and that lower conservation values are involved on the Tb vector control areas. This amounts to $10 million benefit per year [p 52].
7. The net present value of the extra expenditure on vector control, as compared to status quo funding, is $87 million when discounted at 10% [p 52].

3.2 Critique of the cost benefit analysis

Leaving aside the question of whether the assumptions and figures used are credible, the discussion paper's description of the analysis leaves a number of key issues unanswered and it is difficult to verify the results it describes. Some of the most obvious points are listed below.

- The timeframe over which the NPV has been calculated has not been specified.
- The counterfactual, or what is assumed to happen in the absence of this strategy, is not specified. The NPV is based on extra expenditure over the status quo, but since budgeted vector control spending has risen from $27.7 million in 1998/99 to $39.7 million in 2000/01, it is not clear precisely what "status quo" has been projected into the future.
- The assumption on page 51 that the risk of trade sanctions is 20% over the next 10 years (or a 2% chance in any particular year) for the status quo is confusing. If it is assumed that there is a 2% chance in any one year of trade sanctions of potential $1.29 million being invoked, then this can be used to estimate an expected value of loss from those sanctions in each subsequent year.[2] Over 10 years this will amount to a combined expected value of 20% of the one-year potential trade loss, but this does not mean that there is a one in five chance of trade sanctions being invoked over the period, as implied in the discussion paper.
- The potential trade losses to dairy, beef and venison sum to $816 million, and the recovery plan sums to $107 million, having a combined impact of $923 million. If these were "annual losses for the length of time the trade ban continues" [p 50] as described in the discussion paper they would be incompatible with a potential total cost of trade loss of $1.29 billion, given a ban lasting two years with a three year tail. [A table in the appendix to this report shows various combinations of these figures fail to amount to stated figure of $1.29 billion]. The scale of the tail is problematic: if it is meant to refer to the loss in value of the affected markets it would also increase

[2] See Collard, David (1986) "Catastrophic risk: or the economics of being scared"; in Collard D, Ulph D & Pearce D (Eds) *Economics, Growth and Sustainable Environments*, Macmillan, London

the total cost above $1.29 billion. Since $1.29 billion is 1.4 times $923 million, the "annual losses" may refer to total losses during the ban with a tail of two years.

These comments may simply reflect inadequate reporting of the methods used in preparing the cost benefit analysis, but the lack of clearer exposition raises concerns about the adequacy of the analysis undertaken.

3.3 Reconstructing the AHB cost benefit analysis

The discussion paper contains enough detail to attempt a reconstruction of the cost benefit analysis of the proposed national pest management strategy. This would incorporate the following.

1. The principal benefit of such a strategy is the avoided cost of trade bans which might be invoked in its absence. The expected value of such a ban is given by its potential cost times the probability of its occurrence, in each year it is achieved: at 2% of $1.29 billion this is $25.8 million per year. It is questionable when this benefit will be received. The AHB's strategy aims to achieve sufficiently widespread eradication after 10 years, and to maintain it for a further two, to achieve official Tb-free status. A tight assumption might be that the benefit is only achieved 12 years after commencement of the strategy. A looser assumption might be that just by demonstrating commitment to eradication potential trade bans can be averted, in which case the benefits begin at the same time as the strategy.
2. A subsidiary benefit is the biodiversity conservation gain from targeting possums in areas which are not high priority for conservation. This benefit would be realised as soon as the strategy commenced, and may be valued as in the AHB paper at $10 million per year in the first instance.
3. Costs comprise the vector control components of public expenditures on the proposed strategy (i.e. excluding any disease control costs or on-farm costs of restricted movements etc). The 10 annual estimates are given on page 49 of the AHB discussion paper.
4. The counterfactual is problematic.
   - One approach would be to assume that what has previously been spent on Tb vector control is a sunk cost of no relevance to future commitments of funding. In that case the whole of the proposed strategy cost is a new commitment whose worth needs to be examined in the cost benefit analysis.
   - Alternatively, if it is reasonable to assume that the current pest management strategy would be rolled over and renewed on termination next year, it is only necessary to examine the increment of expenditure over this presumed baseline strategy. Because the AHB paper's description of risks is confusing, the incremental benefit over the counterfactual in this case is unclear, e.g. is the risk of trade ban any greater by virtue of a lower commitment to vector control?

The foregoing defines a number of variable dimensions to the assessment of the strategy which can be illustrated through variants of a reconstructed analysis.

3.3.1 Alternative results – Full strategy costs

The first option examined here is the benefits obtained from the full costs of the proposed strategy, incurring $600 million on vector control over 10 years. The effects over the 12 years required to achieve Tb-free status are outlined in the table below, which shows the net benefit per year, the cumulative net benefit and the benefit cost ratio obtained by comparing gross costs and benefits in present value terms. The costs and benefits are projected in constant dollar terms before discounting.

The results of this analysis are strongly negative. The benefits of avoiding trade bans and to conservation last beyond the strategy period, assuming it is successful in eradicating bovine Tb from wild vectors. However, these annual benefits are only around half the annual costs during the strategy implementation periods, and become progressively smaller when discounted into the future. Even though annual net benefits turn positive from year 11, 70 years after the launch of a successful strategy the annual increment of benefit drops below $100,000, the cumulative net present value is minus $15 million, and the benefit cost ratio is 0.96.

BENEFITS (COSTS AVOIDED) OF BOVINE Tb STRATEGY

Discounted 10.00%	**Cumulative NPV $M**	**Net Benefit PV$M**	Strategy Cost $M	**Biodiversity** Benefit to Public $M	**Trade Ban** Expected Value $M	Risk	Potential *$M*	**Gross BCR**
			600.2					
1	-31.7	-31.7	67.5	10.0	25.8	2.00%	1290	0.530
2	-51.4	-19.7	57.5	10.0	25.8	2.00%	1290	0.571
3	-69.0	-17.6	57.1	10.0	25.8	2.00%	1290	0.587
4	-85.8	-16.8	58.1	10.0	25.8	2.00%	1290	0.593
5	-107.8	-22.1	68.1	10.0	25.8	2.00%	1290	0.581
6	-122.6	-14.7	59.5	10.0	25.8	2.00%	1290	0.583
7	-134.4	-11.8	56.7	10.0	25.8	2.00%	1290	0.588
8	-144.8	-10.5	56.2	10.0	25.8	2.00%	1290	0.592
9	-158.9	-14.1	66.0	10.0	25.8	2.00%	1290	0.588
10	-166.4	-7.5	53.5	10.0	25.8	2.00%	1290	0.592
11	-152.6	13.8		10.0	25.8	2.00%	1290	0.626
12	-140.1	12.5		10.0	25.8	2.00%	1290	0.657

Changing the timing so that the full benefit of avoiding trade bans only occurs after the successful completion of the strategy simply defers benefits to a further future in which their discounted value is smaller. By year 70 the cumulative net benefit is minus $208 million and the benefit cost ratio is 0.49.

Despite the obvious simplifications in this case, given the current assumptions, it would be hard to demonstrate that such a strategy would be economically worthwhile if viewed as a "new" investment.

3.3.2 Alternative results – Incremental strategy costs

The same table has been reproduced to illustrate the cost and benefit effects of the incremental spending required of the proposed strategy, compared to a status quo which is assumed as $30 million per year over the next 10 years.

Because the level of costs is lower than in the previous table, the net present value turns positive from year two and accumulates most years thereafter. By year 70 the cumulative NPV reaches $188 million, with a benefit cost ratio of 1.91. Both these results could justify proceeding with the proposed strategy, although it would depend on whether the benefit cost ratio has sufficient margin over the break-even ratio of 1 to allow for the risks involved. For instance, since some of the funding is sought from government, whose budget constraints mean there may be other potential uses of the funds achieving comparable or greater benefit cost ratios over a shorter period of time, it is not clear that a benefit cost ratio of 1.9 over 70 years would be sufficient to justify diverting funds from other applications.

BENEFITS (COSTS AVOIDED) OF BOVINE Tb STRATEGY

Discounted 10.00%	**Cumulative NPV $M**	**Net Benefit PV$M**	Strategy Cost $M	**Biodiversity** Benefit to Public $M	**Trade Ban** Expected Value $M	Risk	Potential *$M*	**Gross BCR**
			300.2					
1	-1.7	-1.7	37.5	10.0	25.8	2.00%	1290	0.955
2	5.8	7.5	27.5	10.0	25.8	2.00%	1290	1.094
3	13.0	7.2	27.1	10.0	25.8	2.00%	1290	1.154
4	18.8	5.8	28.1	10.0	25.8	2.00%	1290	1.178
5	17.2	-1.6	38.1	10.0	25.8	2.00%	1290	1.131
6	21.2	3.9	29.5	10.0	25.8	2.00%	1290	1.141
7	26.3	5.1	26.7	10.0	25.8	2.00%	1290	1.159
8	31.2	4.9	26.2	10.0	25.8	2.00%	1290	1.175
9	31.1	-0.1	36.0	10.0	25.8	2.00%	1290	1.159
10	36.3	5.2	23.5	10.0	25.8	2.00%	1290	1.177
11	50.2	13.8		10.0	25.8	2.00%	1290	1.244
12	62.7	12.5		10.0	25.8	2.00%	1290	1.305

If a tighter definition of benefits is adopted, such that the avoided trade ban only occurs after year 12, the effect of discounting is such that the incremental analysis fails to return positive net benefits. By year 70 the cumulative net present value is minus $5.5 million, and the benefit cost ratio is 0.97.

3.3.3 How critical is the assumed risk of trade ban?

Although such analysis is useful in giving some shape and form to the expectations held for the strategy, all these estimates are highly uncertain and it would be misleading to attach too much precision to the results. Varying the scale of input variables illuminates the sensitivity of the results to particular assumptions. In particular it is informative to examine how the size of the expected value of trade ban damage, and the assumed risk level, affects the results.

One way of doing this is to consider the risk level required to yield a comparable return to some other forms of public investment. A well known return rate is the benefit cost ratio of 4 after 25 years, which is the cut-off ratio at which road proposals are accepted or declined for public funding. By way of comparison, to yield a benefit cost ratio of 4 after 25 years, the assumed risk of trade ban would need to be 12% for the full strategy costs and just under 6% in the case of the incremental strategy costs. In other words, the expected value of avoided trade bans would need to be six times those quoted in the AHB paper in the case of the full strategy costs, and three times in the case of the incremental strategy costs, for the proposed NPMS to achieve a comparable return. The differing nature of the risks between these investments means that the return is unlikely to be exactly the same, but the comparison nevertheless puts some perspective on the identifiable net benefits, considering alternative potential uses of the resources. This is apart from the question of whether the potential magnitude of trade ban loss is realistic, given its implicit assumption of simultaneous action across New Zealand's premium product markets.

Any risk assumption is going to be imprecise, and there are questions of detail – such as whether to consider an appreciable difference in risk under the full strategy cost or the incremental strategy cost – which are not examined here. The key question thrown up by this analysis is whether it is realistic to expect there to be a risk of between one in eight and 1 in 16, each year, of a trade ban of this magnitude being initiated?

3.3.4 A refinement of approach

The above tables are a simplified approach to cost benefit analysis which is appropriate as a preliminary examination, given that the discussion paper is not specific about how its analysis is put together. However, a cost benefit analysis in these circumstances ought strictly to treat the risk of trade ban differently to reflect changes in probability over time: e.g. the expectation of facing a trade ban will be different in the first year of the strategy than in say the fifth year, having already survived four years without a ban. This requires progressively raising over time, by a factor related to the risk, the discount rate applied to the potential trade ban alone, with the effect of lowering the expected value of damage towards the end of the strategy. Hence the tables above are likely to overstate slightly the benefit from avoided cost of trade ban.

3.4 Conclusions on cost benefit analysis

Having examined the cost benefit analysis in the discussion document describing the proposed bovine Tb national strategy, there are a number of aspects in which there appears insufficient basis for assessing the economic worth of this proposed strategy. In particular:

- The description is not transparent as to the detailed estimation methods used and assumptions made.
- The figures quoted in the report do not reconcile with each other.
- The derivation of the $87 million net present value is opaque and apparently at odds with other figures quoted in the text.
- There is no explicit assessment of the sensitivity of the results to changes in the assumptions used.

These are technical issues which it might be argued have no place in a public discussion document. However, for the document to form the basis of informed public debate it needs to offer insights into the likely future outcomes with and without the strategy in place. In this respect:

- The discussion paper offers only the vaguest hint at what is the counterfactual against which the proposed strategy is to be assessed.
- The discussion paper offers no detailed examination of alternative options to the strategy proposed[3], but rather appears to be promoting one option selected for non-economic purposes.

The critique above suggests the proposed strategy only appears worthwhile when examined as an increment of costs above a continuation of the current strategy. The discussion paper does not explore what is the increment of benefit obtained from the increment of costs – for instance, there is no consideration of the change in trade ban risk (if any) from different levels of expenditure, or of public conservation benefit from different configurations of areas being treated for possum control. Given these observations, the support for the proposed strategy provided by the cost benefit analysis is less than compelling.

[3] Although there is some background work on technical rates of herd infection for intermediate steps between the status quo and the proposed strategy, in Livingstone P, Ryan Y & Crews K "Forecasts of Tb infected herds to 2011 – an analysis of possible outcomes"

4. KEY ASSUMPTIONS

4.1 Trade impacts

International trade in agricultural products is fraught with difficulties. Tariff barriers are high relative to industrial goods, anti dumping cases are frequent and non tariff barriers are common. The signing of the Uruguay Round Agreement between contracting parties has ushered in a comparatively stable era in international agricultural trade. Stable, that is, relative to the 1970s and 1980s. Two important outcomes of the Uruguay Round are: the formation of the WTO and the introduction of rules and disciplines to underpin agricultural trade, bringing it into line with industrial goods trade, albeit at much higher levels of protection.

Part of the Uruguay Round Agreement was the strengthening of WTO disputes settlement procedures, giving the WTO "more muscle" in dealing with disputes that occur. Decisions are now binding when taken to a WTO panel.

4.1.1 AHB methodology and validity of calculations

In the discussion paper "*Towards a Tb free New Zealand*" the Animal Health Board (AHB) see most of the benefits from avoiding "Targeted trade measures against New Zealand on the basis of our relatively high Tb rates and lack of full compliance with international standards" [p50]. While they foresee other threats such as "consumer panic" and "creeping consumer concern" also have potential for creating trade barriers they have not attempted to model the impacts of such threats.

The AHB have calculated losses from a ban at $NZ347 million (dairy), $NZ396 (beef) and $NZ73 million (venison). The losses are the difference between the price they could achieve in high value markets such as the European Union and United States and the lower yielding markets of Mexico (dairy) and Russia (meat). The total trade loss is $NZ1.29 billion.

It is difficult to comment on the calculations, since we do not know how they have been derived. For example, the beef export trade is worth approximately NZ$1.4 billion, of which roughly 70% is exported to United States. We presume that the AHB have assumed that the beef has been redirected to lower returning markets such as Russia and the resulting loss in revenue is $NZ396 million, about 40% of the current US trade. The large differentials in price are due to the product, which is subject to the trade bans, being sold in high value quota markets that attract premiums and much lower prices in other markets. This underlies the distorted nature of world agricultural markets.

4.1.2 Likelihood of trade bans

The AHB, after consulting industry, have put the risk of trade sanctions at 2% per year or 20% over the next ten years[4]. Furthermore, they claim that this risk would be

[4] As noted in the examination of cost benefit analysis, these probabilities are problematic and cannot realistically be taken to mean a 1 in 5 chance of a trade ban over the next decade. It is more plausible to interpret this as an expected value loss of 20% of $1.29 billion, equivalent to a 2% annual risk of incurring this loss. On this latter interpretation, reducing the risk to 2.5% implies an expected value loss of 2.5% times $1.29 billion while the strategy is in operation, which on average equates to $3.2 million or

reduced to 2.5% and eventually to zero over the next 10 years under the proposed strategy.

What is the validity of the stated claims that a potential threat to New Zealand's trade exists? The chance of New Zealand facing such a ban simultaneously in our major overseas markets is very small. So small in fact that it is almost non existent.

Why are we so sure that New Zealand would win a WTO panel case if the United States or European Union banned New Zealand product? The WTO rules have two important principles (backed up by case law) which apply:

- Firstly, importing regions that have a disease or carry out a particular practice can not ban other countries from trading with the importer in that product, and must treat imported and domestic products alike.
- Secondly, any trade ban must be based on sound science.

Regarding the first point, the European Union still have a significant problem with Tb, particularly in Ireland, and could not sustain a case before the WTO. The United States tried to ban Mexican tuna from the United States supermarkets on grounds that Mexican fishing boats were catching tuna using nets of a particular size that also caught dolphins. One of the WTO panel's reasons for rejecting the ban was that it was difficult to tell whether the incidental dolphin kill was due to different practices of the two fleets or the different operational areas, i.e. it was difficult to tell whether it was geography or practices that were contributing to a higher incidental dolphin kill rate. The fact that the United States had waited until their fishing fleet had abandoned that area of the Pacific frequented by Mexicans did not help their case. Furthermore, the standards applied by the United States were retroactive and variable and therefore inappropriate.

Regarding the second point, it would be difficult to demonstrate sound scientific basis for such a ban. What are the risks associated with humans catching Tb from eating meat or drinking milk? There are no verifiable cases of humans catching Tb in this way. Furthermore, all exported New Zealand meat has been tested and milk pasteurised certifying that it is Tb free.

In a recent WTO panel the United States won a ruling against the European Union when it tried to ban United States beef because it contained growth hormones. The European Union was unable to provide any evidence that suggested that there was a link between beef growth hormones and a risk to human health. If a trade ban is not made on sound science then it is very difficult to see how it can stand up to international law operated under the WTO.

4.2 Other assumed benefits

The only other quantified benefit in the AHB analysis is the benefit to conservation of possum control, valued at 25% of the cost per hectare implied by DOC's spending on this activity on conservation lands. The value of this benefit is not zero, and while the method is debatable, it is as good as any for assigning a non-zero value in the analysis.

Other potential benefits, such as contributions to government fund management and assisting the "clean green image", are rightly treated as negligible and there are no likely other items significant enough to overturn the assessment of the analysis.

0.25% per year over 10 years. This means the expected value of benefit is $22.6 million per year during the strategy operation and $25.8 million on completion of eradication. This changes the figures in the cost benefit analysis slightly, but is so small it does not change the results.

4.3 Further questions and issues

This assessment has been limited by focusing primarily on the AHB's public discussion paper, and given more time further information might become available from documentation supporting that paper. Some remaining questions and issues requiring consideration in any further review of the proposed strategy are outlined below.

- Is the proposed strategy based on an assessment of social costs and benefits? No: it only considers programme funding implications, not the consequent costs of compliance for farmers and others.
- The strategy document alludes to, but does not explicitly demonstrate, the sensitivity of its results to changes in assumptions used.
- In principle the optimal level of Tb control can be expected to be less than full eradication because of diminishing returns to eradication effort - at some point before full eradication, marginal costs will exceed marginal benefits. The target of eradication, even if technically feasible, is ambitious and likely to encounter increasing marginal costs.
- Does the strategy document demonstrate the least cost means of achieving the target of eradication? No: there are no options presented other than that of full eradication, and even the "do nothing" counterfactual is vaguely defined as continuation of the past five years' experience of declining incidence of Tb in livestock but an expansion in the areas carrying vector risk.
- The proposed strategy does not consider alternatives to meeting the international OIE standard of lowering the herd infection rate to 0.2% of herds, or demonstrating appropriate procedures in place if this standard cannot be met. It adopts an eradication target likely to be more costly than one of doing sufficient to meet the minimum OIE standard, spreading costs across groups other than the main industry beneficiaries.
- Intermediate solutions, such as eradicating bovine Tb from areas where it is less rife, and using private management solutions (such as herd inoculation) in areas where Tb remains, have not apparently been examined. Yet it is to be expected that an optimal level of Tb control would include a mix of control techniques, ranging from individual solutions in areas where these are most cost effective, to collective measures in areas where they are more likely to be worthwhile, because of economies of scale and local externality effects which would otherwise suffer from free-riding. The mix of actions under the eradication programme is not explicitly explained.
- The analysis of exacerbators and beneficiaries for cost allocation uses a method derived from local government practice, but as reported in the discussion document in tables 14 and 15 it appears uninformative as to who pays for what, because the tables only consider total benefits and exacerbation, rather than trying to identify marginal extensions to the strategy. An alternative would be to itemise distinct parts of the strategy for which the exacerbator / beneficiary mix can be expected to vary: for instance, for vector control on Crown land the Crown is principal beneficiary and exacerbator, but moving successively further from these reservoirs of vectors, into adjacent buffer zones and down riparian corridors, other landowners and parties have more control over management and potential to exacerbate or benefit from vector control. Such itemised costs presumably underpin the AHB's strategy formulation and its inclusion in the discussion document in summary form would make the proposed allocation more transparent.

5. COST ALLOCATION FOR BOVINE TB CONTROL

The Biosecurity Act (1993) provides for regulatory intervention to manage pests and unwanted organisms, within a cost-benefit framework. For pest management strategies made under Part V of the Act, section 57 specifies that funding proposals for the strategy may require persons to meet directly the costs of implementing the strategy where the benefits accruing to those persons as a group will outweigh the costs, or where those persons contribute to the creation, continuance or exacerbation of the problem being addressed.

Section 61 requires a proposal for a pest management strategy to contain a rationale for the proposed allocation of costs, identifying the extent to which any persons are likely to benefit from the strategy, and the extent to which any persons contribute to the creation, continuance or exacerbation of the problems proposed to be resolved by the strategy. But the Act provides no specific guidelines as to how to allocate costs between a strategy's beneficiaries and exacerbators. Section 87 states that a national pest management strategy will impose obligations on the Crown according to its tenor, and section 99 enables local authorities to contribute using their capabilities under the Rating Powers Act 1988.

The Act therefore retains some latitude as to how costs of a national pest management strategy can be allocated. This has wide ramifications for the distribution of the costs. The table below compares the distribution of costs in the proposed bovine Tb NPMS with that in the currently operative strategy. This shows that the combination of increasing annual expenditures on a more ambitious target, with reassessment of the allocations under different categories, results in the contributions of the Crown and industry more than doubling under the proposed strategy, while the regional contribution contracts.

DISTRIBUTION OF VECTOR CONTROL COSTS

	Current NPMS	Proposed NPMS	Current NPMS	Proposed NPMS
	$M	*$M*		
Mean Annual Total	29.72	61.74		
Industry levies	7.1	18.5	24%	30%
Regional contribution	7.4	6.2	25%	10%
Crown as beneficiary	7.1	3.1	24%	5%
Crown as exacerbator	8.0	34.0	27%	55%
Year 1	26.2	67.5		
Year 2	29.3	57.5		
Year 3	30.3	57.1		
Year 4	31.6	58.1		
Year 5	31.2	68.5		
Five year total $M	148.6	308.7		
Five year average $M	29.72	61.74		

Sources: AHB (2000), AERU (1999), Draft NPMS (1995)

Current Crown funding is based on its two roles as exacerbator and as beneficiary. The AHB discussion paper notes that the previous Government decided its beneficiary funding should cease at completion of the current NPMS in 2001 [p13]. However, the

proposed NPMS retains a Crown beneficiary contribution as well as doubling its exacerbator contribution. The proposed Crown contribution rise from around $15 million to $37 million is proportionately about the same as that imposed on industry (around 160% increase), but represents a substantial increase in this one activity area when compared with the $91 million of current appropriations to Votes Biosecurity.

5.1 Economic principles of cost allocation

Economics provides no precise guide as to how shared costs of a system or service supply should be allocated to different types of user. At the least each user or user group should pay the marginal cost of their use, i.e. the additional costs their use imposes on the system. At most each user could pay up to what it would cost them to obtain the same outputs on a stand-alone basis. Cross-subsidy and inefficient incentives occur when any one user group is required by a funding mechanism to pay more for a service than necessary under a stand-alone scheme.

These principles set the boundaries within which individual contributions can efficiently be set, but in practice the difference between these boundaries can be wide, and it can be difficult to identify the relevant marginal costs or stand-alone service equivalent. Where attributable variable costs can be identified and used as proxies for marginal cost, there are various methods available for allocating the remainder. There are full cost distribution formulae that allocate joint costs to users in proportion to some measure of their share of attributable activity: a practical but inefficient method in that it may load costs disproportionately onto groups least able to bear them. An alternative is to apply Ramsey pricing principles which allocate costs in inverse proportion to users' price sensitivity. This is efficient in that it minimises the disincentive on use of the service, but generally impractical in that it requires knowledge of respective price elasticities of demand which is difficult to come by. Joint costs for services with public good characteristics are likely to be allocated according to political assessment of what are fair shares, although equal shares are not necessarily the most efficient or equitable from an economic perspective.

5.2 The reasons for cost allocation in the proposed bovine Tb strategy

The AHB discussion paper recognises that disease control directly benefits farmers, especially owners of herds with high Tb risks, and that it is reasonable and practicable for this group of beneficiaries to bear the major or full costs of disease control programmes. It considers it more appropriate for government to contribute to vector control than to subsidise on-farm disease control, as has been the approach of Australian and other governments [p 53].

It further identifies the beneficiaries of vector control as a diverse group including farmers, the Crown, users of the conservation estate and regional parks and reserves, owners of private reserves, tourists and the general public. The diffuse nature of the benefits of vector control give it the character of a public good [p 55]. The exacerbators are a large group of landowners and landholders whose properties harbour vectors. Within this group, the Crown is the largest single owner of land carrying vectors.

The discussion paper uses an approach similar to that used under the Local Government Amendment Act 1996 for developing its rationale, but the derivation of the weightings to different contributors remains obscure. The paper claims grounds for a much higher Crown contribution following re-assessment of the Crown's role as exacerbator which found that vectors on Crown land are imposing costs on farming at

a higher level than previously assumed. Currently the Crown funds control on Crown land and buffer strips around it. Amongst the AHB's supporting arguments are:

1. Of the 22 new vector risk areas declared over the past four years, 10 are on Crown land;
2. Evidence that now suggests vectors use riverbanks as corridors for radiating out from Crown land; the discussion paper concludes that these areas should be treated as if they are Crown land buffer strips, resulting in 30% higher Crown contribution [p 56];
3. The Crown's historic exacerbator role in establishing and protecting possums in the 1920s;
4. Public benefits from vector control such as conservation, biodiversity and amenity protection;
5. The Crown benefits from assistance with the mitigation of trade shock risk and protection of clean green image [p13].

The present formula-based method of funding is seen to fairly distribute responsibilities, although it is acknowledged to be somewhat cumbersome and inflexible. The structure provides for industry levies for livestock owner contributions, regional rates for landowner contributions and tax appropriations for Crown contributions.

5.3 Critique of cost allocation

Given the latitude in both the legislative and economic guidelines on cost allocation, any distribution of costs is likely to be a difficult task for an administering agency. However, there are certain economic aspects of the current distribution which appear not to have been taken into account. In particular, the happy coincidence of both industry and Crown contributions increasing by the same proportion has questionable basis and is unlikely to be efficient.

A prime efficiency requirement of cost allocation is not to unintentionally create disincentives for alleviating the problem being addressed. Providing incentive to minimise risk is usually served by placing responsibility close to those whose actions are able to affect the risk. Conversely, shielding people from some the costs and risks in their actions may encourage them to increase the risk exposure of their activities, or fail to adopt lower cost abatement options. In this respect increasing the proportion of funding sought from the Crown removes some responsibility from those whose herd and land management practices most closely affect the risk of vector contact and infection. For instance, vector control on riparian strips which tend to be long, thin, and quite likely more costly to populate with traps may offer lower cost private options for controlling infection risk through land and vegetation management.

The AHB discussion paper provides no compelling explanation for the reduction in regional council contribution on behalf of landowners, or why vector control on riparian strips, whose management has traditionally been a responsibility of landowners and catchment authorities, should be transferred to the Crown. Persuading regions to contribute has traditionally been a contentious issue, since some regions do not perceive themselves as facing significant Tb risks, and one regional council (Otago) has declined to use its rating powers to provide a contribution. Notwithstanding this, it is not self-evident why an increase in overall Tb vector control, many of whose costs can be pin-pointed geographically, should result in a reduction in regional contribution when other stakeholder contributions increase.

More generally, the process by which the formulae for contributions work has not been considered in the discussion paper, despite acknowledgement of rigidities and previous commentary on inefficiencies in the system[5]. A re-examination of the use and potential role of matching grants and similar devices, which would share the costs between apparent vector generators and recipients and refocus incentives on the ground, could result in both a containment of government liability and regional activities reflecting more directly their regional priorities.

Regarding the specific justifications given for increasing the Crown's contribution:

- The increase in vector risk areas on Crown land is a justifiable reason for some increase in Crown contribution.
- The evidence on riverbank corridors may justify some increase, but appears to encroach onto management responsibilities more justifiably held at local level. Treating these as de facto Crown land buffers loads an excessive responsibility on the Crown and may deter lower cost management options for landowners and catchment authorities consistent with reducing risk of Tb vector spread.
- The Crown's historic responsibility in introducing possums is of little relevance to the current issue. The root cause of the problem is not the presence of possums but rather their infection with Tb, as is clear from areas like Taranaki which have possums but are Tb free. The historic spread of bovine Tb from the Westport area in the 1960s does not conform to the wavelike expansion expected from diffusion theory if the disease were spread by wild animal movements; rather, outbreaks in patches in the South Island and subsequently more widely and across Cook Strait, suggests that Tb was spread by transport of infected animals, i.e. livestock, leaving the historic responsibility with the industry.
- Public benefits from conservation and amenity are probably modest, since priority areas for possum control for conservation do not coincide with priority areas for Tb control. The discussion paper notes an option of research into vaccinating possums against Tb, which would be an activity without any conservation benefit and maybe disbenefits if healthier possums become more prolific. The estimates of conservation benefit in the discussion paper amount to more than a quarter of the quantifiable benefit of the strategy, which raises questions over the validity of the Crown's beneficiary and exacerbator roles.
- The public benefit from avoiding trade shocks additional to the general trade benefits (which are privately appropriated by industry) is, as the discussion paper acknowledges, likely to be small.

In conclusion, the justification for the different stakeholder contributions has not been fully demonstrated in the discussion paper. Having regard to efficiency considerations, it is questionable why the Crown and industry groups should face the same proportional increase in contributions. Having regard to equity considerations, it is questionable why private landowners should be relieved of liability through regional contributions while the Crown as landowner faces increased liability. Neither the Act nor economic principles give precise guidance to what the split between contributors should be, but the current proposal has the appearance of expediency and treating the Crown as a residual funder, a deep pocket to be picked.

[5] See Greer G, Bicknell K, Cullen R & Hickling G (1999) "Efficiency and effectiveness review of the Animal Health Board's Tb vector control programme"; Agribusiness & Economics Research Unit, Lincoln University. This noted among other things a mismatch between funds raised by different stakeholder groups, which led to expenditures being determined by the lowest contributor and some collected levy funds being accumulated and left unspent.

6. SUMMARY AND CONCLUSIONS

The purpose of this investigation is to provide an economic analysis of the proposed bovine tuberculosis national pest management strategy described in the Animal Health Board's discussion paper "*Towards a Tb free New Zealand*", paying particular attention to the economic incentives and resource use implications of this strategy. It does not aim to rework the AHB analysis, but rather assess the validity of the information, assumptions and frameworks used in support of the proposed strategy

Determining the optimality of the proposed strategy is not possible without agreed values for components in the analysis. To circumvent the problem of indeterminacy of risk probabilities, costs and benefits in biosecurity issues, the research investigated two sets of questions: first, whether the proposed strategy applies a framework which is appropriate, reasonable and internally consistent in light of its legislation and government intentions; and second, whether the actual assumptions and estimates used are reasonable, highlighting questions to consider rather than providing definitive alternatives.

Legal background of the Pest Management Strategy

The Biosecurity Act 1993 provides for National Pest Management Strategies to be made where the benefits are assessed to exceed the costs, with contributions from the Crown, local authorities and other parties. It requires a strategy to have a rationale for cost allocation between beneficiaries and exacerbators of the problem being addressed, but provides no guidance as to how this is to be done. Economic theory does not provide precise guidance on allocating shared costs, other than that an efficient allocation would have each contributor paying at least the marginal cost they impose on the system, but not more than the cost of their stand-alone alternative. The band defined by these principles can be wide, and the boundaries difficult to determine, so from both a legal and an economic perspective there is some latitude as to how costs are allocated between contributing parties.

Key components of the strategy

The key components of the proposed NPMS for bovine Tb vectors are:

- The goal has shifted from one of containment and management to eradication of bovine Tb;
- The annual expenditure requirement over the next 10 years doubles over that under the current strategy;
- The contribution sought from the Crown and industry more than doubles under the proposed allocation, but that from regional landowners contracts;
- The Crown, which has traditionally covered the funding of vector control on Crown land and buffer zones around such land, has been reassessed as a greater exacerbator than under the previous strategy, and its responsibility is extended to vector control over wider areas, including a 30% expansion of buffer zones down riverbanks along which vectors move and migrate;
- Despite a previous government decision to end the Crown's funding as beneficiary of vector control, the proposed strategy retains a 5% beneficiary contribution from the Crown, and public benefits in the form of conservation gains comprise more than 25% of quantifiable benefits.

Assumptions and rationale of the strategy

The rationale for the strategy is that the current level of bovine Tb poses a risk of trade disruptions from formal sanctions or consumer resistance in overseas markets, because of New Zealand's failure to comply with OIE standards and procedures. Other potential benefits are ignored because they are so small as to be negligible, as in the case of reducing the public health risk of humans contracting Tb, or internalised by the livestock industry in the case of on-farm production benefits.

An economically efficient response would be to develop alternative options for reducing such risk and choose the one which meets the OIE standards at least cost per unit risk reduction. But the discussion paper gives little detailed consideration of what alternatives there are, or what their cost and benefit implications might be.

The principal assumption behind the proposed strategy is that there is a potential trade loss from sanctions amounting to $1.29 million per trade ban incident, with a 2% risk of occurrence each year, which can be avoided by the strategy. This is based on the assumption that the ban would be instigated in premium markets for beef, dairy and venison products, diverting New Zealand produce to lower priced markets. The detailed estimation of these figures is not explained in the paper, but the order of magnitude of potential loss does not appear unreasonable.

More critical, however, is the probability of such a trade ban occurring, for it would be difficult to sustain a case for such a ban under World Trade Organisation rules. The EU in particular has higher Tb incidence than New Zealand in some member states and would be in a weak position to introduce a ban against New Zealand produce.

Another critical assumption is that the strategy can in fact deliver a level of bovine Tb incidence so low in 10 years that New Zealand can be internationally recognised as Tb-free. The marginal cost of eradication can be expected to rise the closer the goal of eradication is approached, and there is a risk that at the end of the strategy that the goal has not been achieved, but there is no evidence in the discussion paper that either of these possibilities have been taken into account.

The only other quantifiable benefit identified in the discussion paper is a public benefit to biodiversity conservation from possum control inherent in the strategy. This is valued at $10 million per year, estimated as 25% of the cost per hectare treated that the Department of Conservation currently spends on possum control, on the grounds that the areas treated for Tb-infected possums are not the highest priority areas for conservation. This is not an unreasonable method for assigning value to an intangible benefit, given that alternative methods are complex and contentious.

In summary, the figures in the discussion paper suggest an expected value of trade risk avoided of $25.8 million per year in constant dollar terms once eradication is achieved, and a further $10 million of public conservation benefit. In other words the ancillary benefit to conservation amounts to 28% of the quantified benefits.

Incentive structures resulting from the strategy

Although the costs of the proposed NPMS have been allocated by a process similar to that used in local government, the weightings to different components are not transparent and produce some unlikely results. In particular, the happy coincidence of both industry and Crown contributions increasing by the same proportion is difficult to square with their different beneficiary and exacerbator roles, and is unlikely to be efficient.

Providing incentive to minimise risk is usually served by placing responsibility close to those whose actions are able to affect the risk. So increasing the proportion of funding sought from the Crown removes some responsibility from those whose herd and land management practices most closely affect the risk of vector contact and infection. The AHB discussion paper provides no compelling explanation for why private landholder contributions through regional council rates should decline, or why vector control on riparian strips, whose management has traditionally been a responsibility of catchment authorities and landholders, should be transferred to the Crown. This may provide disincentive for cost effective measures against possums on the receiving environment of river banks and adjacent private land.

Some regional councils have been reluctant in the past to contribute to a national strategy which they perceive as benefiting other regions more than themselves, but this is not a sufficient reason to shift costs onto other contributors. The implicit assumption that the Crown is major exacerbator by virtue of the reservoirs of infected possums on Crown land is contradicted by the assumed public benefits to conservation quoted in the AHB paper: part of the benefit to conservation from possum control on private lands on the fringes of the public estate is to protect against the risk of re-infestation from those lands, caused by the potential flow of possums being two-way. In this context making the Crown solely responsible for funding possum control on river banks is likely to reduce the effectiveness of such control, and efficiency would be served by explicitly sharing the cost of such activity between exacerbator and beneficiary through some sort of matching contribution from the private landowners.

Consequences of the strategy

The proposition underlying the proposed strategy is that without eradication there is a continuing risk of trade ban faced each year in perpetuity. In addition there is a continuing requirement for possum control on the fringes of Crown land for conservation purposes, to which the paper attaches a $10 million annual value. Both these can be eliminated with eradication, and these avoided costs become potential benefits from the strategy received in perpetuity.

The AHB discussion paper states the Net Present Value of its proposed NPMS is $87 million and that this is robust to changes in assumptions used, but it cites no evidence of any sensitivity analysis of changing assumptions. No indication is given of how long it takes for this NPV to be achieved, there are inconsistencies in some of the figures given in the discussion paper, and we have not been able to replicate the results claimed by the AHB.

If the strategy were claimed as an entirely "new" investment, ignoring what has been achieved in previous years, the quantified benefits would not justify the resource commitments required. Treating the total strategy cost of $600 million over 10 years as the input requirement, the NPV is strongly negative into the long term future, even assuming eradication is successful.

If it is assumed, as the AHB paper does, that the expenditure at issue is just the additional increment to the current NPMS commitments of around $30 million per year, the quantified benefits will achieve a positive NPV given successful eradication. However, the discounted future benefits in perpetuity are modest, and the benefit cost ratio does not exceed 2 until more than 70 years after commencement. Allowing for the risks associated with the NPMS, both of failure to eradicate in the first instance, and of the risk of re-infection at some future date, it may not represent the best use of the available resources if it means diverting them from higher yielding uses elsewhere.

All these estimates are highly uncertain and it would be misleading to attach too much precision to the results. However, such analysis is useful in giving some shape and form to the expectations held for the strategy.

By way of comparison, the expected value of avoided trade bans would need to be three times those quoted in the AHB paper for the proposed NPMS to achieve a benefit cost ratio of 4 after 25 years, which is the cut-off ratio at which road proposals are accepted or declined for public funding. These options are not strictly comparable because the nature of the risks differ, but the comparison gives an indication that the evidence in the discussion paper for identifiable net benefits is a less than overwhelming endorsement of the national value of the proposed strategy, considering alternative potential uses of the resources.

APPENDIX A: SCALE OF TRADE BAN IMPACT

The table below illustrates attempts to reconcile the $1.29 billion total cost with the components given in the description of the trade ban impact in the AHB paper . Each block reconstructs a variant interpretation of the trade ban estimate, both undiscounted and discounted at 10%.

DR=	10%	Years =	1	2	3	4	5
		Total	**2 yr ban**		**Tail**		
A			*Quoted annual cost*		*20% loss of 1 yr costs*		
	Impact	**1958.4**	816	816	163.2	163.2	163.2
	Recovery	**256.8**	107	107	21.4	21.4	21.4
	Total $M	**2399.8**	**923**	**923**	**184.6**	**184.6**	**184.6**
	Total PV$M	**2179.4**	923.0	839.1	152.6	138.7	126.1
B			*Quoted cost/2 yrs*		*20% loss of 1 yr costs*		
	Impact	**979.2**	408	408	81.6	81.6	81.6
	Recovery	**128.4**	53.5	53.5	10.7	10.7	10.7
	Total $M	**1199.9**	**461.5**	**461.5**	**92.3**	**92.3**	**92.3**
	Total PV$M	**1089.7**	461.5	419.5	76.3	69.3	63.0
C					*20% lost export value only*		
	Impact	**1305.6**	408	408	163.2	163.2	163.2
	Recovery	**107**	53.5	53.5			
	Total $M	**1412.6**	**461.5**	**461.5**	**163.2**	**163.2**	**163.2**
	Total PV$M	**1250.0**	461.5	419.5	134.9	122.6	111.5
D					*20% loss of 2 yr costs*		
	Impact	**1142.4**	408	408	163.2	163.2	163.2
	Recovery	**149.8**	53.5	53.5	21.4	21.4	21.4
	Total $M	**1476.8**	**461.5**	**461.5**	**184.6**	**184.6**	**184.6**
	Total PV$M	**1298.4**	461.5	419.5	152.6	138.7	126.1
E					*Tail over two years only*		
	Impact	**1142.4**	408	408	163.2	163.2	
	Recovery	**149.8**	53.5	53.5	21.4	21.4	
	Total $M	**1292.2**	**461.5**	**461.5**	**184.6**	**184.6**	**0**
	Total PV$M	**1172.3**	461.5	419.5	152.6	138.7	0.0

Block A shows that treating the quoted component figures as "annual" costs produces a total impact far larger than $1.29 billion. The other blocks split these costs between the two years of the trade ban proper, and apply various combinations of impact and recovery cost in the tail. Block D is closest to yielding a present value total cost of $1.29 billion, but this requires the tail to reflect 20% of the two year cost (i.e. 40% of annual cost) of both impact and recovery, contrary to the paper's description; and convention would suggest rounding this up to $1.3 billion. Block E comes closest to $1.29 million in undiscounted terms, but the tail is spread only over two years, not three.

The significance of this table is not so much the precision of the figures, which are only able to indicate a ball-park estimate of the scale of potential impact, as with the clarity of the explanation and the thinking behind it. The $1.29 million figure appears to imply a smaller annual impact but a bigger lingering tail than that described in the text.