NOTE: The costs within this partial RIA are based on Defra’s Cost Benefit Analysis which was completed before the initial results from the proactively culled areas of the Randomised Badger Culling Trial became available. The analysis will be revised in the light of those results, further information arising from the Trial and responses to the consultation.

Title of Proposal


Purpose and intended effect

Objective:

2. To contribute to a sustained reduction in the incidence of bovine TB in cattle in high incidence areas in England. This will be achieved by reducing the rate of direct contact between cattle and the *M. bovis* agent originating from infectious badgers, and the indirect contact of cattle with an infected environment.

Background:

3. Bovine tuberculosis (bTB) is one of the most difficult animal health problems that the farming industry faces in GB today. The scale of the challenge facing both Government and industry in seeking to reverse the long-term upward disease trend is considerable.

4. Existing EU and domestic legislation governs the routine testing of cattle for bTB, notification of disease, slaughter valuation and compensation, and the restriction of the movement of animals in herds affected by disease. The disease is managed through regular testing of herds, and by slaughtering those animals that test positive. Animals reacting positively to the tuberculin skin test (known as reactors) are separated from the herd and sent for slaughter. If bTB is found in a herd, restrictions are imposed on movements onto and off the premises until all animals in the herd have been tested and been found clear on two consecutive occasions in the instance where infection was confirmed, or after one subsequent test where infection was not confirmed. In addition to the restrictions on movement the sale of non-heat treated milk and milk products to the public is also not allowed until the
restrictions are lifted. In a herd suffering a breakdown enquiries are carried out to find the origin of the disease. Movements off, and where relevant onto the property, are traced and tested and contiguous premises are tested.

5. Routine surveillance is carried out at either 1, 2, 3 or 4-year intervals depending on the incidence of TB in a parish. (Minimum testing intervals are specified in EU Directive 64/432).

6. Government’s strategic framework for the sustainable control of bovine TB (Defra report PB105 28) set out a 10-year vision for the future and the principles that will be applied in order to achieve this. The strategic framework is a sub-strategy of the wider Animal Health and Welfare Strategy.

**Government strategic framework - Vision:** To develop a new partnership based on the Animal Health and Welfare Strategy so that Government and stakeholders can work together to reduce the economic impact of bTB and maintain public health protection and animal health and welfare. We aim to slow down and prevent the geographic spread of bTB to areas currently free of the disease, and achieve a sustained reduction in disease incidence in cattle in high incidence areas.

7. A separate RIA sets out the proposals for addressing overcompensation for bTB. If overcompensation can be addressed fairly, it would remove the perverse incentives that presently exist whereby cattle farmers may not be taking all appropriate actions to prevent the introduction of bTB into their herd.

8. Pre-movement testing of cattle is a key measure to be implemented to achieve Defra’s PSA9 target. The aim of this is to reduce the spread of bTB to new parishes in England to below the incremental trend of 17.5 confirmed new incidents per annum by the end of 2008. This measure (for which there is also a separate RIA) will also contribute to reducing the spread of disease due to cattle movements within high incidence areas.

9. In the high incidence areas, where the majority of costs of pre-movement testing and compensation will fall, there is a reservoir of infection in the badger population. Without tackling this exogenous infection reservoir, cattle based measures alone may not be sufficient to have a significant impact on the incidence of disease.

10. Badgers are a native species that is widespread and common throughout most of GB. Badgers and their setts are protected by law under the Protection of Badgers Act 1992. They are also protected under the Wildlife and Countryside Act 1981. Under this legislation it is now illegal to injure, kill
or take a badger under any circumstances unless a licence has been granted. The Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats 1979) prohibits causing local disappearance or serious disturbance to badgers.

11. The only information about the number of badgers in Britain comes from two national surveys. The first survey (Cresswell, Harris & Jefferies, 1990) estimated the pre-breeding number of badgers in Britain to be approximately 250,000 (range 230,000 – 276,000). The second survey (Wilson, Harris & McLaren, 1997) suggested an increase in the number of social groups of 24% since the first survey. Although the authors did not publish a population estimate, applying the same figure of 5.9 badgers per social group gives a population estimate of about 296,000 (range 271,000 – 322,000). In a separate exercise, the authors used changes in badger activity levels to estimate that the badger population had increased by 77% since the first survey. Multiplying the first population estimate of 250,000 by this figure gives a higher population estimate of 442,500 (no confidence limits given).

12. The Protection of Badgers Act contains provision for removal of badgers for preventing the spread of disease. It has been Government policy not to issue licences whilst the Randomised Badger Culling Trial (RBCT) is in progress. The RBCT was intended to assess the effectiveness of badger culling as a means of controlling TB in cattle.

13. Farmers in high incidence areas perceive the Government initiatives on pre-movement testing and the compensation changes to be unfair in the absence of action from Government to address the reservoir of infection in the protected badger population. Against this, we know that badgers are also valued and cherished by the general public.

14. The Independent Scientific Group (ISG) will present initial findings of the Randomised Badger Culling Trial (the headline figure of the influence of proactive culling on the number of TB breakdowns in cattle) to Defra in 2006, though the final report will not be presented to Ministers until 2007. The Group published a summary of the interim analyses of the data from the proactive culling treatment in December 2005. This showed a decrease in cattle herd breakdowns over the areas culled, averaging 19% (CI 6-30%) after the first cull to 23% (CI 6.5-36%) after the first follow-up culls. Results from areas outside the trial but within 2 km of the boundary of proactively culled areas, show a 29% (CI 5-58%) initial increase in herd breakdowns, and a strong trend to an increase of 22% (CI 6.9% decrease-59% increase) in breakdowns after the first follow-up cull. Further analyses of the data will be undertaken once the Randomised Badger Culling Trial has finished.

15. The Irish Four Areas Trial, published early 2005 (Griffin et al., 2005), has shown that in the four areas examined, there was a lower probability of herds
being under restriction in the areas where badgers had been removed compared to the reference areas.

16. The bTB strategy made clear that, in developing policy decisions on badger management Government would take into account the scientific evidence, (recognising decisions may be made in light of uncertainty), costs and benefits, conservation, animal welfare and views of wider society. Any badger management policy would also need to be balanced with cattle control measures.

17. Estimates of costs and benefits in this RIA are taken from an internal Defra cost benefit analysis (CBA).

Rationale for government intervention

18. bTB is a serious infectious and zoonotic disease of both humans and animals, though the cattle measures in place mean the risk to human health is currently very low. There are major regional variations in the incidence of the disease in cattle. Around 6% of GB cattle herds were affected by bTB restrictions at some point during 2003. 95% of confirmed new incidents occurred in the south west of England, Cumbria, central and south Wales. Despite the surveillance and control measures in place, the long-term trend is for an increasing incidence in cattle herds of about 18% per annum (see Annex B figures 1.1 – 1.4 and 2), with costs to Government and industry increasing year on year. Government expenditure in 2004/5 was forecast at £92 million.

19. The average length of time that a herd remains under restriction has risen steadily over the last 10 years. Between 1997 and 2002 the average duration of a herd restriction due to a confirmed incident of bTB has increased from 215 days to 292 days (the average duration due to an unconfirmed incident over the same period has increased from 113 days to 149 days) (see Annex B figures 3.1 & 3.2).

20. Veterinary advice is that fundamental principles of infectious disease control need to be employed to reduce the risk of transmission of disease from badgers to cattle. At present, the only method known to reduce the number of infectious badgers is lethal removal. This would permit a balanced approach to bTB control that deals with the principle transmission risks.

21. The primary reason for concern about the spread of bTB and the justification for further intervention is the need to reduce the economic cost to both the taxpayer and industry. The economic benefits to the farming industry of a lower incidence

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1 95% of confirmed new incidents occurred in the following counties: Devon, Cornwall, Hereford & Worcestershire, Dyfed, Gloucestershire, Powys, Somerset, Wiltshire, Staffordshire, Shropshire, Avon, Derbyshire, Gwent, Dorset, Cumbria, Cheshire and West Glamorgan.
of bTB would be the reduction in the short term costs of movement restrictions, testing and lost output (as estimated in the CBA, Defra research report, SE3122; Sheppard & Turner, 2005)). There is also the reduction in the loss of productivity, the risk of loss of consumer confidence in the product and the possible closure to some international markets. However, the cost of surveillance, control and compensation, as well as research, associated with bTB currently falls largely to the taxpayer.

22. Decisions about whether or not to introduce a badger control policy in the short term must be seen against the current upward disease trend, the value society places on badgers, the need to win co-operation with farmers on introducing movement testing and compensation, and the wider objective of industry, over time, bearing a progressively greater share of the costs of bTB controls.

23. The publication of the interim RBCT results has shown that perturbation which could increase bovine TB breakdowns in surrounding herds may be a risk to any culling policy. On the current timetable, detailed analysis of the results of the proactive treatment will be ready in 2007. The Independent Scientific Review of the RBCT and associated epidemiological research, published in March 2004 indicated that results may be inconclusive, difficult to interpret and that it may take longer than originally projected before firm trends might emerge. The reactive triplet results were reported in November 2003 as showing a biologically unexplained 27% increase in herd breakdowns compared to the survey-only triplets, at which point Ministers suspended the reactive treatment. Subsequent spatio-temporal analyses of the reactive culling data have shown equivocal results. Further analyses of the data need to be undertaken before conclusions may be drawn.

24. The Irish Four Areas Trial published in January 2005 (Griffin et al., 2005) is the latest published evidence showing that removal of badgers has been effective in reducing bovine TB in the Republic of Ireland.

25. Decisions on whether and how to intervene in badger populations to control bTB in cattle must recognise the uncertainty within the scientific evidence base. The existence of a reservoir of infection in badgers seems likely to be a factor in our ability to control the disease in cattle in high incidence areas. Due to the persistence of M.bovis in cattle and badgers in parts of England, sporadic cases of infection in companion animals and other spill-over hosts living on farms and in rural or suburban premises are not unexpected (6 cases in domestic cats in 2004). After considering the scientific evidence including a review of the international literature that he commissioned and advice from the Science Advisory Council, Defra's Chief Scientific Adviser has concluded that, on balance, badger culling can contribute to a reduction in herd breakdowns if intensive removal over a wide area is practised, but it does not allow any recommendations to any particular approach to culling or provide any means of predicting the effectiveness in terms of reduction of herd breakdown. However, data from interim analyses of the proactive element of the RBCT indicate that, if
not conducted efficiently and over a wide area, there is a possibility that culling could lead to an increase in the spread of disease due to perturbation effects; this needs further, careful analysis.

26. Although vaccination of cattle and/or badgers remains Government’s long-term aim, it is not anticipated that an effective vaccination policy could be in place within the next 10 years. In any case, once available, it is likely that to be effective, a vaccination policy would need to be combined with a culling policy.

27. In conclusion, the introduction of effective badger control measures alongside cattle measures, has the potential to make, over time, a contribution to disease control objectives in high incidence areas. However, the level of risk presented by perturbation is unknown and cannot be ignored.

Consultation

28. Government held a 3-month public consultation in February 2004: ‘Preparing for a new GB strategy on bovine TB’ (Defra report PB 9066). One of the main purposes of the consultation was to consider options for badger management/control against the various possible outcomes of the RBCT.

29. The written consultation was supported by a series of regional meetings with stakeholders across GB. Views of key stakeholder organisations on the principle of whether there should be some form of badger control to reduce bTB are well known. There are strongly opposing views that cannot be reconciled. Views on particular badger culling options have not, to date, been sought.

Options

Option 1: No badger management (at least pending the outcome of the RBCT):

30. Rely on action to improve surveillance for and control of disease in cattle until such time as sufficient evidence to support a specific culling policy, or a vaccine is available.

Option 2: State controlled cull:

31. Defra, or one of its delivery agencies, would be responsible for carrying out badger culling in target areas using powers under the Animal Health Act 1981. This method relies on obtaining landowner consent. Sett based control using gassing can be considered under this option. Experience from
establishment of the existing Wildlife Unit (WLU) suggests a long lead time for recruiting and training staff (3 years for the RBCT). As currently staffed, the WLU could cull over 1000 km$^2$ approximately.

32. Because of the intermittent nature of state culling, target areas would need to be large enough (similar to those identified in the RBCT or the Irish Four Areas Trial – 100 or 250 km$^2$) to minimise “edge effects”. In order to be effective and avoid potential perturbation effects it is envisaged that culling would have to be carried out more than once a year, and would have to be carried out for at least five years (although this might need to be reconsidered in the light of ongoing monitoring).

**Option 2a - RBCT proactive cull methodology: trapping and shooting with a handgun**

33. Teams of two will carry out a primary survey and cull in year 1, followed by secondary survey and single cull in years 2 to 5. Eight nights (days) effort would be expended on the trapping procedure itself. Culling would be carried out over an area of 100 km$^2$.

**Option 2b – Restrains method (based on RoI four areas trial methodology), snaring and shooting.**

34. In the RoI Trial set restraints in any area 2-3 times a year, with contracted staff. This exact approach is unfeasible in GB for Health & Safety and security reasons (if inspection through the night is required). Therefore, similar costs for restraints have been used, but with different team sizes, and frequency of culls. GB overheads and capital costs are also included instead of ROI equivalents.

35. Teams of two will carry out primary survey and 2 culls in year 1, followed by 2 culls a year in years 2 to 5. Four nights (5 days) effort would be expended on restraining and dispatching. Primarily snaring will occur at sett entrances. Culling will be carried out over an area of 250 km$^2$.

**Option 2c - RBCT proactive cull methodology using sett based control. Gasssing.**

36. Teams of 4: Primary survey and cull in year 1, followed by 1 cull a year in years 2 to 5. Assumed that half of setts require re-gassing in a given year. 100 km$^2$ areas.

37. This would permit small local groups of landowners to take responsibility for the control of disease in cattle through control of the local disease reservoir in badgers, until such time as a vaccine is available. Licences would be issued under the Badger Protection Act to permit the culling of badgers in target areas. There would be no charge for a license.

38. Applications would need to be made by groups of farmers, although the licence would need to be issued to the person(s) who would actually carry out the culling activity. Methods available would include stop restraint and shooting or shooting of free running badgers. Trapping and shooting would not be permitted, as killing trapped badgers requires the use of a handgun. If rifles were to be used, firearms certificates would need to be amended to cover badgers.

39. Because licences would be issued for relatively small areas (3 to 20 km²), the efficiency of culling would need to be very high in order to avoid edge and perturbation effects.

40. Issuing of licences would be subject to the requirement that landowners can achieve 75% coverage of the licensed culling area. The culling area would extend 1-2.5 km from boundaries of land associated with herds in 1-2 year testing parishes with a disease history of 2 confirmed new incidents (CNI’s) in 4 years and/or movement restrictions in place for more than 24 months.

41. It is assumed that farmers will survey in year 1 and cull around 3 times per year for years 1 to 5 (4 nights effort at a time).

42. This option is not “reactive culling” as carried out in the RBCT. This was carried out in response to a single breakdown (i.e. including new breakdowns where there was no reason to suppose that there was badger involvement) and was carried out only once, often inefficiently, thus maximising any possible perturbation effects.

Farmer delivered culling over larger eg 250 km² areas has also been considered as a variant. This would be delivered by specific licences or using a general licence under the Protection of Badgers Act. The Act would need to be amended to provide for such a general licence.

43. Costs and benefits

Sectors and groups affected

Note: This report was completed before the initial results from the proactively culled areas of the Randomised Badger Culling Trial became available. The analysis will be revised in the light of those results, further information arising from the Trial and responses to the consultation.
44. The monetary estimates in this RIA take account of the quantifiable impact on farm businesses and Government (taxpayers).

45. Cattle farming businesses and landowners in high incidence bTB areas in England will be affected by any proposal to manage badger populations in these areas.

46. Government and Government Agencies will be affected as a result of administering and possibly delivering the policy, paying compensation for reactor cattle, funding routine surveillance and disease control tests, addressing policing/security issues that arise in delivering any badger culling policy, measuring the effectiveness of the measure and monitoring the impacts on badger populations and wider ecological impacts.

47. Badger protection and welfare groups will be affected as badger populations in high incidence TB areas will be reduced as a result of any badger management policy. In terms of tourism, businesses which organise badger watching excursions and individuals who watch badgers independently may also be affected.

**Analysis of costs and benefits**

48. **NB:** This analysis is based on a wide range of scientific, veterinary and cost assumptions. As a result there is a high degree of uncertainty about the estimates presented, particularly as they relate to the effect of badger removal on the incidence of bTB in cattle. The headline values arise from assuming that about half of all confirmed TB incidents arise from badger-to-cattle transmission and that these can be reduced in proportion to the reduction in badger population.

49. This analysis relates to the impact of each policy option for a given area of land rather than for any particular region or locality within the United Kingdom. The main figures cover a period of 10 years, assuming that a culling policy is operated for 5 years and that benefits continue to be experienced for a further 5 years after culling ends. This reflects a prudent planning period, the possible introduction of a vaccine or other policy developments, and general increased uncertainty about behaviour of repopulating badgers and prevalence of bTB.

50. Assessment of possible policing costs will be made in the course of consultation.

51. Badgers culled for disease control purposes will be classed as category 1 waste under the Animal By-Products Order and must be disposed of accordingly (with incineration the norm). Costs of badger carcase disposal have been estimated as £75/badger.
52. Further discussion of the assumptions used to generate the costs and benefits estimates are described in Annex A

**Option 1: No badger management**

**Economic costs**
53. It would be expected that the current trends for increase in incidence and spread of the disease in high incidence areas would continue. The current loss per herd due to bTB would persist. An average cost of a herd breakdown in high incidence areas in England is estimated at £18,000 with potential impact on other herds adding another £9,000. A detailed break down of this cost can be seen in Table 1.

54. It is against this cost that the costs of the other options are compared to assess the benefits of each strategy. Introduction of the new compensation arrangements would reduce significantly Government spending on bTB. However, over the long term the rate of increase would be expected to continue as at present.

55. A decision to follow this approach could be subject to challenge on the basis of refusal to issue licenses under the Protection of Badgers Act 1992 for preventing spread of disease.

**Economic Benefits**
56. None identified.

**Environmental/social costs**
57. There are social costs associated with continuing hardship and suffering of farmers in areas of high bTB incidence. A recent report from the University of Exeter (Sheppard & Turner, 2005) highlighted stress amongst farmers in the South West of England due to bTB in their herds. Doing nothing offers little hope for these farmers. This option also risks an increase in illegal badger culling – potentially using inhumane methods. Uncoordinated action by farmers could worsen the disease situation in their cattle due to possible perturbation of the badger population.

**Environmental/social benefits**
58. We know that badgers are highly cherished by the British public. A decision not to manage badgers to help control bTB is consistent with what we know about wider public opinion on the issue. A recent Defra funded University of Reading study (SE3116) provided some information on this; 83% respondents thought badgers to be an important wildlife species in Britain; 71% thought management wildlife sometimes necessary though 73% objected to badgers being intentionally killed; 51% thought there could be fewer badgers as long as they don’t become endangered and; 92% agreed that controlling bTB is important.
Table 1: Estimate of the cost of a cattle herd breakdown (CHB)

<table>
<thead>
<tr>
<th>Benefit resulting from saving one CHB</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loss of slaughtered cattle</strong></td>
<td></td>
</tr>
<tr>
<td>Per animal</td>
<td></td>
</tr>
<tr>
<td>Compensated value</td>
<td>£849</td>
</tr>
<tr>
<td>- salvage + haulage</td>
<td>-£189</td>
</tr>
<tr>
<td>Other losses to farmer</td>
<td>£309</td>
</tr>
<tr>
<td>Number of animals</td>
<td>9.7</td>
</tr>
<tr>
<td></td>
<td>£9,369</td>
</tr>
<tr>
<td><strong>Restrictions</strong></td>
<td>£439</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>£224</td>
</tr>
<tr>
<td><strong>Testing (breakdown testing until clear)</strong></td>
<td></td>
</tr>
<tr>
<td>Per test</td>
<td></td>
</tr>
<tr>
<td>Costs to farmer</td>
<td>£336</td>
</tr>
<tr>
<td>Costs to Defra</td>
<td>£1,115</td>
</tr>
<tr>
<td>Number of tests</td>
<td>5.4</td>
</tr>
<tr>
<td>Costs to farmer</td>
<td>£1,823</td>
</tr>
<tr>
<td>Costs to Defra</td>
<td>£6,041</td>
</tr>
<tr>
<td>Contiguous and traced tests avoided</td>
<td>£2,263</td>
</tr>
<tr>
<td>Spread to other herds prevented</td>
<td>£6,603</td>
</tr>
<tr>
<td></td>
<td>£26,762</td>
</tr>
</tbody>
</table>

**Option 2a – RBCT proactive cull methodology**

Economic costs
59. The costs per km$^2$ of RBCT proactive methodology were calculated using the costings model developed by Reading University (Defra report SE3112) were updated to reflect changes in staff, fuel, vehicle and other costs. The costing framework produces an average cost of the operation per km$^2$ per year of £4100 using parameters as they are in the current RBCT.

60. This figure was validated with a top-down approach considering the annual cost of the Defra Wildlife Unit (WLU) and how much area is covered in the proactive culls. In financial year 2003–2004 the WLU included 133 field staff, and cost £6.8M to run. WLU staff estimate around 60% of this cost was associated with the culling effort (as opposed to other research activity) in 10 areas of 100 km$^2$. This equates to an annual cost of £4080 per km$^2$. 
61. Changes to the input parameters of the costings model were made, to reflect the fact that the RBCT is a trial with scientific, rather than disease control objectives. Overheads have therefore been reduced to reflect how the methodology might be applied if it were adopted as a policy to control badger numbers.

62. **It is estimated that a 5 year operation will have average annual costs of £3,779 per km$^2$.**

63. The breakdown of these costs (discounted) over a 5 year period are as follows:

Table 2: Estimated costs of carrying out a culling strategy based on the RBCT methodology. Discrepancies will be due to rounding error.

<table>
<thead>
<tr>
<th>Summary of costs over 5 years (discounted).</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>cost of primary surveying</td>
<td>£4,244</td>
</tr>
<tr>
<td>cost of secondary surveying</td>
<td>£2,497</td>
</tr>
<tr>
<td>cost of subsequent culls</td>
<td>£9,172</td>
</tr>
<tr>
<td>Monitoring</td>
<td>£1,563</td>
</tr>
<tr>
<td>farmer costs</td>
<td>£234</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>£17,709</strong></td>
</tr>
</tbody>
</table>

**Economic benefits**

64. In light of the assumptions made in the economic model, over 5 years the headline figures assume an average reduction in herd breakdowns of 0.028 CHB per km$^2$ per year. Over 5 years this would result in total benefits of £6,120 per km$^2$ (discounted to present value).

**Summary**

65. Taking the costs of this strategy into account the net present value (NPV) of this option is -£11,590 per km$^2$, i.e. this strategy is estimated to increase the costs of managing bTB by £11,590 per km$^2$. (This data is summarised in tables 7 & 8).

66. For this option to break even (NPV $\geq$ 0) it estimated that a reduction in cattle herd break downs of 89% per km$^2$ per year would need to be achieved (Table 9).

67. As with all the other three culling strategies (2b, 2c & 3). Benefits in reduced CHB’s would be expected to take some time to be realised. In the shorter term policies would be expected to have an effect on shortening breakdowns and reducing reactor numbers.
Option 2b – Restraints method (based on four areas trial methodology)

Economic costs
68. Most overheads were identical to those in option 2a, but the policy is significantly cheaper because teams can cover areas much more quickly. The policy also captures more badgers as two 4-day operations per year are assumed.

69. It is estimated that the average annual cost of this policy over 5 years to be £2,387 per km\(^2\).

70. The breakdown of these costs (discounted) over a 5 year period are as follows.

<table>
<thead>
<tr>
<th>Summary of costs over 5 years (discounted)</th>
<th>£/km(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>primary survey and 1st cull</td>
<td>£2,454</td>
</tr>
<tr>
<td>cost of secondary surveys</td>
<td>£2,427</td>
</tr>
<tr>
<td>cost of subsequent culls</td>
<td>£4,450</td>
</tr>
<tr>
<td>farmer costs</td>
<td>£234</td>
</tr>
<tr>
<td>Monitoring</td>
<td>£1,563</td>
</tr>
<tr>
<td>Total</td>
<td>£11,128</td>
</tr>
</tbody>
</table>

Economic benefits
71. In light of the assumptions made in the economic model, over 5 years a reduction in herd breakdowns of 0.036 CHB per km\(^2\) per year is assumed. Over 5 years this would result in total benefits of £7,922 per km\(^2\).

Summary
72. Taking the costs of this strategy into account the NPV of this option is -£3,206 per km\(^2\), i.e. this strategy is estimated to increase the costs of managing TB by £3,206 per km\(^2\). (This data is summarised in tables 7 & 8).

73. For this option to break even (NPV ≥ 0) it estimated that a reduction in cattle herd break downs of 56% per km\(^2\) per year would need to be achieved (Table 9).

Option 2c – RBCT proactive cull methodology using sett based control (gassing)
Economic costs

74. Most overheads were identical to those in Option 2a, but the policy is significantly cheaper because teams can cover areas more quickly. In any one operation the policy captures a higher proportion of badgers present since gassing is assumed to be more effective than trapping and shooting, and half of all setts are re-gassed.

75. **It is estimated that the average annual cost of this policy over five years to be £2,462 per km².**

76. The breakdown of these costs (discounted) over a 5 year period are as follows.

Table 4: Estimated costs of carrying out a culling strategy using sett based controls. Discrepancies will be due to rounding error.

<table>
<thead>
<tr>
<th>Summary of costs over 5 years (discounted)</th>
<th>£/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>primary survey and 1st cull</td>
<td>£2,917</td>
</tr>
<tr>
<td>secondary surveys</td>
<td>£2,760</td>
</tr>
<tr>
<td>cost of subsequent culls</td>
<td>£4,041</td>
</tr>
<tr>
<td>Farmer costs</td>
<td>£234</td>
</tr>
<tr>
<td>Monitoring</td>
<td>£1,563</td>
</tr>
<tr>
<td>Total</td>
<td>£11,514</td>
</tr>
</tbody>
</table>

Economic benefits:

77. In light of the assumptions made in the economic model, over 5 years a reduction in herd breakdowns of 0.038 CHB per km² per year is assumed. Over 5 years this would result in total benefits of £8,425 per km².

Summary

78. Therefore taking the costs of this strategy into account the NPV of this option is £3,089 km², i.e. this strategy is estimated to increase the costs of managing bTB by £3,089 per km². (This data is summarised in tables 7 & 8).

79. For this option to break even (NPV ≥ 0) it estimated that a reduction in cattle herd break downs of 57% per km² per year would need to be achieved (Table 9).
Environmental and social impacts of options 2 a, b, c

Environmental costs
80. Widespread removal of badgers would create tensions with conservation commitments under the Bern Convention. Wide scale or long term removal could impact on other species or habitats. Potentially negative effects include increased fox populations and a decline in the numbers of brown hare, a high priority species under UK Biodiversity Action Plan. Against that, badger removal appears to result in increased numbers of hedgehogs.

Environmental benefits
81. A state controlled policy would be more easy to monitor in terms of humaneness of culling and control of culling over targeted areas. Evidence from field trials suggests that efficient culling over larger areas and maintaining low badger numbers can deliver benefits in cattle herd breakdowns. It also minimises risks from perturbation, where disturbance of the badger population results in increased contact and transmission between badgers and increased risks to cattle.

Social costs
82. As set out in relation to Option 1

Social benefits
83. A badger culling policy that was effective in reducing the severity and number of CHB’s in high incidence areas would lessen the stress and financial hardship caused to farmers by bTB breakdowns.

Option 3 – Licensing groups of farmers to cull under the Protection of Badgers Act 1992.

Economic costs
84. Capital costs and overheads are reduced heavily in this method. Assumptions have been made regarding how much farm capital depreciation will be associated with culling effort, compared to other farming activities. A standard value is placed on farmers’ time.

85. It is estimated that the average annual cost of this policy over five years to be £ 909 per km$^2$, although this depends heavily on farmer behaviour in response to a successful licence application. Costings have been done on the assumption that smaller targeted areas would coalesce to make larger areas, but without detailed consideration of where or how big those areas actually are.
86. The breakdown of these costs (discounted) over a 5 year period are as follows.

Table 5: Estimated costs for carrying out a culling strategy involving licensing landowners. Discrepancies will be due to rounding error.

<table>
<thead>
<tr>
<th>Summary of costs over 5 years (discounted.)</th>
<th>£/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>License admin</td>
<td>£30</td>
</tr>
<tr>
<td>Survey and first cull</td>
<td>£1,049</td>
</tr>
<tr>
<td>subsequent culls</td>
<td>£2,299</td>
</tr>
<tr>
<td>Monitoring</td>
<td>£2,605</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>£5,983</strong></td>
</tr>
</tbody>
</table>

87. This option applied over larger areas would be expected to involve additional costs in co-ordinating the consent, licensing and culling operations on behalf of many more landowners.

Economic benefits

88. In light of the assumptions made in the economic model, over 5 a reduction in herd breakdowns of 0.036 CHB per km² per year is assumed. Over 5 years this would amount to total benefits of £7,922 per km².

89. Applying this option over a larger area would result in a less targeted approach, meaning that there would be cattle incidents in the area to be culled that might be less likely on average to be related to badgers. Larger areas might be less homogenous in terms of land use and may have lower social cohesion. This might lead to lower participation rates. This differences might be expected to reduce the effect of culling on bTB reduction in cattle.

Summary

90. Taking the costs of this strategy into account the NPV of this option is +£1,939 per km², i.e. this strategy is estimated to reduce the costs of managing bTB by £1,939 per km². (This data is summarised in tables 7 & 8).

91. For this option to break even (NPV ≥ 0) it estimated that a reduction in cattle herd break downs of 30% per km² per year would need to be achieved (Table 9).

92. Further analysis is needed over the scale (and detailed criteria) should a farmer licensing approach be pursued further. The interim RBCT results as presented in the ISG’s letter may tend to support the importance of the following factors in combination in determining the effect of any culling policy on bTB in cattle: large, bounded areas, high participation, effective culling methods and coherent targeting.
**Environmental and social impacts**

**Environmental costs**

93. Although there is no direct scientific evidence for the efficacy of this specific methodology, present scientific evidence indicates, on balance, that the intensive removal of badgers from an area can contribute to a reduction in herd breakdowns.

94. Careful scientific monitoring and analysis of the expected benefits and the effects on wildlife will be necessary to reduce the risks of unnecessary and ineffective removal of badgers.

95. In relation to larger areas, the environmental costs could be similar to option 2, though low uptake is likely to increase any edge effects.

**Environmental benefits**

96. Targeted culling under licence minimises conservation concerns. If high levels of culling efficiency are achieved it would avoid perturbation/edge effects. This benefit is less likely to be achieved if this approach is applied over large areas.

**Social costs**

97. As set out in relation to **Option 1**

**Social benefits**

98. A badger culling policy that was effective in reducing the severity and number of CHB’s in high incidence areas would lessen the stress and financial hardship caused to farmers by bTB breakdowns.

**Summary of costs and benefits**

99. On the basis of the above analysis, compared with the no badger management option, option 3 (licensing farmers in small, targeted areas) is likely to be the most cost-effective approach. Option three also requires the smallest reduction confirmed new incidents of bTB to allow the policy to break even. (figure 1.)

100. Table 6 shows the distribution of costs and benefits of each culling option for farmers and taxpayers. It is important to recognise that currently, it is the taxpayer who bears the bulk of the costs of bTB surveillance and control (see Rationale section). With the exception of option 3, all the options result in increased net costs to the taxpayer, with net benefits falling to farmers.
Figure 1. Breakeven analysis: Impact on bTB in cattle needed to justify costs of badger removal

Table 6: Estimated division of costs and benefits for each culling option

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
<th>Costs £/km²</th>
<th>Benefits £/km²</th>
<th>NPV £/km²</th>
<th>Costs £/km²</th>
<th>Benefits £/km²</th>
<th>NPV £/km²</th>
<th>Total NPV £/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>RBCT cages</td>
<td>£234</td>
<td>£1,182</td>
<td>£1,638</td>
<td>£17,476</td>
<td>£4,248</td>
<td>£13,228</td>
<td>£11,590</td>
</tr>
<tr>
<td>2b</td>
<td>Defra restraints</td>
<td>£234</td>
<td>£2,423</td>
<td>£2,190</td>
<td>£10,894</td>
<td>£5,498</td>
<td>£5,396</td>
<td>£3,206</td>
</tr>
<tr>
<td>2c</td>
<td>Defra passing</td>
<td>£234</td>
<td>£2,577</td>
<td>£2,344</td>
<td>£11,280</td>
<td>£5,848</td>
<td>£5,433</td>
<td>£3,089</td>
</tr>
<tr>
<td>3</td>
<td>Licensing (restraints)</td>
<td>£3,348</td>
<td>£2,423</td>
<td>-£925</td>
<td>£2,635</td>
<td>£5,498</td>
<td>£2,864</td>
<td>£1,939</td>
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</tbody>
</table>

101. The main calculations in this CBA assume standard levels of benefit per CNI prevented and per km². In reality there are wide variations in the incidence of bTB within the high incidence areas and variations in the enterprise mix in those areas. Both of these factors change the expected benefits.

102. The following table illustrates the point about enterprise mix. Even within areas of cattle production there are likely to be wide variations in intensity of operation and value of cattle. The average costs of a CNI using the method set out earlier is about two and a half times higher in £/km² on a dairy farm than a beef farm (assumed here to be a low ground cattle/sheep farm).
Table 7. The cost of a CNI dependent on beef and dairy farming

<table>
<thead>
<tr>
<th>Farm type</th>
<th>BEEF</th>
<th>DAIRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughters</td>
<td>£4,341</td>
<td>£13,705</td>
</tr>
<tr>
<td>Restrictions and isolation</td>
<td>£205</td>
<td>£1,067</td>
</tr>
<tr>
<td>Testing</td>
<td>£5,195</td>
<td>£9,197</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>£9,741</td>
<td>£23,969</td>
</tr>
</tbody>
</table>

103. It follows that if badger removal is similar in terms of cost per km² then it is likely to be more cost-effective where there is a high intensity of cattle production - particularly dairy production - and a high likelihood of bTB incidents (assuming a similar proportion of them are caused by badgers).

104. The tables below summarise the figures discussed with respect to the culling options above.

Table 8: Estimated total costs of the different culling options

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
<th>Costsaverage£/km²/year</th>
<th>Present valueof costs£/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>RBCT cages</td>
<td>£3,799</td>
<td>£17,709</td>
</tr>
<tr>
<td>2b</td>
<td>Defra restraints</td>
<td>£2,387</td>
<td>£11,128</td>
</tr>
<tr>
<td>2c</td>
<td>Defra sett-based</td>
<td>£2,462</td>
<td>£11,514</td>
</tr>
<tr>
<td>3</td>
<td>Licensing (restraints)</td>
<td>£909</td>
<td>£5,983</td>
</tr>
</tbody>
</table>

Table 9: Comparison of the estimated costs and benefits associated with each culling option

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
<th>Present valueof costs£/km²</th>
<th>Present valueof benefits£/km²</th>
<th>NPV £/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>RBCT cages</td>
<td>£17,709</td>
<td>£6,120</td>
<td>-£11,590</td>
</tr>
<tr>
<td>2b</td>
<td>Defra restraints</td>
<td>£11,128</td>
<td>£7,922</td>
<td>-£3,206</td>
</tr>
<tr>
<td>2c</td>
<td>Defra sett-based</td>
<td>£11,514</td>
<td>£8,425</td>
<td>-£3,089</td>
</tr>
<tr>
<td>3</td>
<td>Licensing (restraints)</td>
<td>£5,983</td>
<td>£7,922</td>
<td>+£1,939</td>
</tr>
</tbody>
</table>
Table 10: The average reduction in CHBs/km²/year needed to produce NPV>0, i.e. the effectiveness level which would allow the policy to break even.

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
<th>Average reduction in CNIs/km²/year (simplified assumptions)</th>
<th>Average reduction in CNIs/km²/year needed to produce NPV&gt;0</th>
<th>Average reduction in CNIs/km²/year needed to produce NPV&gt;0 (as a percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>RBCT cages</td>
<td>0.028</td>
<td>0.080</td>
<td>89%</td>
</tr>
<tr>
<td>2b</td>
<td>Defra restraints</td>
<td>0.036</td>
<td>0.050</td>
<td>56%</td>
</tr>
<tr>
<td>2c</td>
<td>Defra sett-based</td>
<td>0.038</td>
<td>0.051</td>
<td>57%</td>
</tr>
<tr>
<td>3</td>
<td>Licensing (restraints)</td>
<td>0.036</td>
<td>0.027</td>
<td>30%</td>
</tr>
</tbody>
</table>

Small Firms Impact Test

105. For the purpose of Regulatory Impact Assessments, small firms are firms with:

- fewer than 50 employees;
- no more than 25% of the business owned by another enterprise (which is not a small business);
- and either
  - less than £4.44 million annual turnover; or
  - less than £3.18 million annual balance sheet total.

106. Based on these criteria, virtually all farms in England are small firms and only 0.2% of farms are not small firms. The impact of the proposal on farms is set out in the “Costs and benefits” section above, and includes both cash and non-cash impacts.

Competition assessment

107. The relevant market is the market in cattle products, primarily beef and milk. Both have an international dimension since both beef and dairy products are traded within the EU. The policy options will primarily affect cattle farmers in the areas of England where bTB incidence is the highest. Affected beef and dairy farmers comprise almost one third of the farms in England with cattle, but a small section of the market internationally.
108. No business has more than 10% of the market, and the three largest businesses have less than 50% market share. The regulation will affect some farms substantially more than others, since only those farms subject to, or affected by a culling policy will be affected. The requirement for licensing would lead to extra initial and continuing costs when compared to farms not operating a cull; however individual farms would be free to participate according to their own business criteria. The sector is not characterised by rapid technological change. The requirement will have minimal impact on market structure.

109. Overall, there are no anti-competitive effects of this policy which would have detrimental effects on consumers.

**Enforcement, sanctions and monitoring**

110. Under all possible badger management options, there will be a need for Government to monitor badger populations and wider ecological impacts of any badger culling in order to ensure that conservation objectives and welfare standards are met. Although detailed arrangements are under consideration these costs are likely to be substantial.

111. Cattle herd breakdowns and indicators of the severity of those breakdowns e.g. number of reactors / breakdown, or length of time under restriction will also need to be monitored to assess effectiveness of the measure. Details are under consideration.

112. Option 1: If a decision is taken not to permit badger culling, or a decision is delayed and there was less farmer co-operation for disease control measures, this would lead to increased enforcement requirement for the SVS in relation to cattle surveillance and control measures for bTB, particularly pre-movement testing. Any increased illegal badger culling would lead to increase demands for police involvement.

113. Option 2: One obstacle to this strategy could be the refusal of landowners to permit access to Defra agents who are to carry out the culling. To overcome this, powers of entry could be use to gain access. However, at this time there is no intention to invoke these powers. This approach is also most readily subject to interference by those opposing the policy.

114. Option 3: This provides for voluntary action by landowners. There is no element of compulsion to apply for a licence. They will also have to achieve a coverage of 75% of the required culling area. Applicants must have written permission from all landowners on whose land they will be carrying out the culling. License approval may be dependent on applicants agreeing to carry out additional bio-security measures to reduce badger-cattle interaction.
115. Compliance with the requirements of the culling policy will be measured through field inspections of 10% of licensees every year.

116. Non-compliance with conditions of the license will be a criminal offence under the Protection of Badgers Act 1992. Details of what sanctions will/can be invoked if a licensee or group of licensees fails to cull a sufficient number of badgers will be considered in the consultation period.

117. Monitoring of the incidence of bTB in cattle will continue with current surveillance techniques. The number of badgers culled will be monitored through 6 monthly returns by the licensees. Other monitoring arrangements for badger populations and other wider ecological impacts will be worked up during the consultation period.

**Implementation and delivery plan**

118. [To be completed after consultation]

**Post-implementation review**

119. There would be a formal policy review after 5 years.

**Compensatory simplification measures**

120. [To be completed after consultation]

**Summary and recommendation**

121. [To be completed after consultation]

**Declaration and publication**

*I have read the regulatory impact assessment and I am satisfied that the benefits justify the costs*

Signed …………………………

Date

Minister’s name, title, Defra
References


ANNEX A

Costs
1. Costs for all options draw on the methodology developed by Reading University as part of (Defra report SE 3122). All details of the costings have been reviewed and updated since that study to take account of more recent experience in the RBCT.

2. Some parameters have undergone more significant revision, to reflect the fact that the RBCT is a scientific trial rather than an operational wildlife control policy. For example, the administrative input required for has been reduced considerably. Rates of working have been amended.

3. The adapted costing model was used to calculate the inputs of staff time, resource and expenditure for each policy option. Variable costs, depreciation of capital costs and all overheads apply uniformly to each km$^2$ of land over which wildlife management is carried out.

4. The provision for monitoring is substantially higher than previously. It is assumed that one in five badger carcases is pathologically analysed at a cost of around £250 per carcase. In addition there are costs for monitoring of ecological and disease impacts, including monitoring of compliance with any licensing requirements. These unit costs are indicative at this stage as details of appropriate systems have not been determined.

5. No provision has been made for potentially substantial cost of training, information and policing (likely to be required under all five options).

6. Down time is assumed to account for 10 weeks a year for all staff, including private sector staff acting under licence. This intended to account for holidays, illness, training and part of any time when some operations are ruled out because of weather or close season. Some use of the latter periods for surveying and paperwork relevant to the policy is implied.

7. The major differences between the costs of options 2a, 2b and 2c are associated with the rate of working for the different management methods. Cage-trapping is a significantly slower operation then the other two methods. Unit costs for option 3 are the lowest and the difference arises from single working (rather than teams of two), significantly smaller over heads and lower travel, subsistence and vehicle costs.

Unit benefits
8. bTB incidents impose costs on farmers and taxpayers. The main costs of an incident are the loss of reactor cattle and dangerous contacts, the resources used in herd testing following the breakdown, and the impact of restrictions
imposed on the farm business until the herd is cleared. The costs arise directly from the present control policies, which serve to minimise the potential impact of bTB incidents on cattle productivity, animal welfare and human health so the latter elements of cost can be ignored. The benefits of a wildlife management policy arise from the saving in costs of bTB incidents prevented. This approach is similar to that of previous studies including MAFF (Power and Watts), Reading University and Exeter University.

9. The unit benefit figures are particular to the typical breakdowns experienced in the annual testing parishes of England, where badger-to-cattle transmission is assumed to occur. The calculations distinguish between herd sizes, herd types, and the duration and scale of breakdowns. An average is used in the text, although it is recognised that this is the average of a wide range and highly skewed distribution.

10. There is no information available on whether an incident arising from badger to cattle spread is different in duration or severity from any other incident. It is assumed that a badger-caused confirmed new incident (CNI) presents the same average costs as average CNI in the area.

11. Calculations are based on VetNet records of CNIs for England annual testing parishes in 2003. This year was chosen to be recent, reasonably long after FMD, but far enough back for most CNIs to have been completed - i.e. the herd is now out of restrictions and the full extent of the breakdown is known. The data include numbers of cattle slaughtered, duration of restrictions and number of tests carried out.

12. A highly targeted approach (whether licensing or public delivery) may involve herds with different characteristics. Preventing incidents in areas with more intensive cattle systems and high value animals (dairy herds, especially with pedigree stock) will produce substantially higher benefits

Cattle lost

13. Unit costs of cattle compulsorily slaughtered are estimated using the methodology and basic values from the Reading University survey. They include the loss of output until an animal can be replaced. Reading values were raised in line with average cattle prices and replacement heifers since the period to which that survey relates. Loss of milk yield is included here but arguably may be lower than some farms experience.

14. Compensation values (the cost to the taxpayer net of salvage value) for cattle compulsorily slaughtered were based on the new compensation system.
**Isolation and Movement restrictions**

15. Unit costs are based on the Reading survey. The duration and herd size are taken from VetNet (2003 CNIs).

**Breakdown testing**

16. The number of tests was obtained from VetNet (2003 CNIs). A deduction was made for tests which would have occurred in the absence of the breakdown (some disclosing tests and all routine surveillance tests). Defra testing costs are based on total national expenditures divided by herds and animals tested. Farmer costs again are based on the Reading survey.

**Contiguous and trace testing**

17. Each CNI triggers contiguous herd tests and traced bovine tests. Contiguous herds may be tested again after 6 months and will be after 12 months. The number of such tests associated with an average CNI are estimated from VetNet.

**Other costs to farm business and farm family**

18. Following other studies, it is accepted that wider costs are not quantifiable.

**Onward Transmission**

19. Each CNI has the potential to cause onward spread. This calculation estimates the cost of onward spread via movement as follows. Movements of cattle off the 2003 CNI herds within the 12 months preceding the breakdown are taken from CTS data. Potential prevalence of bTB in these cattle is assumed to be about one fifth of the incidence in the herd detected during the incident. 80% of those infected cattle would be detected by pre-movement testing under the new arrangements, preventing onward transmission. Cost of the remaining onward transmission is taken from the RIA for pre-movement testing. No account is taken of possible onward spread by cattle contact to contiguous herds “over the fence”, straying or shared grazing.

**Routine testing and requirement for PRMT**

20. It is assumed that breakdown reductions that are achievable in the lifetime of this policy would not be enough to take a parish out of annual testing.
Effectiveness of badger removal operations

21. The initial impact of removal operations is measured by the number of badgers removed in each year of operation. Data on past experience is available from the RBCT and has been adapted in this CBA for the active management policy options. Number of badgers assumed to be taken in Option 2a is higher than the past RBCT experience to reflect information that culling of badgers encroaching at boundaries will be higher than was the case in the past.

22. Current assumptions on efficacy of each culling method are shown in the next table. Option 2c (gassing) is assumed to be highly effective in the first year, hence numbers of badgers removed in later years is very low. Option 2a is assumed to be the least effective in terms of badger capture because of the proportion of trap-shy animals and a lower level of effectiveness due to difficulty setting traps in some locations in a limited time of operation. Restraints are assumed to be equally effective whether operated by Defra or farmers, reflecting the balance of longer operation during the year by farmers against probable variable efficiency between farmers.

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a</td>
<td>RBCT cages</td>
<td>3.8</td>
<td>2.6</td>
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<td>2b</td>
<td>Defra restraints</td>
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<td>Defra sett-based</td>
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<td>Licensing (restraints)</td>
<td>8.0</td>
<td>2.9</td>
<td>0.5</td>
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</table>

23. The assumed number of badgers removed affects the estimated costs because badger carcasses are either sent for laboratory analysis or safe disposal.

24. The number of badgers remaining after removal operations is assumed to follow a simple pattern based on potential reproduction rates. This is not intended to be a scientific representation of actual badger populations but rather a simple set of assumptions to provide indicative figures.

25. Reading University (2004b) estimated the value to the public of changes in the level of the badger population. No valuation is applied here. Neither is there any attempt to value any disbenefit to the public which may arise from the act of removing badgers itself. The Reading study did not set out to value this effect but did give an indication that it might be of greater importance to the public than the level of population.
## Summary of field operations under the active management options

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
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<th>year 2</th>
<th>year 3</th>
<th>year 4</th>
<th>year 5</th>
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<tr>
<td>2b</td>
<td>Defra restraints</td>
<td>primary survey</td>
<td>secondary survey</td>
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<tr>
<td></td>
<td>2 culls</td>
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<td>2 culls</td>
<td>2 culls</td>
<td>2 culls</td>
</tr>
<tr>
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<td>Defra sett-based</td>
<td>'farmer' survey</td>
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<td>no formal survey</td>
<td>no formal survey</td>
<td>no formal survey</td>
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<tr>
<td></td>
<td>Gas and re-gas half</td>
<td>Gas and re-gas half</td>
<td>Gas and re-gas half</td>
<td>Gas and re-gas half</td>
<td>Gas and re-gas half</td>
<td>Gas and re-gas half</td>
</tr>
</tbody>
</table>

### Key ‘team coverage’ assumptions:

<table>
<thead>
<tr>
<th>Option</th>
<th>Method</th>
<th>team size</th>
<th>Team coverage per activity</th>
<th>Team coverage per activity</th>
</tr>
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<tbody>
<tr>
<td>2a</td>
<td>RBCT cages</td>
<td>2</td>
<td>2 km² per week</td>
<td>2 km² per week</td>
</tr>
<tr>
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ANNEX B

Figure 1.1 Confirmed bTB by county in 1990: number of confirmed new incidents of bTB per 100 herds

For each county, the area of the circle varies with the percentage of herds with CNIs.

The denominator used here is the number of herds registered on VetNet for at least 6 months in the year.

Figure 1.2 Confirmed bTB by county in 1995: Number of confirmed new incidents of bTB per 100 herds

For each county, the area of the circle varies with the percentage of herds with CNIs.

The denominator used here is the number of herds registered on VetNet for at least 6 months in the year.

Figure 1.3. Confirmed bTB by county in 2000: Number of confirmed new incidents of bTB per 100 herds

For each county, the area of the circle varies with the percentage of herds with CNIs.

The denominator used here is the number of herds registered on VetNet for at least 6 months in the year.

Figure 1.4. Confirmed bTB by county in 2004: Number of confirmed new incidents of bTB per 100 herds

For each county, the area of the circle varies with the percentage of herds with CNIs.

The denominator used here is the number of herds registered on VetNet for at least 6 months in the year.
Figure 2. Monthly numbers of total and confirmed new bovine TB incidents

Exponential trend calculated for March 1986 to February 2001, continued from March 2001 to December 2004

Total incidents: trend is 13.8% / year, $R^2 = 0.802$

Confirmed incidents: trend is 18.0% / year, $R^2 = 0.811$
Fig. 3.1. Distribution of the mean lengths of time that confirmed incidents ending in between January 1986 and December 2004 had remained under restriction
Fig. 3.2. Distribution of the mean lengths of time that confirmed incidents ending in between January 1986 and December 2004 had remained under restriction, by herd size.