

PACEC

Public and Corporate
Economic Consultants

TBSPG

***Cost Benefit Analysis against
Baseline of Draft Strategic
Recommendations***

Final Report



December 2016

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Annexes

See separate report.

This report has been prepared based on the methodology reflected within our proposal (dated 21 June 2016) and adjusted to reflect subsequent amendments that have been agreed via correspondence with TBSPG and DAERA (“the CLIENT”).

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Abbreviations and acronyms

Abbreviations	Acronyms
AFSB	Agri-Food Strategy Board
AHT	Annual Herd Test
AHWI	Animal Health and Welfare Inspector
AVS	Approved Veterinary Surgeon
bTB	Bovine Tuberculosis
BTEC	Brucellosis and Tuberculosis Eradication Campaign
BVD	Bovine Viral Diarrhoea
DAFM	Department of Agriculture, Food and the Marine (Republic of Ireland)
DAERA	Department of Agriculture, Environment and Rural Affairs (Northern Ireland)
DEFRA	Department of Environment, Food and Rural Affairs (UK)
DNA	Deoxyribonucleic Acid (polymer carrying genetic information)
DRT	Disease Response Teams
EADRA	Emergency Animal Disease Response Agreement
EC	European Commission
ERAD	Eradication of Animal Disease Board
EU	European Union
FMD	Foot and Mouth Disease
GB	Great Britain
GHG	Greenhouse Gas(es)
HMT	Her Majesty's Treasury
IFNG	Gamma Interferon Test

Abbreviations	Acronyms
IR	Inconclusive Reactor
NI	Northern Ireland
NPC	Net Present Cost
N/PMS	National/Pest Management Strategy
OECD	Organisation for Economic Co-operation and Development
OIE	Office International des Epizooties (World Organisation for Animal Health)
OTF	Officially Tuberculosis Free
OTFW	Officially TB Free Withdrawn
PVP	Private Veterinary Practitioners
ROI	Republic of Ireland
SDRs	Standard Definitions & Rules
TBEP	TB Eradication Partnership
TBSPG	TB Strategic Partnership Group
TVO/VOT	Temporary Veterinary Officer/Veterinary Officer Testing
UK	United Kingdom of Great Britain and Northern Ireland
VNTR	Variable Number of Tandem Repeats (a tandem repeat is a short sequence of DNA that is repeated in a head-to-tail fashion at a specific chromosomal locus)

KEY MESSAGES

Key messages emanating from this report are as follows:

- Funding the implementation of the TBSPG recommendations would involve a significant investment, with this independent cost: benefit analysis placing this in the range of an additional £244m across the next 40 years (based on 2016 prices).
- Inclusive of estimated compensation payments, continuation of the status quo over the next 40 years would cost government an estimated £1,055m, while full implementation of the recommendations, including the additional investment, would cost an estimated £850m (both based on 2016 prices).
- Implementing the changes in full, therefore, would lead to a saving to government of approximately £205m over 40 years (based on 2016 prices) when compared directly with retaining the status quo and the current programme.
- It is also estimated that implementing a scaled down programme after achieving eradication would cost c£8.5m per year compared to maintaining the status quo, with ongoing estimated costs of c£24m-£28m dependent on continuing variations in disease incidence rates (both based on 2016 prices).
- Implementation of the TBSPG Recommendations and a move toward achieving eradication would also present substantial non-monetary benefits including enhancing industry reputation, developing a more favourable international trade position and removing burden and stress from farming communities.

1 EXECUTIVE SUMMARY

1.1 Introduction

Bovine Tuberculosis (bTB) is an infectious disease of cattle. It is caused by the bacterium *Mycobacterium bovis* (M. bovis), which can also infect and cause disease in many other mammals including humans, deer, goats, pigs, cats, dogs and badgers. In cattle, it is mainly a respiratory disease but clinical signs are now rare. TB in humans is usually caused by a very closely related infectious agent, *Mycobacterium tuberculosis*, but may also be caused by M. bovis.

bTB is a very complex, multifactorial and challenging disease that has proven difficult to eradicate worldwide. It has an adverse impact on affected farm businesses due to the interruption to market access and the additional disease control measures that are required. It is widely regarded as the most difficult animal disease problem currently facing government, the veterinary profession and the farming industry in these islands and it is widely accepted that eradication of bTB will require the use of a range of measures aimed at addressing the infection in cattle and preventing its spread to and from wildlife and between cattle.

In September 2013 the then Department of Agriculture and Rural Development Minister, Michelle O'Neill MLA, announced a plan to establish a government/industry strategic partnership group, which would review the ongoing bTB eradication programme and develop a long-term strategy/implementation action plan to eradicate the disease from Northern Ireland's (NI's) cattle population.

The TB Strategic Partnership Group (TBSPG) was established in September 2014 and was tasked to act in the public interest to develop a long-term strategy to eradicate bTB, to produce an associated action plan to implement the strategy, to provide advice on how the strategy and outcomes can be achieved, and to engage with a wide range of stakeholders and gather evidence to support their final recommendations.

Following extensive and detailed evidence gathering, the TBSPG produced an Interim Report in June 2015, which was the subject of a 10 week public consultation. Consultation responses were analysed and categorised under seven thematic categories (i.e. Existing Tools and Processes; Herd Health Management, Wildlife and Vaccination; Governance, Culture and Communication; Finance, Funding and Compensation; and, Research).

This report represents a Cost: Benefit Analysis of **the implementation of TBSPG recommendations whilst continuing with the implementation of the baseline programme activities** (Option 2), compared to **the Status Quo - the current DAERA bTB eradication programme** (Option 1).

1.2 Overview of the Analysis Process

Figure 1.1 illustrates that the analysis carried out by this report has involved three key areas of activity, namely:

1. Quantitative Analysis - involving the development of discounted cashflows for a 40 year period, identifying quantifiable economic costs/ benefits and Net Present Cost (NPC) associated with each option. This process has involved estimating:

- The cost to farmers of a TB breakdown – the total cost of breakdowns to farmers will vary in direct proportion to the level of disease incidence;
- The costs to government of a TB breakdown – the total cost of breakdowns to government will vary in direct proportion to the level of disease incidence ;
- Ongoing costs associated with the current bTB Programme, some of which vary as disease incidence levels change; and
- Additional costs incurred by government in implementing TBSPG recommendations.

The projected impact of each option on future bTB herd incidence levels has been extrapolated using bTB incidence trends from the Republic of Ireland (RoI). Experience in the RoI has features that make it the best available predictor of how the level of bTB in Northern Ireland would respond to a package of eradication interventions. These are:

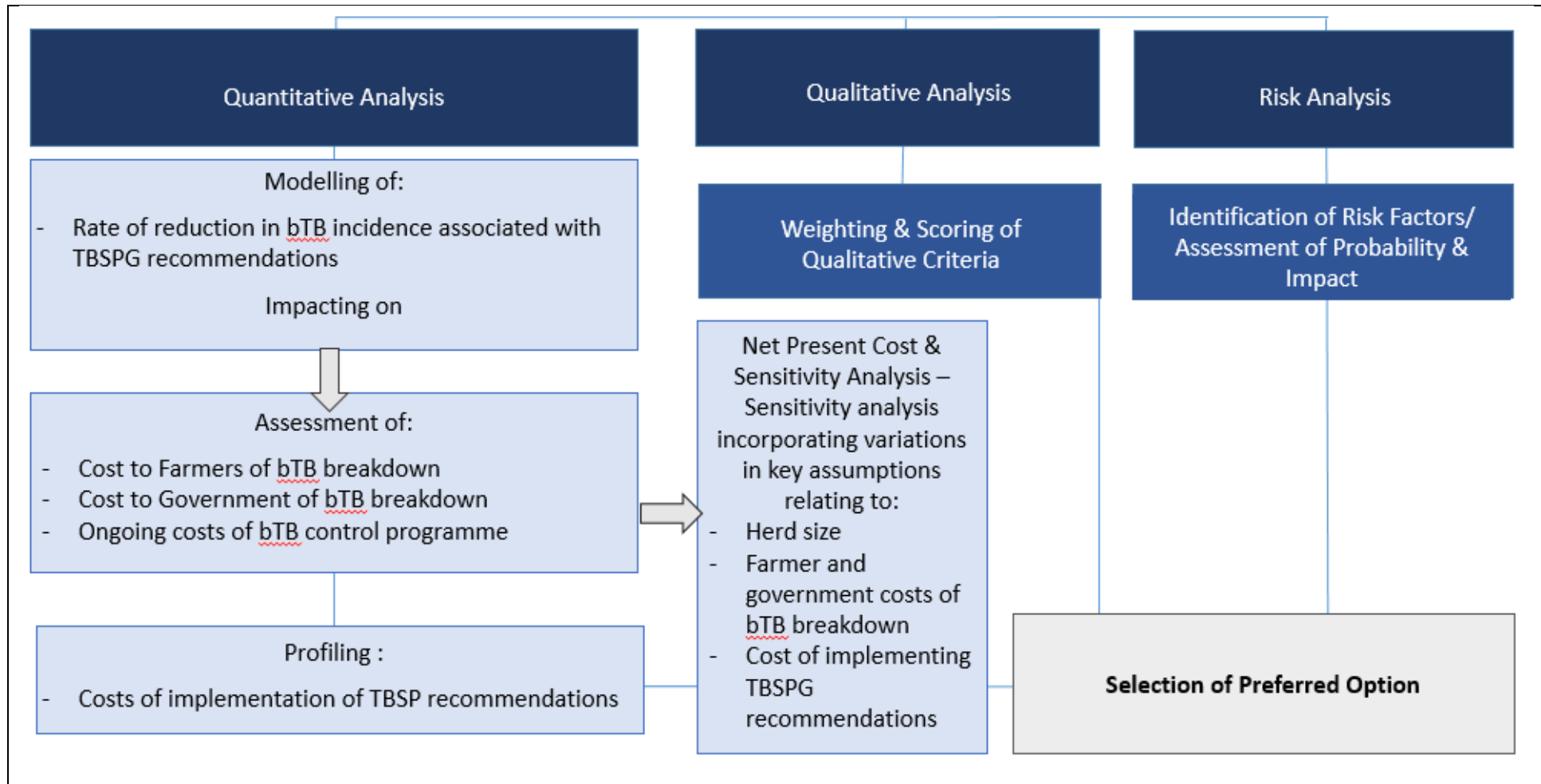
- the presence of a wildlife reservoir of infection (primarily the badger)
- comparable badger ecology;
- similar in farm structures, production systems and farm practices
- a comparable physical landscape;
- the existence of a long standing ongoing bTB control programme that has shown strong signs of success; and
- its development of a multi-faceted and integrated control programme, including the national roll-out of a wildlife intervention.

Disease projections indicate that the Status Quo (Option 1) would result in a bTB herd incidence level in the range of 6-7% by Year 40 (2056), whereas implementation of TBSPG recommendations, whilst continuing with the implementation of the baseline programme activities¹ (Option 2), would result in a herd incidence level of 0.1%. The bTB herd incidence level in 2015 was 7.0%.

2. Risk Assessment – incorporating assessment of key areas of risk to programme implementation, identification of risk mitigation strategies and carrying out a range of sensitivity analyses on NPC calculations.

¹ Although baseline bTB programme activities continue, they reduce in scale and cost as disease levels fall

Figure 1:1: Overview of Approach



3. Assessment of Qualitative Costs and Benefits - a weighting and scoring exercise has been adopted to illustrate in quantitative terms how each option performs against identified non-monetary criteria. The criteria being:

- Contribution to improved perception of product quality, enhanced industry reputation and international trade;
- Improvement in animal health;
- Improvement in the health and welfare of farm workers and farm families;
- Reduction in negative long term impacts on farm businesses; and
- Enhanced benefits associated with governments partnership working with stakeholders.

The results of each of the above strands of analysis were used to assess the balance of advantage between the options and to select a preferred option. An analysis of affordability and funding of the Preferred Option has also been profiled.

1.3 Results of Analysis and Selection of Preferred Option

Table 1.1 summarises the results of the analysis, identifying that:

- when quantitative economic costs and benefits are considered over a 40 year period, Option 2 (full implementation of TBSPG recommendations) is c10% less expensive than the Option 1 (the Status Quo option);
- Option 2 scores considerably higher than Option 1 in terms of non-monetary benefit;
- When an NPC per non-monetary score is considered, Option 2 is ranked highest; and
- Option 2 is exposed to a significantly higher level of risk than Option 1.

Considering the above, on balance, **Option 2 (implementation of TBSPG recommendations, whilst continuing with the implementation of the baseline programme activities²) emerges as the Preferred Option**, as it offers the potential to achieve the TBSPG’s stated objective of bTB eradication, whilst providing greatest value for money (as measured by NPC per non-monetary score).

Table 1.1 Summary of Results of Quantitative (reflecting Net Present Cost [NPC] to government and farmers, reflecting a discount rate of 3.5%) Qualitative and Risk Analysis

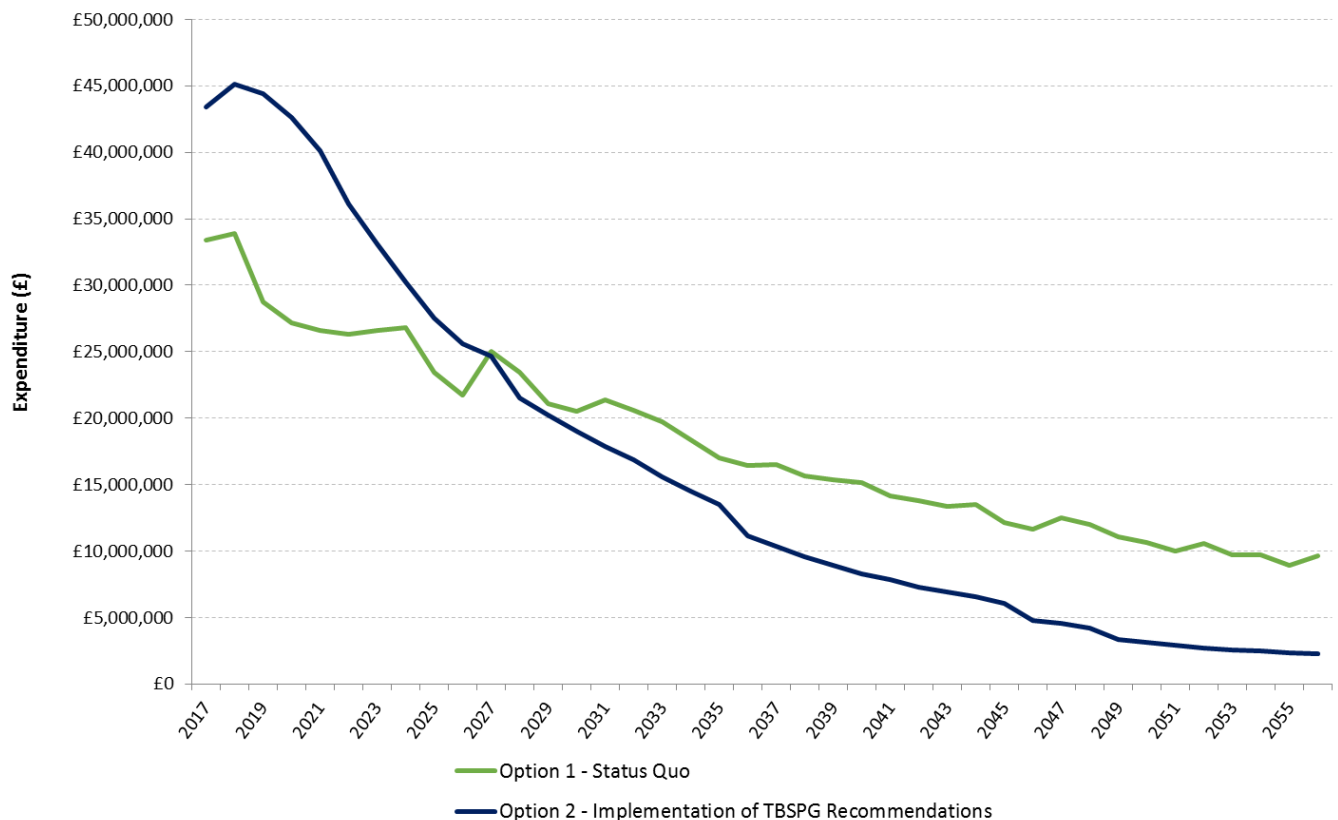
Option	NPC ³ Over 40 Years (£m)	Ranking	Non Monetary Score	Ranking	NPC per Non Monetary Score (£m)	Ranking	Risk Score	Ranking
Option 1 - Status Quo	£725	2	140	2	5.2	2	63	1
Option 2- Implementation of TBSPG recommendatio ns	£650	1	688	1	0.9	1	159.8	2

² Although baseline bTB programme activities continue, they reduce in scale and cost as disease levels fall

³ Reflecting a discount rate of 3.5%

Figure 1.2 highlights that in 2027 (Year 10), the total annual NPC of Option 2 falls below that of the Status Quo. After Year 10, the annual NPC of Option 2 declines at a faster rate than that of Option 1, due to the projected reduction in disease associated with implementing Option 2.

Figure 1.2: Total Annual NPC of the Status Quo compared to Preferred Option (Discount Rate = 3.5%), 2017 - 2056



Key areas of potential benefit associated with Option 2, when compared to the Status Quo, include:

- A reduction in the number of bTB herd breakdowns. The Preferred Option is projected to result in c22 herd breakdowns by 2053 (Year 37), reflecting the achievement of eradication i.e. a bTB herd incidence level of 0.1%. The Status Quo option is projected to result in c1,461 herd breakdowns by 2056 (Year 40), reflecting a bTB herd incidence level of 6.63%. The 2015 baseline was 1,688 breakdowns (7%);
- A reduction in ongoing DAERA bTB programme costs – refer to Sections 1.4 and 9.3; and
- A wide range of important benefits that are difficult to quantify including:
 - The enhancement of the local agri-food industry’s reputation and improved perceptions of product quality among consumers;
 - A positive contribution to future international trade negotiations/ arrangements;
 - An improvement in animal health;
 - An improvement the health and welfare of farm workers and farm families;
 - A reduction in negative long term impacts on farm businesses i.e. through lessening the disruption to farm business due to fewer bTB breakdowns; and
 - Enhanced levels of public and private sector partnership working.

That said, Option 2 is exposed to significant number of risks that must be successfully mitigated in order for it to deliver in an effective manner. These areas of risk include, but are not limited to: affordability; delays in programme implementation; resource costs higher than budgeted, uncertainty in disease outcomes; negative media coverage; and opposition from environmental lobby groups.

The results of our sensitivity analyses identify that variations in cost assumptions have little impact on the ranking of options in terms of their NPC. However, a 50% slower decline in disease reduction does impact on the ranking of options i.e. the Status Quo option exhibits a lower NPC than the 'Preferred Option' (Option 2) in this scenario, using both a 3.5% and 8% discount rate. This analysis highlights that the achievement of progress towards anticipated disease reduction levels, in line with the disease projections and budgets profiled within this report, would be central to achieving value for money.

1.2 Assessment of Funding Models and Affordability

TBSPG recommendations include a number of proposals relating to the compensation of slaughtered cattle, namely:

- that a cap in compensation levels would be introduced with a maximum of £1,500 for non-pedigree bovine animals and a 20% premium for pedigree bovine animals (to a maximum of £1,800) and that the cap be introduced as soon as practical;
- a herd-keeper will be permitted to receive compensation up to a cap of £3,500 for one pedigree stock bull per year with no carry-over from one year to the next; and
- that consideration should be given by TBEP of a further reduction in the level of compensation paid following valuation – TBSPG provided an **example** of a cap of 75% of the market value of animals. This would be in addition to the introduction of capped payments. Thus for a non-pedigree animal valued at £1,600 the cap would be £1,500 and if the percentage reduction were to be 25% then the actual payment would be £1,125. The implementation of a percentage reduction is not to be put in place until after consideration of progress and circumstances 3 years after the cap is in place.

Our analysis highlights that:

- when compensation payments for both the Status Quo and the Preferred Option are profiled based on 2015 averages, Option 2 generates c£244 million of savings over the 40 year appraisal period;
- introduction of the proposed cap under Option 2, would result in further savings of c£16 million over the 40 year appraisal period, when assessed against the Status Quo. A further reduction in compensation to 75% of market valuation would generate a further £57 million of savings over 40 years;
- depending on the scenario used, the annual compensation paid under Option 2 at 'Steady State' is between £9 - 13 million less than that paid under the Status Quo option.

N.B. the impact of a cap of £3,500 for pedigree stock bulls is not captured within this analysis, as the future number of these bulls cannot be estimated with any certainty. It is anticipated that the number of these bulls and resulting impact on compensation levels will be negligible.

Table 1.2 details the total cost to government of implementing each option at current prices. This table highlights that over a 40 year period, there is a difference of c£205 million in cost between Options 1 and 2, with Option 2 (the Preferred Option) exhibiting the lower cost. **This cost differential includes projected savings associated with the proposed cap on compensation. It does not include further savings that may be generated through the adoption of payment on the basis of 75% of an animal’s market value.**

Table 1.2: Total Cost to Government – Status Quo compared to Preferred Option (at 2016 prices)

	Option 1 (status Quo)	Option 2 (Implementation of TBSPG Recommendations)	Variance
Total programme cost to government over 40 years (excluding compensation)	£589m	£644m	-£55m
Compensation paid over 40 years ⁴	£466m	£206m	£260m
Total Cost over 40 years	£1,055m	£850m	£205m
Average annual costs over 40 years	£26m	£21m	£5m
Range in annual costs over 40 years	£28m - £24m	£39m - £8.5m	
Estimated Annual Cost after Year 40	£28m	£8.5m	£19.5m

Figure 1.3 highlights that in c2028, the total cost to government of implementing TBSPG Recommendations, including compensation payments, would fall below the total cost of maintaining the Status Quo (Option 1).

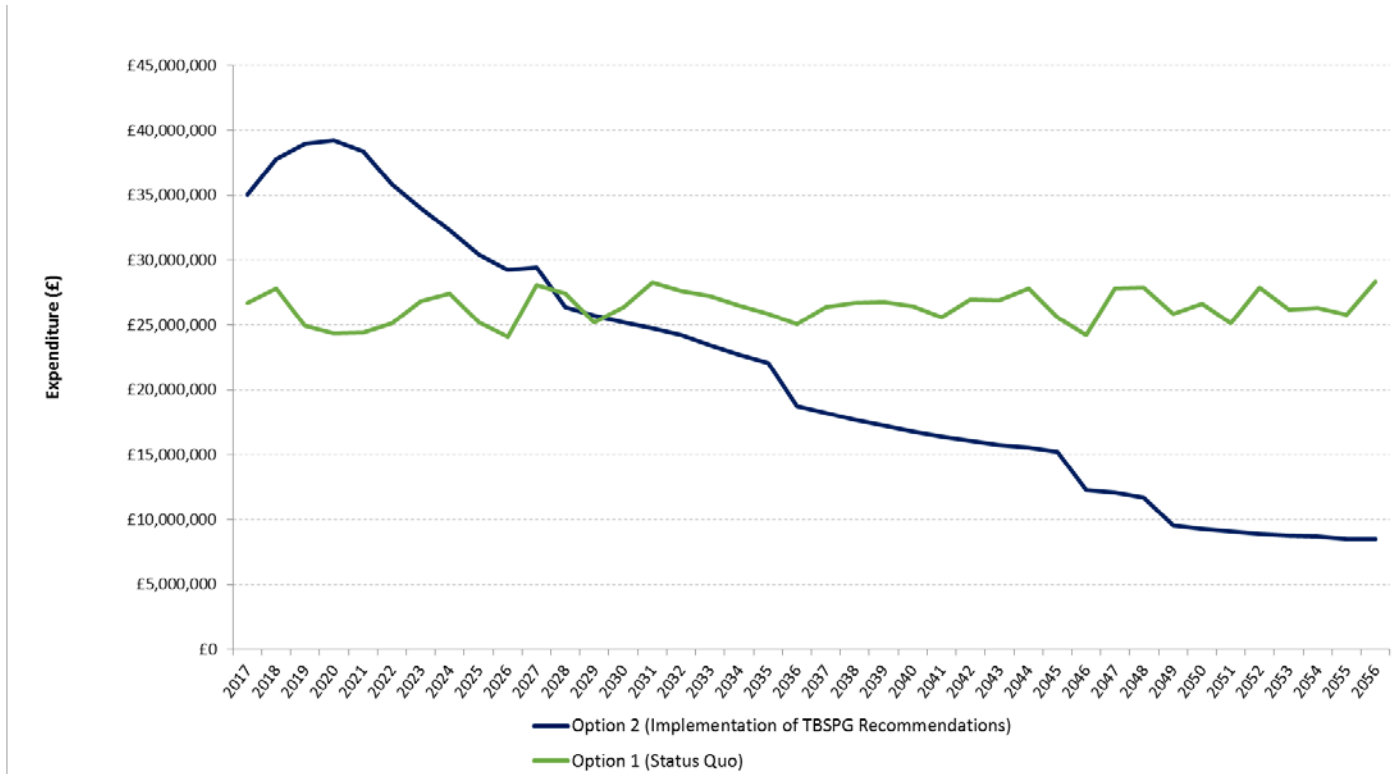
Figure 1.3 also highlights that the annual cost to government of implementing the Preferred Option (Option 2) ranges from £39 million in Year 4 to c£8.5 million in Years 38- 40. The delivery of TBSPG recommendations would require additional funding in the early years of the programme, before significant cost savings can be achieved later in the programme period via a reduction in disease incidence.

As highlighted in Table 1.2 and Figure 1.3, at Year 40 the Preferred Option exhibits a significantly lower annual programme cost than the Status Quo, c£8.5 million compared to £28 million. If the Status Quo option was to be pursued and bTB herd incidence levels remained static at c6.63%, this higher level of annual cost would be incurred each year ad infinitum. Continuance of disease levels at this rate would pose a number of significant risks, particularly in relation to future trading

⁴ Compensation levels associated with Option 2 reflect the introduction of the proposed cap only. The Status Quo reflect no change to existing compensation arrangements.

arrangements post-Brexit, where NI's current rate of bTB may have a detrimental impact on any potential future trade deals.

Figure 1.3: Total Cost to Government (including compensation) – Status Quo compared to Preferred Option (at 2016 prices), 2017 - 2056



The extent to which any eradication programme is both successful and affordable depends to a significant degree on the appropriate sharing of costs between the public sector and industry. Cost sharing is a complex and sensitive issue.

This report provides a summary of the main factors that enabled bTB eradication programmes to have successful outcomes in other jurisdictions (i.e. New Zealand, Australia and the ROI), with an assessment of their applicability to NI. In essence, both industry co-funding and joint governance are the main enabling factors that could be applied to NI.

The development of a co-funding model to support programme implementation (utilising the 'beneficiary pays' principle) would make a significant contribution to the management of risks associated with public sector underinvestment (due to restricted public sector finances).

The establishment of a co-funding model is consistent with the new governance arrangements proposed by the TBSPG, which aim to create a shared ownership of the bTB Programme among stakeholders. It would also help reinforce positive behaviours and farm management practices that support efforts to control and eventually eradicate the disease.

2 STUDY BACKGROUND AND TERMS OF REFERENCE

2.1 Introduction

The following section provides an overview of the context of this cost benefit analysis, its terms of reference, our approach and structure of this report.

2.1.1 Project Background

DAERA has responsibility for food, farming, environmental policy and the development of the rural sector in NI. It provides a business development service for farmers and growers, and a veterinary service with administration of animal health and welfare. DAERA is responsible to the Department of the Environment, Food and Rural Affairs (Defra) in Great Britain for the administration of schemes affecting the whole of the UK. DAERA also oversees the application of EU agricultural and rural development policy to NI.

The Animal Health & Welfare Policy Division within DAERA exists to develop policies that promote the welfare of animals, reduce and eradicate animal diseases which have significant economic or public health consequences and secure the effective traceability of livestock through identification, registration and movement controls.

On 17 September 2013 the then Department of Agriculture and Rural Development Minister, Michelle O'Neill MLA, announced a plan to establish a government/industry strategic partnership group, which would review the ongoing bovine tuberculosis (bTB) eradication programme and develop a long-term strategy/implementation action plan to eradicate bovine TB from NI's cattle population.

The TBSPG was established in September 2014. The TBSPG operates independently from the Department, although the Chief Veterinary Officer and the Director of Animal Health and Welfare Policy Division are ex officio members of the Group. The Chair of the Group is independent, as are the external members of the group consisting of two former Presidents of the Ulster Farmers' Union plus two experts in the scientific and veterinary fields.

Specifically, the TBSPG has been tasked to act in the public interest to develop a long-term strategy to eradicate bTB, to produce an associated action plan to implement the strategy, to provide advice on how the strategy and outcomes can be achieved, and to engage with a wide range of stakeholders and gather evidence to support their final recommendations.

The TBSPG conducted extensive and detailed evidence gathering and produced an Interim Report in June 2015, which was the subject of a 10 week public consultation, ending on 4 September 2015. Consultation responses were analysed and categorised under thematic categories.

TBSPG has highlighted within their Interim Report that:

“Success elsewhere was predicated on a shared understanding and commitment by government, private vets, farmers, the agri-food industry and environmental bodies to progressively reduce the levels of bovine TB until the aim of eradication was realised. Achievement of that success took time,

resource input, industry discipline, and a united focus on the desired outcome. There is every reason why we, with common purpose, should be able to deliver the same desired result.”

2.2 The Disease

Bovine TB is an infectious disease of cattle. It is caused by the bacterium *Mycobacterium bovis* (M. bovis) which can also infect and cause disease in many other mammals including humans, deer, goats, pigs, cats, dogs and badgers. In cattle, it is mainly a respiratory disease but clinical signs are now rare. TB in humans is usually caused by a very closely related infectious agent, *Mycobacterium tuberculosis*, but may also be caused by M. bovis.

Bovine TB is a very complex, multifactorial and challenging disease that has proven difficult to eradicate worldwide. This is due to the characteristics of the disease itself, the difficulties in diagnosis, the existence of reservoirs of infection in other species and the nature of the local farming industry, e.g. fragmented holdings and a large number of cattle movements.

It has an adverse impact on those farm businesses affected due to the interruption to market access and the additional disease control measures that are required. It is widely regarded as the most difficult animal disease problem currently facing government, the veterinary profession and the farming industry in these islands and it is widely accepted that eradication of bTB will require the use of a range of measures aimed at addressing the infection in cattle and preventing its spread to and from wildlife and between cattle. It is also accepted that there is no simple cost-effective solution or ‘quick fix’.

2.3 Draft Strategic Recommendations

Annex A-F provides detailed information on the implementation and expenditure associated with those TBSPG recommendations that incur additional expenditure by government. TBSPG recommendations are structured within seven thematic areas. An overview of each theme and their associated recommendations is provided in Table 2.1 overleaf.

Table 2:1: TBSPG Recommendations by Theme

Theme	Associated Strategic Recommendations
Existing tools and processes	<ul style="list-style-type: none"> • Expand use of severe interpretation of skin test • Increased use of gamma interferon testing • PVP to DNA tag on farm when they detect a reactor. • DAERA to expand use of molecular techniques to eliminate bTB from cattle • Ensure any PVP contracts align with TBSPG recommendations • Depopulation should be considered in herds with multiple reactors and partial depopulation should be considered when reactors represent a significant proportion of a particular group • Measures to resolve or minimise impact of chronic herds • Herd test prior to restocking after TB breakdown • Reducing the number of NVL reactor animals required for a herd to be considered OTW to 2 or more • Rigorous inspection to detect lesions at slaughter plants • Consider limited moves with specific conditions from bTB breakdown herds to approved rearing / finishing herds or 100% housed and met strict biosecurity conditions. • GIS resource to be developed for use of DAERA, PVPs and governance groups • Introduction of an additional 6 month test for derestricted herds • Design and implementation of a field trial of counter fraud measures
Herd Health Management	<ul style="list-style-type: none"> • Encouragement of herd keepers to improve herd health management and take responsibility for herd health management on individual holdings. • Development of bio-security self-assessment checklist • Provision of advice to farmers about on farm practice and herd health management measures specific to that farm by PVPs and DAERA staff. • farmers should use a biosecurity self-assessment checklist to be developed by DAERA

Theme	Associated Strategic Recommendations
	<ul style="list-style-type: none"> • Consideration to be given to the development of statutory ‘Improvement Notices’ • Awareness raising actions on “informed purchasing” should be put in place as an integral part of an overall communications strategy • Farming industry should adopt an informed approach to the purchase of stock • Encouragement of livestock markets to display information to better inform prospective purchasers • DAERA to undertake a review of existing farm fragmentation data to establish whether it adversely impacts on the control of TB following a breakdown • Introduce segregation notices to protect those herds that are at risk of disease spread from high risk groups within bTB breakdown herds. • We recommend that the TBEP should keep under review the potential benefits of the use of herd classification and purchasing based on herd bTB history as operated, for example, in New Zealand • We recommend that industry leaders should actively encourage farmers to use the “TB Advantage” genetic index • We recommend that famers thoroughly clean and disinfect vehicles and disinfect and equipment after transportation of farms animals
Wildlife	<ul style="list-style-type: none"> • Implementation of badger vaccination strategy along with the strategic removal of badgers. Each main intervention area will comprise a central area, where badgers will be removed, the core zone, and a surrounding buffer zone where badgers will be captured, tested, removed if tested positive and vaccinated and released if tested negative. An intervention area will usually cover at least 100km². • Implementation will be from two/three areas in first year increasing to up to ten areas. The intervention will be for a minimum of four years and following this four year period, vaccination of badgers will continue in the core zone for a minimum of three years or as long as deemed necessary. The longer term use of vaccination, including the development of oral bait vaccine, to be kept under review. • The position with regards wild deer and camelids to be kept under review. • The Road Traffic Accident (RTA) Survey to be expanded.
Governance	Establishment of new bTB governance structures to include:

Theme	Associated Strategic Recommendations
	<ul style="list-style-type: none"> • a NI level oversight body – the TB Eradication Partnership (TBEP); • a small number of sub-regional eradication partnerships; • responsive local Disease Response Teams (DRTs). DRTs will be formed on an ad hoc basis and have the objective of providing local direct involvement in disease control.
Culture and communication	<ul style="list-style-type: none"> • Development and implementation of a robust publicity and communication strategy
Finance	<ul style="list-style-type: none"> • Cap in compensation levels of £1,500 for non-pedigree bovine animals and £1,800 for pedigree animals. A herd-keeper will be permitted to receive compensation up to a cap of £3,500 for one pedigree stock bull per year with no carry-over from one year to the next. • TBEP to consider a percentage reduction in the level of compensation paid.
Research	<ul style="list-style-type: none"> • Integration of targeted research projects commissioned by DAERA into TB Eradication Programme with research results used to facilitate future policy development and new innovations to help tackle the disease with TBEP recognised as a significant stakeholder and a TBEP representative to sit on the steering group.

2.4 Terms of Reference and Scope of Report

The original specification for this assignment identified the following requirements:

- Assessment of potential economic effectiveness of the TBSPG's draft recommendations via a cost: benefit assessment of the individual draft recommendations and an assessment of the overall integrated package of TBSPG's draft recommendations to reduce disease levels so that the relative effectiveness in tackling the disease (in cost: benefit terms) can be determined;
- Assessment of the net economic costs and benefits of a range of options and identification of a preferred option (see details below);
- Assessment of potential financial implications of the preferred option, including the financial implications of the proposals (to government; stakeholders, etc);
- Identification of potential funding principles and models for the proposed programme; and
- Provision of a view from an economic perspective on the preferred options' ability to deliver eradication.

As detailed in Section 4, subsequent discussions with DAERA and TBSPG confirmed that this cost benefit analysis should be limited to the assessment of the following options:

- i. 'Do nothing' option – which would see no government testing or bTB programme
- ii. 'Status Quo' option – i.e. the current bTB programme employed to tackle the disease; and
- iii. 'Implementation of TBSPG recommendations in full'.

Although the appraisal techniques in this report reflect guidance provided by the Her Majesty's Treasury (HMT) "Green Book"⁵ and NI Guide to Expenditure Appraisal and Evaluation (NIGEAE), this report does not represent a full economic appraisal of options. A separate behavioural analysis of options⁶ and scientific review of TBSPG recommendations⁷ has also been undertaken. Where applicable, report will utilise the content of these standalone appraisal/ review reports.

2.5 Report Structure

The remainder of this report is structured as follows:

- Section 3: Overview of NI's Farming and Agri-Food Sectors;
- Section 4: Option Identification and Shortlisting;
- Section 5: Quantitative Analysis of Options;
- Section 6: Risk Assessment (including Sensitivity Analysis);
- Section 7: Qualitative Analysis of Options;
- Section 8: Selection of Preferred Option; and
- Section 9: Farmer Compensation, Programme Affordability and Potential Funding Models.

⁵ "The Green Book: appraisal and evaluation in central government", HM Treasury (October 2015 update)

⁶ "Behavioural Appraisal of the Recommendations of the TB Strategic Partnership Group (TBSPG)", Dr Philip Robinson, Harper Adams University (6 September 2016)

⁷ "The Bovine Tuberculosis Eradication Programme in Northern Ireland Proposals from the Tuberculosis Strategic Partnership Group (TBSPG), Scientific peer review, Final report", Simon J. More, University College Dublin (31 August 2016)

3 OVERVIEW OF NORTHERN IRELAND’S FARMING AND AGRI-FOOD SECTORS

3.1 Introduction

NI covers an area of 14,130 km², of which 46.4% (6,560 km²) is rural. Of the rural land, agricultural land consists of 69% of the Utilized Agricultural Area (UAA), 82% is permanent grassland and meadows and 88% of farms in NI are providers of dairy, sheep and or beef⁸.

The following section provides an overview of the key components of the farming and agri-food sector, recognising their mutual dependency and linked growth.

3.2 Northern Ireland’s Farming Industry

Farming and agriculture is a core component to NI’s economy and society, contributing directly to 1% (£351m) of NI’s GVA (compared to 0.6% in the UK), and contributing to the direct FTE employment of approximately 26,000 persons (representing 3.2% of total employment in NI, compared to 1.1% of UK employment).

Table 3.1 overleaf provides a summary of the key agricultural statistics produced by DAERA (2016) on the size and state of the farming industry. This information highlights that:

- Compared to the UK in general, NI has a higher proportion of very small farms and a significantly lower proportion of large or very large farms;
- Farm income reduced over the period 2013/14 to 2014/2015; and
- Cattle numbers have increased slightly (0.3%) over the period 2010 – 2015, with a significant increase in the number of dairy cows (11%) and a marginal increase or a reduction in all other categories.

Table 3:1: Key Agricultural Statistics for NI

⁸ European Commission (2014) ‘Northern Ireland Factsheet on the 2014-2020 Rural Development Programme’ Available at: http://ec.europa.eu/agriculture/rural-development-2014-2020/country-files/uk/factsheet-northern-ireland_en.pdf

Number of Farms	There are 24,907 registered farms (2015) in Northern Ireland. This equates to approximately one farm for every 72 persons.⁹																																																																																																																
Total Number of Farmers and Workers	47,979 (2015) ¹⁰																																																																																																																
Average Farm Size	40.1 Hectares (Ha) (2015) ¹¹																																																																																																																
Average Income by type of farm (2014/15)	<p>Average Farm Income (all types, above 0.5 SLRs)¹²</p> <table border="1"> <thead> <tr> <th></th> <th>2013/14</th> <th>2014/15</th> </tr> </thead> <tbody> <tr> <td>Farm Business Income</td> <td>£30,047</td> <td>£24,942</td> </tr> <tr> <td>Cash Income</td> <td>£48,141</td> <td>£42,411</td> </tr> <tr> <td>Net Farm Income</td> <td>£24,915</td> <td>£19,899</td> </tr> </tbody> </table>		2013/14	2014/15	Farm Business Income	£30,047	£24,942	Cash Income	£48,141	£42,411	Net Farm Income	£24,915	£19,899																																																																																																				
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Number of Farms by size (June 2015) in NI¹³	<ul style="list-style-type: none"> • Very Small: 19,078 (76.6%) [70% UK] • Small: 2,951 (11.8%) [12% UK] • Medium: 1,249 (5%) [6% UK] • Large/Very Large: 1,629 (6.5%) [12% UK] 																																																																																																																
Distribution of Farm Outputs¹⁴	<ul style="list-style-type: none"> • Dairy: 27.5% of NI farm gross output, 42.1% of gross margin, and 21% of on farm employment. • Beef: 22.6% of NI farm gross output, 21.3% of gross margin, and 50% of on farm employment 																																																																																																																

⁹ DAERA (2015), 'Statistical Review of NI Agriculture' Available at: <https://www.daera-ni.gov.uk/sites/default/files/publications/dard/stats-review-2015-final-amended.PDF>

¹⁰ ibid

¹¹ ibid

¹² DAERA (2015) 'Review of Farm Incomes in Northern Ireland (2014/15) Available at: <https://www.daera-ni.gov.uk/sites/default/files/publications/dard/farm-incomes-in-northern-ireland-2014-15-final.PDF>

¹³ DAERA (2015) 'Agricultural Census in Northern Ireland' Available at: <https://www.daera-ni.gov.uk/sites/default/files/publications/dard/agricultural-census-ni-june-2015.pdf> N.B. Farm business size is determined by calculating each farm's total Standard Labour Requirement (SLR). The total SLR for each farm is calculated by multiplying its crop areas and livestock numbers by the appropriate SLR coefficients and then summing the result for all enterprises on the farm. UK agricultural statistics business size bands are as follows: Very Small, less than 1 standard labour unit (1 standard labour unit = 1900 hours); Small 1 < 2 standard labour units; Medium 2 < 3 standard labour units; and Large 3 < 5 standard labour units; and Very Large 5 or more standard labour units. Since there are very few farms in the 'Very Large' size range in Northern Ireland, these are included in the 'Large' category in Census analyses.

¹⁴ Table 5 of DAERA Agri-Food Statistics Report 2016

3.3 Northern Ireland’s Agri-Food Sector

The importance of the Agri-Food industry to the NI economy was recognised in the 2011-15 Programme for Government with the appointment of the industry-led Agri-Food Strategy Board (AFSB) to develop a Strategic Action Plan for the local industry, now known as ‘Going for Growth’ strategy (2013). The AFSB set out an update on the sector’s performance in March 2016¹⁵, which includes performance statistics for 2014. These are summarised in Table 3.2 below.

Table 3:2: Size and Performance of the NI Food and Drinks Processing Sector (2014)¹⁶

	Indicators
Overall Value of Food and Drinks Processing Sector (2014)	Turnover: £4,544m GVA: £721m Employees: 20,758 External Sales (outside NI): £3,299m Export Sales (outside UK): £1,289m
Value of Beef and Sheepmeat (Food Processing) to NI economy (2014)	Turnover: £1,244m GVA: £134m Employees: 4,550 (FTEs) External Sales (outside NI): £1,023.1m Export Sales (outside UK): £240.6m
Value of Dairy Products (2014)	Turnover: £994m GVA: £80.7m Employees: 2,135 External Sales (outside NI): £673.8m Export Sales (outside UK): £457.2m

Source: DAERA (2016)

¹⁵ AFSB (2016) Delivering Growth – Update on Actions to support the NI Agri-Food Industry

¹⁶ DAERA (2016) ‘Size and Performance of the NI Food and Drink Processing Sector’ Available at: <https://www.daera-ni.gov.uk/sites/default/files/publications/dard/Size%20and%20Performance%20NI%20Food%20%26%20Drink%202014-15%20Final%282%29.PDF>

The Strategic Vision for the industry is to ‘grow a sustainable, profitable, and integrated agri-food supply chain, focused on delivering the needs of the market’ with the following strategic targets for 2020:

- Grow sales by 60% to £7bn ;
- Grow employment by 15% to 115,000;
- Grow sales outside NI by 75% to £4.5bn; and
- Grow by 60% to £1bn the total value added of products and services from local companies

Table 3.3 provide a summary of the themes and sectors that the Strategic Action Plan identifies as key areas of focus.

Table 3:3: “Going for Growth” Strategy – Identified Areas of Focus

Collective Industry Focus (7 Themes)	Individual Sector Focus (10 Sectors)
<ul style="list-style-type: none"> • Growing Market Share • Working Together • Sustainable Growth • Innovation, Entrepreneurship and Skills • Better Regulation • Financing Growth • Food Fortress 	<ul style="list-style-type: none"> • Beef and Sheep • Dairy • Poultry and Eggs • Drinks and Beverages • Bakery and Snacks • Pig • Arable Crops, Fruit and Vegetables • Fish and Aquaculture • Animal By-Products • Animal Feeds

As part of this industry focus, the AFSB recommends that the central premise of ‘one supply chain’ is followed by farmers, processors, distributors/wholesalers, and retailers/food servicers. This is particularly important with regard to TB eradication as it signals the need for cross-industry and government collaboration to achieve suitable outcomes. Furthermore, TB eradication is recommended within the Strategic Action Plan highlighting the need to ‘*strengthen our brand perception through eradication of animal disease such as TB*’ to improve international market share.

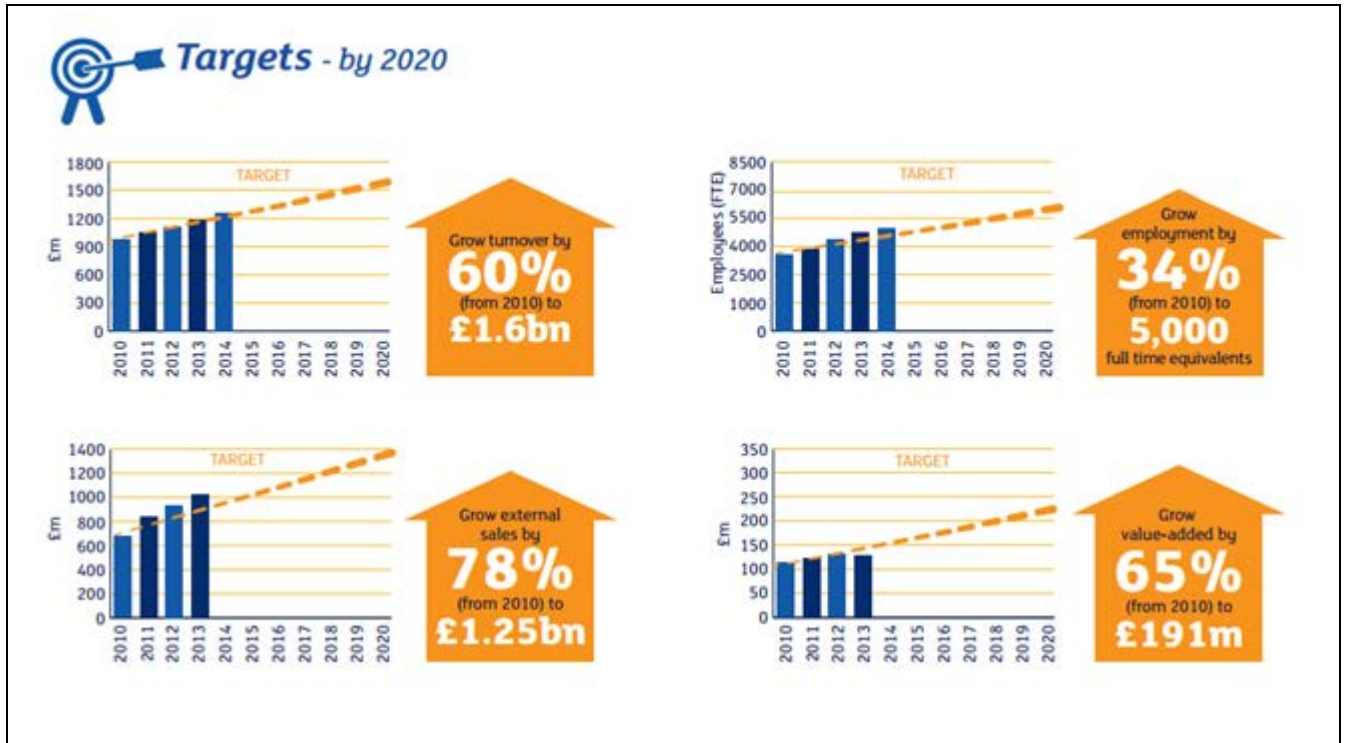
In the NI Executive Response to *Going for Growth* (2014)¹⁷, DAERA confirmed that it would establish a government/industry TB Strategic Partnership to develop a joint TB long term eradication strategy.

¹⁷ https://www.daera-ni.gov.uk/sites/default/files/publications/dard/ni_executive_response_to_going_for_growth.pdf

3.3.1 Performance of the Beef and Sheepmeat Subsector

The Beef and Sheepmeat (2014) subsector appears to be on track to meet most of its AFSB targets for 2020, and has a substantial potential benefit with regard to enhanced turnover, external sales, value add, and employment outcomes.

Figure 3.1: AFSB Beef and Sheepmeat 2020 Targets

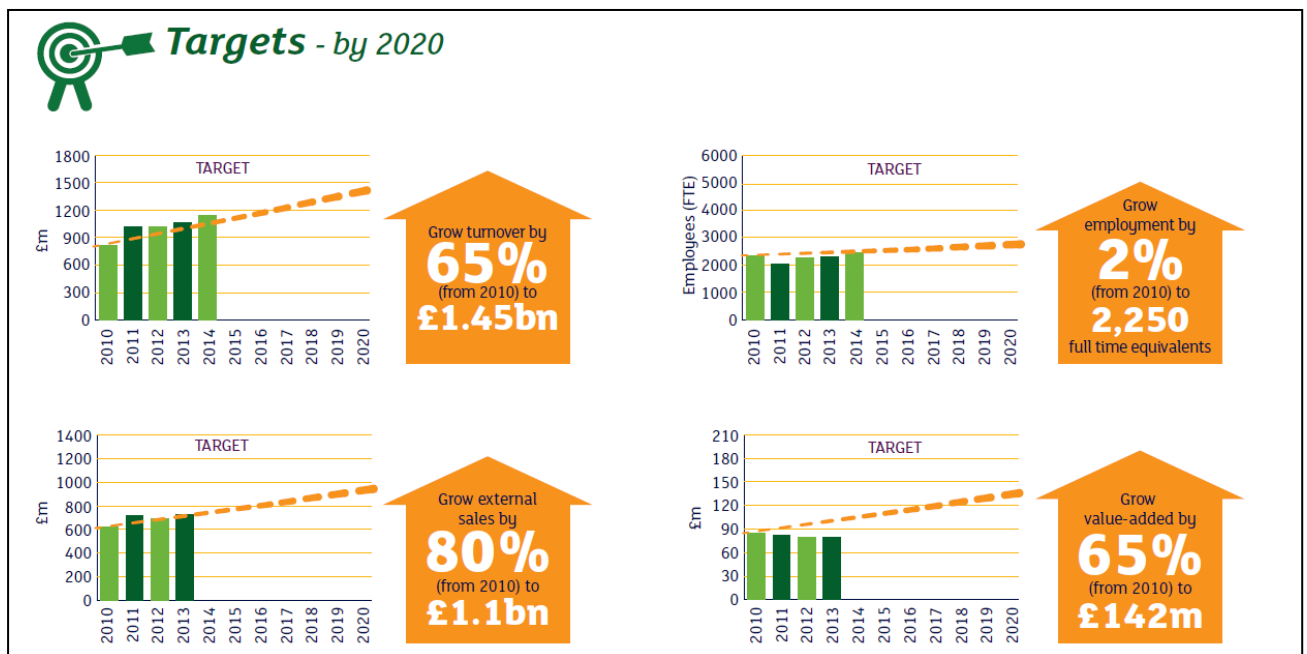


Source: AFSB (2016) *Delivering Growth – Update on Actions to support the NI Agri-Food Industry*

3.3.2 Performance of the Dairy Subsector

The dairy subsector also has shown signs of growth with regard to turnover and external sales up to 2014; however, employment gains are anticipated to be limited, and value add has actually declined in recent years given pressures on wholesale prices of milk.

Figure 3.2. AFSB Dairy 2020 Targets



Source: AFSB (2016) *Delivering Growth – Update on Actions to support the NI Agri-Food Industry*

3.4 Summary

The above sections highlight that agriculture and the agri-food sector are central to the NI economy and that NI’s reliance on these sector is proportionally much greater than that in the UK overall. The beef and dairy sectors form key components of these sectors and eradication of bTB has been identified as a key requirements to strengthen brand perception and to contribute to achievement the targets established by the ‘Going for Growth’ strategy.

4 OPTION IDENTIFICATION & SHORTLISTING

4.1 Introduction

Following appointment, detailed discussions with DAERA and TBSPG confirmed that this cost/benefit analysis should be limited to the following options:

- i. 'Do nothing' option – which would see no government testing or bTB programme
- ii. 'Status Quo' option – i.e. the current bTB programme employed to tackle the disease; and
- iii. 'Implementation of TBSPG recommendations in full'.

The remainder of this chapter provides an overview of each option.

4.2 Option Identification

4.2.1 Do Nothing (Cessation of DAERA's current bTB control measures)

This option represents the removal of all compulsory field cattle control measures and would, in theory, return NI to the situation prior to the introduction of the compulsory bTB eradication scheme in 1959. Previous to its introduction, a voluntary bTB eradication scheme was in place from 1949 but even with this, an estimated 2,000 tonnes of meat was condemned due to bTB and a 10% reduction in milk yields in infected animals was suggested (Robinson, 2015). During the 1940s, there was an average of more than 400 clinical bovine cases detected per year and the dairy cow animal incidence was estimated at 33% (Robinson, 2015). This was during a period when the total cattle population in NI was approximately half of present cattle numbers and much less intensive cattle management systems were in place.

Current meat hygiene inspection processes and the continuation of pasteurisation of milk would continue to effectively protect the vast majority of the human population from any increased zoonotic threat posed by increases in bTB incidence in cattle. However, there would be a potentially serious increased risk to those working in close contact with cattle or those that continue to consume unpasteurised milk.

Although the impact on human health may be marginal if live cattle testing was stopped, a significant increase in bTB would have serious negative implications for animal health, impacting on the health of both cattle and wildlife in contact with cattle, causing a general state of illness, coughing and eventual death.

The costs and disruption associated with bTB would also have a negative impact on the productivity of farm businesses. Furthermore, it would threaten export markets. The current NI bTB testing programme complies with European Directive 64/432 (as amended) and the OIE (World Organisation for Animal Health) Terrestrial Animal Health Code, thereby enabling NI to trade internationally in cattle products. A 'Do Nothing' scenario would inevitably fail to meet EU/OIE standards and consequently meat, milk and live cattle exports from NI would be avoided by other countries and potentially banned within the EU single market.

The NI cattle industry relies heavily on its trade in meat and milk as well as live cattle movements for its economic viability. Indeed, the threat of Britain prohibiting cattle exports from the island of Ireland

was a main driver for the instigation of the compulsory bTB eradication scheme both north and south of the border.

Additionally, as the UK is leaving the EU, it will most likely have to negotiate future trade arrangements and the incidence of bTB and the level of controls applied to it are very likely to be a factor in negotiations. Again, failure to meet these standards would ultimately prevent international trade occurring and would have a severe detrimental impact on the NI agri-food sector.

Given the above, the ‘Do Nothing’ option is not considered to be a feasible option and therefore, it has not been shortlisted for further appraisal.

4.2.2 ‘Status Quo’ Option

The ‘Status Quo’ reflects the baseline option i.e. the continuation of DAERA’s current bTB control measures.

DAERA has an EU Commission approved bTB eradication programme which is based on testing to detect infected cattle, removal of infected animals, and reducing the risks of spread through movement controls and other biosecurity measures.

Disease surveillance comprises two elements, namely:

- i. Post mortem inspection of all animals slaughtered for human consumption.
- ii. Live animal surveillance based primarily on the skin test, which is carried out by directly employed DAERA vets (VOTs) or Private Veterinary Surgeons (PVPs) that test under contract. All cattle herds must be tested at least once a year but some are tested more frequently if they are considered to be at increased risk of infection. Animals that react positively to the skin test are called reactors and the herd is called a TB breakdown herd.

Early detection of infection is important to reduce the risk of spread. The interferon gamma blood test is used to supplement the skin test to improve the diagnosis of bTB in certain situations, and there are currently constraints on the extent to which it can be used. In addition the cut off points for skin test readings can be adjusted (severe interpretation) to improve the diagnosis of bTB.

Disclosure of disease leads to compulsory slaughter of reactors with compensation at full market value. The valuation is conducted by a DAERA valuation officer. A DNA tag is applied to the reactor immediately when it is detected by a DAERA vet, or at valuation if it was detected by a PVP. Therefore if a PVP finds a reactor there is a delay in the application of the tag. The DNA tag produces a tissue sample and the purpose of the tag is to allow a comparison to be made with a sample taken at slaughter to check that the reactor animal on the farm is the same animal that is slaughtered.

Every TB breakdown is subject to an epidemiological assessment by a DAERA veterinary officer and specific public and animal health advice is provided. In addition, disease control measures are instigated to prevent the spread of bovine TB to and from other herds, mainly by prohibiting the movement of animals between herds. The epidemiological assessment will result in the identification of herds or animals that are at higher risk of infection because of previous exposure. These herds and animals are then tested and the tests are categorised as risk tests.

The breakdown herd is also subject to additional testing categorised as restricted herd tests. The herds may also be blood tested and severe interpretation of the skin test employed to detect and remove as many potentially infected animals as possible. To further control the disease animals within the breakdown herd that have had significant exposure to infected animals may be removed as negative contacts (NICs), even if they do not give a positive skin test result.

Compulsorily slaughtered animals are subject to post mortem examination which along with further laboratory diagnostic work provides further information to the programme. Strain typing of the causal agent, *Mycobacterium bovis* (M bovis), is carried out in all cases where it is confirmed by laboratory culture.

Post mortem and laboratory test results, including strain type information, are provided to the farmer during the course of a confirmed TB breakdown, as well as biosecurity advice and advisory leaflets.

As disease incidence rises so do the number of additional tests, investigations and disease control actions, leading to increased programme costs.

In line with NIGEAE and HM Treasury “Green Book” guidance, the status quo option has been shortlisted for further appraisal as it will provide a comparator to assess the ‘do something’ options against. Key assumptions associated with the status quo option are as follows:

- There will be no significant implementation of TBSPG recommendations over and above those already actioned by DAERA;
- There will be no significant change in the level of activity and expenditure related to the bTB programme i.e. programme activities and costs will remain at 2015 levels, see details in Table 4.1 and 4.2 below; and
- There will be no significant change in the incidence of bTB. DAERA forecasts suggest that adoption of the ‘status quo’ will result in an average herd incidence rate of 6.4% over the next 40 years (the 2015 baseline being 7.15%) – refer to Section 5.2 for further details.

Table 4.1 provides a summary of the bTB programme’s incidence rate and rate of testing undertaken in 2015.

Table 4:1: bTB Programme Incidence and Testing (2015)

bTB Incidence Rates	<ul style="list-style-type: none"> • Herd Incidence (2015): 7.15% • Animal Incidence (2015): 0.66% (11,004) • Number of new herd breakdowns (2015): 1,688
Number of Cattle Slaughtered (2015) and number of Lesions at Routine Slaughter (LRS)¹⁸	<ul style="list-style-type: none"> • Cattle Slaughtered Overall: 413,383 • Number with LRS: 1,459 (0.353% of slaughters) • Cattle Slaughtered (excluding direct imports)¹⁹: 383,544 • Number with LRS: 1,362 (0.355%)
Skin Tests	<ul style="list-style-type: none"> • Number of Herd Level Skin Tests (2015): 34,110 consisting of: <ul style="list-style-type: none"> - 6,391 restricted tests; - 11,506 risk tests; - 16,213 routine tests • Number of herds completed a herd test: 23,980 • Number of Animal skin tests (2015): 2,322,451 for 1,652,601 animals
IFNG (Gamma) Tests²⁰	<ul style="list-style-type: none"> • Number of IFNG herd tests (2015): 198 in 177 herds. • Number of IFNG animals IFNG tested (2015): 15,873

Source: DAERA bTB Programme Annual Report (2015) – Draft

The areas of expenditure profiled as the ongoing cost of implementing the status quo are reflected within Table 4.2. This table also highlights a number of adjustments made to this baseline expenditure to take into account other aspects of our analysis, namely:

- Compensation costs have been removed. This expenditure represents a transfer payment to farmers. The actual economic cost to farmers is reflected in cost estimated detailed in Section 5.3.2
- Haulier expenses and salvage monies have been removed. In addition to the ongoing cost of implementing the bTB programme, our approach involves the assessment of the cost of bTB breakdowns to government – haulier expenses and salvage money received is reflected in this calculation. Therefore, in order to remove the potential for double counting, this area of expenditure has been removed from ongoing programme costs;
- PVP tuberculin testing, TVO/VOT tuberculin testing and costs of tuberculin are reflected within our assessment of costs associated with breakdowns and these costs vary in line

¹⁸ Sometimes lesions suggestive of bTB are found in animals at routine slaughter. When this occurs the herd will be put under restriction pending further investigation

¹⁹ Animals imported for slaughter do not contribute to NI TB disease profile.

²⁰ Gamma interferon (IFNG) is a diagnostic blood test used alongside the tuberculin skin test, to improve the sensitivity of the testing regime and identify infected animals more quickly. Using both tests in this way can help to speed up the resolution of confirmed TB breakdowns by identifying as many infected cattle as possible at the earliest opportunity.

disease incidence (refer to Section 5.2). Therefore, they have been removed from ongoing programme costs.

Table 4:2: DAERA bTB Programme Costs (2015)

Programme Activity	2015 Cost (£s)	Include within ongoing programme costs?
Compensation for 12,116 animals (includes reactors, negative in contacts and voluntarily slaughtered interferon gamma positive cattle)	£ 15,450,011	No – reflected in cost to farmers (TB breakdown – refer to Section 5.3.2)
Haulier expenses	£323,913	No – reflected in cost to government (TB Breakdown - refer to Section 5.4.1)
PVP Tuberculin testing (excluding travel)	£6,393,423	Yes – however, total cost of testing incurred in breakdowns to be removed from this figure- refer to Section 5.6.2).
TVO/VOT tuberculin testing (excluding travel)	£1,633,697	As above - refer to Section 5.6.2
Tuberculin	£617,293	As above - refer to Section 5.6.2
Laboratory analysis for interferon gamma and culture	£657,819	Yes
RTA analysis	£141,000	Yes
Veterinary and Administrative Staff (including policy)	£5,808,478	Yes
Salvage monies	£ -2,523,440	No – accounted for in cost of breakdown to government- refer to Section 5.4

Source: DAERA Annual Report (provided to the European Commission)

Section 9.3 of this report highlights that continuance of the Status Quo would incur a total cost to government of c£1,055 million over the next 40 years (including compensation payments), at an average annual cost of £26 million. At the end of the 40 year period, it is projected that the annual cost to government would be c£28 million, reflecting a bTB herd incidence level of 6.63%.

If the Status Quo option was to be pursued and bTB herd incidence levels remained static at c6.63%, this higher level of annual cost would be incurred each year ad infinitum. Continuance of disease levels at this rate would pose a number of significant risks, particularly in relation to future trading arrangements post-Brexit, where NI's current rate of bTB may have a detrimental impact on any potential future trade deals.

4.2.3 Implementation of TBSPG Recommendations in Full

This option proposes the implementation of all TBSPG recommendations in line with the recommended timeline **whilst continuing implementation of the baseline programme activities.**

Table 4.3 (presents the additional costs (at 2016 prices) of implementing TBSPG recommendations. N.B. these costs have been adjusted to reflect changes in disease incidence. The TBSPG recommendations that are anticipated to vary most with disease incidence are as follows:

- Expanded use of severe interpretation during breakdown to include compulsory removal of all animals that are inconclusive on standard interpretation;
- IFNG testing is expanded to remove as many infected animals as soon as possible;
- DNA tags applied to any animal detected with reactor readings at the level of interpretation specified for the test;
- VNTR typing;
- 2NVL becomes OTW; and
- Additional DAERA staff costs.

Provision has been made for additional Veterinary, Epidemiology and Policy staff, to ensure effective implementation of TBSPG recommendations. Additional provision for Policy staff has been profiled for Years 1 and 2 only due to the potential for new legislation linked to the TBSPG recommendations. Additional Veterinary and Epidemiology staff are profiled for each year of the appraisal period, however they are reduced during the appraisal period as disease levels decline. Further details on the assumptions used are provided in Annex G.

Section 5.2 highlights that DAERA epidemiologists have modelled the impact of the implementation of TBSPG recommendations on bTB incidence. These forecasts have informed our quantitative assessment of cost and benefit for this option.

The following should be noted in relation to Research costs - as of 2016 DAERA has 8 TB related research studies ongoing, 4 were commissioned in 2015 with a further 4 commissioned in 2016 and all led by AFBI. The total cost of the 8 projects over their lifetime amounts to approximately £2.6 million. Given that research costs such as these are currently accounted for within the Departmental Capital budget and, on the assumption that current research may be targeted better to take account of the TBSPG recommendations, the Cost: Benefit analysis has not made provision for general research.

The TBSPG does recommend a particular research project to consider farm fragmentation which has been accounted for within this report but in general, the TBSPG recommends a more general outline of how future commissioning of TB related research should be directed and what it should take into account. The TBSPG feel that the TBEP governance group should have a key role in influencing the direction of DAERA's research programme of work; inputting to the research agenda, awareness of all ongoing/proposed research and to aid with dissemination of information to stakeholders.

The TBSPG also recommend that the existing badger Road Traffic Accident (RTA) survey is expanded to have uniform coverage throughout NI to provide a more reliable estimate of changes in prevalence in both time (inter-annual change) and space (changes between regions). This survey

enhancement (50% increased coverage) aims to better inform TBEP and DAERA with regards to wildlife strategy, and the related cost increase has been accounted for within this report with a provision of £71,000 per annum.

When adjusted for reduced levels of disease, the total additional cost of implementing the TBSPG recommendations over 40 years is **£244.3 million**, at 2016 prices (or **£145.6 million** when discounted over time using a discount rate of 3.5%).

Section 9.3 of this report highlights that Option 2 would incur a total cost to government of c£850 million over the next 40 years (including compensation payments), at an average annual cost of £21 million. At the end of the 40 year period, it is projected that the annual cost to government will be c£8.5 million, reflecting a bTB herd incidence level of 0.1%.

Throughout the appraisal period a significant proportion of baseline bTB programme costs will decrease as disease levels decline. Annual expenditure will decline further after Year 40 if the herd incidence level remains at 0.1%, as current EU Directives allow for the testing regime to move to triennial and ultimately, four yearly testing, at these levels.

4.3 Summary of Shortlisted Options

Based on the above, the options shortlisted for further quantitative and qualitative analysis are as detailed/ numbered below:

- Option 1 - Status Quo, the existing DAERA bTB programme; and
- Option 2 – Implementation of TBSPG Recommendations in Full.

Table 4.3: Additional Annual Cost of Implementing TBSPG Recommendations (Year 1 – 10) – modelled to reflect disease level, costs not discounted

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Incidence Rate	7.00%	7.50%	7.20%	7.00%	6.80%	6.50%	6.30%	6.00%	5.70%	5.50%
Recommendation	1	2	3	4	5	6	7	8	9	10
Severe Interpretation	£236,000	£252,857	£242,743	£236,000	£229,257	£219,143	£212,400	£202,286	£192,171	£185,429
IFNG test expansion	£94,000	£283,929	£272,571	£265,000	£257,429	£246,071	£238,500	£227,143	£215,786	£208,214
DNA Tags	£30,000	£18,750	£18,000	£17,500	£17,000	£16,250	£15,750	£15,000	£14,250	£13,750
VNTR Typing	£31,000	£33,214	£31,886	£31,000	£30,114	£28,786	£27,900	£26,571	£25,243	£24,357
2+ reactors OTW	£238,000	£255,000	£244,800	£238,000	£231,200	£221,000	£214,200	£204,000	£193,800	£187,000
GIS provision	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000
Bio-security checklist	£10,000	£0	£0	£0	£0	£0	£0	£0	£0	£0
PVP/ DAERA Advice	£500,000	£500,000	£500,000	£500,000	£500,000	£500,000	£500,000	£500,000	£500,000	£500,000
Livestock mkt display	£50,000	£0	£0	£0	£0	£0	£0	£0	£0	£0
Fragmentation Data Review	£300,000	£300,000	£300,000	£0	£0	£0	£0	£0	£0	£0
Reactor Fraud Measure	£150,000	£160,714	£154,286	£150,000	£145,714	£139,286	£135,000	£128,571	£122,143	£117,857
Wildlife	£1,800,000	£3,600,000	£5,400,000	£7,200,000	£7,730,000	£6,470,000	£5,200,000	£4,030,000	£2,860,000	£2,260,000
Wildlife IT	£109,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000
New Governance	£24,000	£65,000	£60,000	£79,300	£60,000	£60,000	£60,000	£79,300	£60,000	£60,000
Publicity & Comms	£54,000	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500
Expansion of RTA	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000
Additional DAERA staff	£2,864,500	£2,864,500	£2,474,500	£2,474,500	£2,474,500	£2,474,500	£2,474,500	£2,474,500	£2,474,500	£2,474,500
Total Cost	£6,620,500	£8,548,464	£9,913,286	£11,405,800	£11,889,714	£10,589,536	£9,292,750	£8,101,871	£6,872,393	£6,245,607

Table 4.3 (continued): Additional Annual Cost of Implementing TBSPG Recommendations (Year 11 – 20) – modelled to reflect disease level, costs not discounted

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Incidence Rate	5.20%	5.00%	4.70%	4.40%	4.20%	3.90%	3.60%	3.40%	3.10%	2.80%
Recommendation	11	12	13	14	15	16	17	18	19	20
Severe Interpretation	£175,314	£168,571	£158,457	£148,343	£141,600	£131,486	£121,371	£114,629	£104,514	£94,400
IFNG test expansion	£196,857	£189,286	£177,929	£166,571	£159,000	£147,643	£136,286	£128,714	£117,357	£106,000
DNA Tags	£13,000	£12,500	£11,750	£11,000	£10,500	£9,750	£9,000	£8,500	£7,750	£7,000
VNTR Typing	£23,029	£22,143	£20,814	£19,486	£18,600	£17,271	£15,943	£15,057	£13,729	£12,400
2+ reactors OTW	£176,800	£170,000	£159,800	£149,600	£142,800	£132,600	£122,400	£115,600	£105,400	£95,200
GIS provision	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000
Bio-security checklist	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
PVP/ DAERA Advice	£500,000	£375,000	£375,000	£375,000	£375,000	£375,000	£375,000	£375,000	£375,000	£250,000
Livestock mkt display	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Fragmentation Data Review	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Reactor Fraud Measure	£111,429	£107,143	£100,714	£94,286	£90,000	£83,571	£77,143	£72,857	£66,429	£60,000
Wildlife	£3,050,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000
Wildlife IT	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000
New Governance	£60,000	£79,300	£60,000	£60,000	£60,000	£79,300	£60,000	£60,000	£60,000	£79,300
Publicity & Comms	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500
Expansion of RTA	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000
Additional DAERA staff	£2,474,500	£1,855,875	£1,855,875	£1,855,875	£1,855,875	£1,855,875	£1,855,875	£1,855,875	£1,855,875	£1,237,250
Total Cost	£6,995,429	£6,344,318	£6,284,839	£6,244,661	£6,217,875	£6,196,996	£6,137,518	£6,110,732	£6,070,554	£5,306,050

Table 4.3 (continued): Additional Annual Cost of Implementing TBSPG Recommendations (Year 21 – 30) – modelled to reflect disease level, costs not discounted

Year	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
Incidence Rate	2.60%	2.30%	2.10%	1.80%	1.66%	1.52%	1.39%	1.26%	1.13%	1.00%
Recommendation	21	22	23	24	25	26	27	28	29	30
Severe Interpretation	£87,657	£77,543	£70,800	£60,686	£55,966	£51,246	£46,863	£42,480	£38,097	£33,714
IFNG test expansion	£98,429	£87,071	£79,500	£68,143	£62,843	£57,543	£52,621	£47,700	£42,779	£37,857
DNA Tags	£6,500	£5,750	£5,250	£4,500	£4,150	£3,800	£3,475	£3,150	£2,825	£2,500
VNTR Typing	£11,514	£10,186	£9,300	£7,971	£7,351	£6,731	£6,156	£5,580	£5,004	£4,429
2+ reactors OTW	£88,400	£78,200	£71,400	£61,200	£56,440	£51,680	£47,260	£42,840	£38,420	£34,000
GIS provision	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000
Bio-security checklist	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
PVP/ DAERA Advice	£250,000	£250,000	£250,000	£250,000	£250,000	£250,000	£250,000	£250,000	£250,000	£125,000
Livestock mkt display	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Fragmentation Data Review	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Reactor Fraud Measure	£55,714	£49,286	£45,000	£38,571	£35,571	£32,571	£29,786	£27,000	£24,214	£21,429
Wildlife	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000
Wildlife IT	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000
New Governance	£60,000	£60,000	£60,000	£79,300	£60,000	£60,000	£60,000	£79,300	£60,000	£60,000
Publicity & Comms	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500
Expansion of RTA	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000
Additional DAERA staff	£1,237,250	£1,237,250	£1,237,250	£1,237,250	£1,237,250	£1,237,250	£1,237,250	£1,237,250	£1,237,250	£618,625
Total Cost	£5,259,964	£5,219,786	£5,193,000	£5,172,121	£5,134,071	£5,115,321	£5,097,911	£5,099,800	£5,063,089	£4,302,054

Table 4.3 (continued): Additional Annual Cost of Implementing TBSPG Recommendations (Year 31 – 40) – modelled to reflect disease level, costs not discounted

Year	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
Incidence Rate	0.86%	0.73%	0.60%	0.47%	0.34%	0.21%	0.10%	0.10%	0.10%	0.10%
Recommendation	31	32	33	34	35	36	37	38	39	40
Severe Interpretation	£28,994	£24,611	£20,229	£15,846	£11,463	£7,080	£3,371	£3,371	£3,371	£3,371
IFNG test expansion	£32,557	£27,636	£22,714	£17,793	£12,871	£7,950	£3,786	£3,786	£3,786	£3,786
DNA Tags	£2,150	£1,825	£1,500	£1,175	£850	£525	£250	£250	£250	£250
VNTR Typing	£3,809	£3,233	£2,657	£2,081	£1,506	£930	£443	£443	£443	£443
2+ reactors OTW	£29,240	£24,820	£20,400	£15,980	£11,560	£7,140	£3,400	£3,400	£3,400	£3,400
GIS provision	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000	£59,000
Bio-security checklist	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
PVP/ DAERA Advice	£125,000	£125,000	£125,000	£125,000	£125,000	£125,000	£125,000	£125,000	£125,000	£125,000
Livestock mkt display	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Fragmentation Data Review	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0
Reactor Fraud Measure	£18,429	£15,643	£12,857	£10,071	£7,286	£4,500	£2,143	£2,143	£2,143	£2,143
Wildlife	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000	£3,150,000
Wildlife IT	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000	£64,000
New Governance	£60,000	£79,300	£60,000	£60,000	£60,000	£79,300	£60,000	£60,000	£60,000	£79,300
Publicity & Comms	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500	£20,500
Expansion of RTA	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000	£71,000
Additional DAERA staff	£618,625	£618,625	£618,625	£618,625	£618,625	£618,625	£618,625	£618,625	£618,625	£618,625
Total Cost	£4,283,304	£4,285,193	£4,248,482	£4,231,071	£4,213,661	£4,215,550	£4,181,518	£4,181,518	£4,181,518	£4,200,818

5 QUANTITATIVE ANALYSIS OF OPTIONS

5.1 Overview of Approach and Methodological Limitations

The quantitative analysis of options includes an assessment of the costs and benefits of each option over a 40 year period using discounted cashflow models. A 40 year period has been used as a 'steady state' position which is anticipated to be have been achieved within this timeframe – steady state referring to a position where disease incidence and levels of cost/benefit have levelled off.

The discounted cash flows represent the total economic cost of each option. They do not include inflation and they illustrate the Net Present Cost (NPC) of each option using discount rates of both 3.5% and 8%.

The cashflows and underpinning assumptions are presented in Annex G and its supporting spreadsheet model.

As reflected in Figure 5.1, our quantitative analysis of each option involves estimating the following:

- The cost to farmers of a TB breakdown – the total cost of breakdowns to farmers varies in direct proportion to the level of disease incidence;
- The costs to government of a TB breakdown – the total cost of breakdowns to government varies in direct proportion to the level of disease incidence ;
- Ongoing costs associated with the current bTB Programme, some of which vary as disease incidence levels change; and
- Additional costs incurred by government in implementing TBSPG recommendations (applicable to Option 2 only and as profiled in Section 4.2.3).

Costs savings/ benefits will be generated from a reduction in bTB incidence.

Please note, compensation payments to farmers for slaughtered reactors represent a significant element of DAERAs current expenditure on bTB. This expenditure represents a transfer payment to farmers and its value is represented in our calculations within the economic cost of a breakdown to farmers. Issues relating to future compensation payments and their impact on DAERA budgets are considered further in Section 9.

There are a number of areas of cost/benefit that cannot be readily quantified due to a lack of data or adequate proxy, the complexity of the issues involved and the level resource required to carry out such an exercise, these include:

- **Production losses** – potential benefits include: reduction in mortality/culling; increased cow fertility; increased milk yields; and improved productivity of beef animals. Although previous studies have quantified benefits of increased productivity from TB disease control (e.g. Sheehy and Christiansen (1991)²¹ estimated total productivity losses of 3– 4 per cent of

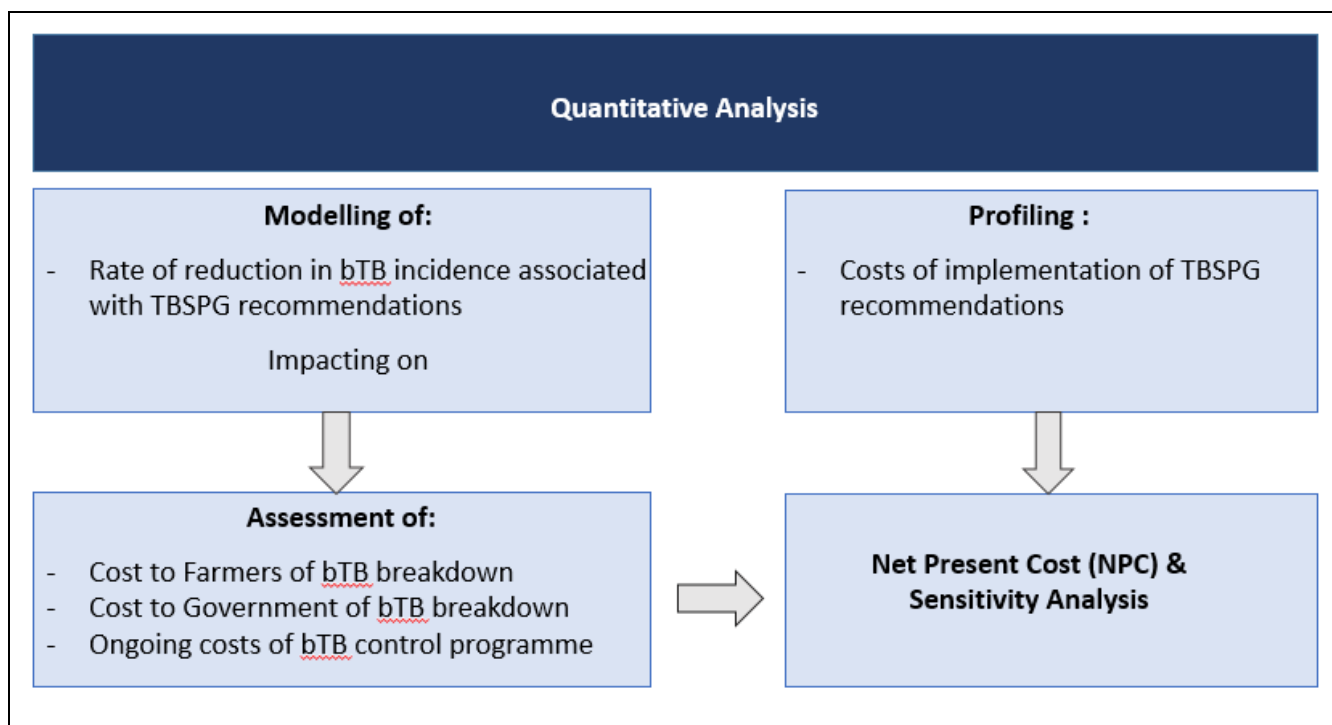
²¹ Sheehy SJ, Christiansen KH (1991). Cost/Benefit Analysis of Irish Bovine Tuberculosis Eradication Schemes. University College Dublin.

output value occurred between a high incidence of TB and the lower incidence achieved with controls), these figures cannot be readily replicated for NI;

- **Exports** - Sheehy and Christiansen also estimated the benefits of more favourable access to the UK market for the Irish economy. These were estimated to be of a similar size to productivity losses. However, the calculations made are of limited relevance to the NI economy, for example, the trade flows are markedly different and uncertainty over the trade implications of Brexit further complicate any possible quantitative assessment;
- **Human Health** - TB was one of the great public health success stories of the twentieth century. In the late 19th century TB caused 1 in 5 of deaths in the UK and even as late as the pre and post-World War II period there was 50,000 TB notifications in England and Wales. The implementation of BCG vaccines, pasteurisation of milk, and the reduction of the incidence of the disease in the cattle population contributed to the effective elimination of the disease as a major health issue in the developed countries. Were there to be a return to past level of infection the risk to the general public would be limited because of the use of BCG and pasteurisation of milk. For farm families who might consume unpasteurised milk or contract the disease through direct transmission the risks could be significant. In addition, numerous studies have highlighted other negative human health impacts of bTB, including distress and anxiety, sometimes leading to physical illness, in farmers and their families following a bTB breakdown ; and
- **Animal Welfare** - If the disease were to re-emerge there could be significant animal welfare problems. It is not likely that these would be acceptable to a population increasingly seeking high welfare standards.

Whilst the above areas of cost/benefit cannot be readily quantified, we have considered these and other factors within the non-monetary analysis (Section 7).

Figure 5:1: Overview of Approach to Quantitative analysis



Also, please note that the modelling of option costs and benefits is constrained by the following key factors:

- The costs and benefits of bTB can be influenced by a wide range of factors including herd numbers, size and type (i.e. dairy and non-dairy). DAERA herd projections do not reflect cattle population change by herd type and it is also acknowledged that, due to relatively low numbers within the dairy sector, projections at herd type level (over a 40 year period) are susceptible to a high level of forecasting error. Consequently, our analysis utilises average herd data across all herd type. Our sensitivity analysis includes three herd size scenarios (refer to Section 6.4) to assess the impact of variances in herd size; and
- Our calculations use NI specific cost data wherever possible, however, much of the analysis of farmer costs has been carried out by DEFRA and, therefore, we have utilised GB derived values where no NI specific value is available.

In recognition of these limitations, we have carried out a range of sensitivity analyses that assess the impact of variations in key assumptions on the NPC (and ranking) of shortlisted options. These variations reflect adjustments to both farmer and government costs associated with bTB breakdowns, as well as the costs associated with implementation of TBSPG recommendations.

5.2 Projected bTB Incidence

The projected impact of each option on future bTB herd incidence levels has been extrapolated using bTB incidence trends experienced by the Republic of Ireland (RoI). Although the RoI TB programme is not directly comparable to the recommended programme in NI, a number of factors mean that it provides the closest relevant comparator to assess the impact of the proposed package of integrated interventions, namely:

- the presence of a wildlife reservoir of infection (primarily the badger) as well as similarities in badger ecology;
- its similarities with NI in terms of production and landscape;
- the existence of a long standing ongoing bTB control programme that has shown strong signs of success; and
- its development of a multi-faceted and integrated control programme, including the national roll-out of a wildlife intervention.

Annex I provides further details relating to approach, assumptions and results used in developing the disease incidence projections, which indicate that:

- implementation of the full package of TBSPG recommendations (whilst retaining the appropriate level of underlying baseline activities) is anticipated to achieve a herd incidence rate of <0.1% by Year 37 (2053) and that it will remain at this rate thereafter. Once incidence falls below 0.1%, it is recorded as being maintained at <0.1% with NI obtaining official tuberculosis free (OTF) status from the EU after six consecutive years at this level; and
- continuance of the 'Status Quo will not deliver any significant reduction in bTB herd incidence. The projections suggest that, at best, the average herd incidence rate will remain at c6.4%.

Current EU directive requirements identify different testing regimes at different infection levels that will apply to Option 2 if disease levels are reduced – see details below:

- If the average determined at 31 December of each year of the annual percentages of bovine herds confirmed as infected with bTB is not more than 1% of all herds during the two most recent annual supervisory periods, the interval between routine tests may be increased to *two years* and male animals for fattening may be exempted – **based on the projections provided, a disease incidence level of 1% and lower is projected to be achieved by 2047 (Year 31), meaning that biennial testing could start in 2049 (Year 33);**
- If the average determined at 31 December of each year of the annual percentages of bovine herds confirmed as infected with bTB is not more than 0.2% of all herds during the two most recent biennial supervisory periods, the interval may be increased to *three years* and/or the age at which animals have to undergo these tests may be raised to 24 months - **based on the projections provided, a disease incidence level of 0.2% and lower is projected to be achieved by 2053 (Year 37), meaning that triennial testing could start in 2057 (Year 41);**
- If the average determined at 31 December of each year of the annual percentages of bovine herds confirmed as infected with bTB is not more than 0.1% of all herds during the two most recent triennial supervisory periods, the interval may be increased to *four years* or providing specified conditions (testing all animals moving into a herd and post mortem examination of all slaughtered animals) are met the CA may dispense with TB testing of herds - **based on the projections provided, this infection level would be achieved by 2053 (Year 37) so this level of testing could commence in 2058 (Year 42).**

Key features and underpinning assumptions relating to the projections associated with full implementation of TBSPG recommendations are as follows:

- There will be a lag of 4-5 years between implementation and fall in reactor numbers due to early detection and enhanced measures to further ensure TB breakdowns herds are clear of infection;
- Assuming that measures are implemented as indicated, benefits from badger interventions start to become observable from year 6 with full benefits as transposed from the ROI data starting from year 7;
- It is assumed that full compliance/buy-in is obtained from all stakeholders;
- It is assumed that bTB can be maintained within the badger population independently i.e. declines in cattle bTB levels is not associated with a significant decline in badger bTB levels;
- Some form of badger intervention will be required over the lifetime of the eradication plan;
- No alternative badger intervention that is more effective is developed.

5.3 Estimates of Costs to Farmers Associated with a TB Breakdown

5.3.1 Overview

The approach undertaken by PACEC to estimate the cost of a TB breakdown within NI builds upon the standard approach outlined within DEFRA (2005) 'Cost benefit analysis of badger management

as a component of TB control in England'²², as well as Bennett et al (2004) paper 'Assessment of the economic impacts of TB and alternative control policies' (on behalf of DEFRA)²³ papers.

This approach aims to facilitate the identification of those areas of cost that will vary in direct proportion to the level of disease incidence.

As identified by Bennett et al (2004) and Bennett and Cooke (2006)²⁴, here are four main areas of potential cost associated with a TB breakdown for farm businesses, namely:

- I. slaughter of reactors and other cattle;
- II. movement restrictions;
- III. isolation; and
- IV. the cost of testing.

Other areas of costs may apply but are difficult to quantify and the above areas of cost represent the main areas of cost incurred. Bennett et. al (2004) also recognise the significant variation in the cost of a bTB breakdown to farmers, depending on herd size, type and incidence. However, this study of English and Welsh bTB breakdowns identified that in 90% of cases, the cost to farmers was estimated at less than £18,513 for dairy herds and £11,462 for beef herds per breakdown.

5.3.2 Slaughter of Reactors

DEFRA (2011)²⁵ identifies that the largest cost associated with a bTB breakdown (or Confirmed New Incident, CNI) is the cost of slaughtered reactors.

The financial cost of these slaughters is currently met by DAERA through compensation payments. Farmers currently receive 100% compensation of the market value of a slaughtered animal. NB an assessment of compensation and the impact of TBSPG recommendations relating to compensation is presented in Section 9 of this report.

However, compensation alone does not capture the true economic value of the slaughtered animals (e.g. disruption of milk output (dairy) and the cost of a replacement heifer). Reflecting data from England (no NI data is available), DEFRA (2011) identifies that the residual cost of slaughter²⁶ to farmers per animal is estimated at £320. Adjusted for 2015/16 prices, this figure is estimated at £342.25.

²² DEFRA (2005) 'Cost benefit analysis of badger management as a component of bovine TB control in England. Available (archived) at: http://webarchive.nationalarchives.gov.uk/20130822084033/http://www.defra.gov.uk/animalh/tb/pdf/badger_d.pdf

²³ Available at; randd.defra.gov.uk/Document.aspx?Document=SE3112_1428_FRP.doc

²⁴ Bennett, R. M. and Cooke, R. J. (2006) *Costs to farmers of a tuberculosis breakdown*. Veterinary Record, 158 (13). pp. 429-432.

²⁵ "Measures to address bovine TB in badgers", DEFRA, 30th November 2011

²⁶ The residual cost figure deducts both salvage value (not quoted) and compensation from the value of loss to the farm (i.e. the actual farm cost of losing the animal due to compulsory slaughter). Thus the total economic loss (of slaughter) is £320 per slaughtered animal plus compensation paid.

As identified in Table 5.1, when this cost is combined with the animal’s compensation value and applied to an average number of animals per breakdown, the average total slaughter cost per breakdown equates to £11,644 (within a range £8,374 for non-dairy and £17,475 for dairy cattle).

Please note, while our cost analysis utilises the average figure across all herd types, figures for dairy and non-dairy animal are presented within Table 5.1 as they are of relevance when assessing funding/cost sharing implications – refer to Section 9.

Table 5.1: Estimated Slaughter Cost to Farmers

Type of Animal	Cattle Value (Lost by Farmer)*	Residual Cost to Farmer	Total Cost per animal	Total Cost per animal x average number of animals slaughtered per breakdown ²⁷
Dairy	£1,322	£342	£1,664	£17,475
Non-Dairy	£1,238	£32	£1,580	£8,374
All	£1,275	£342	£1,617	£11,644

* N.B. DAERA currently pays compensation to the farmer for 100% of the value of slaughtered animals

Source: DAERA (2015) Compensation (Herds and Cattle by Type), and DEFRA (2011, adjusted to 2015-16 prices using ONS Deflator)

5.3.3 Movement Restrictions

DEFRA (2016)²⁸ provides an estimate of costs of movement restrictions on a herd of £419.61 for 213 animals (average herd size) for 295 days (average number of days under movement restrictions per Officially TB Free Withdrawn (OFTW) breakdown). The resulting movement restriction cost per animal is £1.97 (sourced from SAM dataset, APHA 2013 – reflecting data for Great Britain).

Utilising the movement restriction unit cost of £1.97 multiplied by an average herd size of 150 animals (DAERA officials identify that the average herd size for a breakdown in 2015 was 150 animals), and adjusting for current prices (2016), this provides a figure of £305.32 per breakdown.

5.3.4 Isolation Costs

DEFRA (2016) utilises a unit cost of isolation per animal slaughtered for bTB of £27 per animal slaughtered (data sourced from 2014).

This includes the costs of ‘additional labour requirements to feed and milk isolated cattle, additional straw bedding, and loading costs incurred in animal removal (labour).

²⁷ Research identifies that dairy breakdowns average 10.5 slaughtered animals, non-dairy average 5.3 slaughtered animals and the average figure across both herd type was 7.2 animals

²⁸ DEFRA (2016) ‘Options to increase the chance of achieving Officially TB Free (OTF) status for the TB Low Risk Area’ - http://www.legislation.gov.uk/ukia/2016/68/pdfs/ukia_20160068_en.pdf

These costs do not include the actual feed or loading costs, but rather the additional labour required due to the isolation. For reactors, these costs are incurred between disclosure and removal, and for inconclusive reactors (IRs), this time period is the interval between tests when the animal is either cleared or becomes a reactor.

Utilising the NI average units for reactors (7.2), and adjusting for 2015/16 prices, this provides total estimated isolation costs of £197.60 per breakdown. These are primarily labour costs, and are not anticipated to vary between dairy and non-dairy herds.

5.3.5 Testing

Restricted Herd Tests

The Better Regulation (2010-13) Action Plan²⁹ identifies the administrative burden on a herd-owner of testing as £173.01 during the housed period (October to April). An additional burden is incurred through one additional worker's time of £66.16 per day. This provides a total administrative and labour cost incurred per farm test in NI of £239.17 (approximately 8.25 hours of herd-owner and 7 hours additional worker time) - £255.80 at current prices.

DAERA figures show that there were 6,391 restricted tests in 2015 and 1,688 new herd breakdowns, therefore resulting in 3.79 restricted skin tests per herd. Applying the per farm test cost of £239.17 to the number of restricted tests undertaken in NI per herd the total costs to farmers of additional testing is £905.53. Adjusting this figure for current prices results in a total cost of £969.50.

Tracing Tests

DAERA have identified that in 2015, 3,481 tracing tests were carried out by VOs, these involved on-farm testing of a selected number of high risk animals, due to their link to the breakdown herd. In addition, PVPs carried out 1,200 tracing herd tests (i.e. 2.06 tests and 0.71 tests per breakdown, respectively).

Utilising the hourly cost data obtained from The Better Regulation (2010-13) Action Plan, the estimated costs of farmer input per breakdown to these tests is as follows:

- VO tracing tests – 57 minutes input by farmer per test (mirroring the level of VO input) at £32.67 per hour (reflecting current prices) x 2.06 tests = £63.94;
- PVP tracing tests – Applying the per farm test cost of £239.17 updated to x 0.71 herd tests per breakdown = £181.62.

Contiguous Testing

DAERA officials have identified that on average, each breakdown results in 5 contiguous herd tests being carried out and each herd test results in an additional cost to farmers of £255.80 (at current prices), as detailed above. Therefore, the total farmer cost of contiguous herd tests per breakdown is estimated at £1,279.02.

²⁹ "Better Regulation Action Plan 2010-13: Final Re-measurement Exercise", DAERA (Excel spreadsheets)

Please note that this reflects to cost to the farming community of a TB breakdown and does not reflect the cost to a single farmer.

5.4 Estimates of Costs to Government Associated with a TB Breakdown

There are three main types of costs which are met by government in the event of a TB breakdown, namely:

- outbreak-related disease investigative costs
- slaughter related costs (primarily haulier and labour costs minus any salvage value received – see note below re compensation payments); and
- testing costs (restricted, contiguous and tracing tests, which generally include labour, administration, and tuberculin).

As previously highlighted, compensation payments to farmers for slaughtered reactors represent a significant element of DAERAs current expenditure on bTB. However, this expenditure represents a transfer payment to farmers and our methodology reflects its value under the economic cost of a breakdown to farmers, i.e. not within the cost of a breakdown to government.

Breakdown related testing and slaughter costs will vary in direct proportion to the level of disease incidence. VO, AHWI and administrative staff costs are almost exclusively associated with breakdowns and these will vary (albeit not in direct proportion) with changes in disease incidence. Therefore, VO, AHWI and administrative staff costs are reflected in the ongoing costs of the bTB programme (refer to Section 5.6).

The following provides details of key assumptions underpin the calculation of cost of a breakdown to government, reflecting haulier/ testing expenditure and salvage income.

5.4.1 Estimate of the Cost to Government of Slaughter of Reactors

As our approach allocates the cost associated with slaughtered reactors to the farmer (refer to Section 5.3.2), the the core cost incurred to government in the slaughter of reactors is that of haulier expenses and associated labour.

Based on haulier expenses incurred by DAERA in 2015 and the associated number of compensated reactors, the unit cost of haulage to government was £26.73 per animal.

Based on an average of 7.2 animals per herd, this produces a cost to government of £192.46 per breakdown herd.

5.4.2 Estimate of the Cost to Government of Testing

Restricted Herd Tests

The cost met by DAERA of testing (in line with the assumptions above) includes the unit cost of a PVP or VOT skin test (including labour and administration) and the cost of tuberculin. In 2015, approximately 25% of tests were undertaken by VOTs and the remainder by PVPs. Since the

introduction of the new PVP testing contract in April 2016, the unit cost of a PVP skin test was £3.19 and VOT was £2.77. This results in an average unit cost of £3.085.

With tuberculin costings £0.14 per test, the total unit cost of a skin test is £3.22.

Assuming 3.79 tests, with an average of 150 cattle per herd and a cost per test of £3.22, this provides a total cost to DAERA of £1,830 per herd.

Contiguous Tests

DAERA officials have identified that on average, each breakdown results in 5 contiguous herd tests being carried out. Assuming this applies to herds of average size (68.9 cattle), this activity results in a cost to government of £1,109.30 per herd/breakdown.

Tracing Tests

DAERA have identified that in 2015, the following tracing tests were carried out in relation to new bTB breakdowns:

- 3,481 tracing tests were carried out by VOs, These involved on-farm testing of a selected number of high risk animals. Each test incurs an average of 57 minutes of VO time at a cost of £38.57 per hour. Given that 1,688 breakdowns occurred in 2015, this input equates to a cost of £75.48 per breakdown;
- PVPs carried out 1,200 tracing herd tests. Assuming an average of 68.9 animals per herd and 1,688 breakdowns, this equates to 49 animal tests per breakdown. At a cost per test of £3.22, the total cost of this activity per breakdown is estimated at £157.78.

5.4.3 Salvage Income

DAERA data identifies that in 2015, £208.27 per reactor was obtained as salvage income. When applied to an average of 7.2 slaughtered animals per herd, this produces an income per breakdown of £1,499.54.

5.5 Summary of Costs of a TB Breakdown in Northern Ireland

Table 5.2 and 5.3 provide a summary of a TB breakdown to NI government and farmers, respectively.

Table 5.2: Estimated economic costs of an average TB breakdown (government cost centre)*

Cost Area and Associated Elements	Number of Animals/Tests	Cost	Cost to Government
Haulier	7.2 animals per herd	£26.73	£192.46
Restricted tests (PVP/VOT time plus tuberculin)	150 animals per herd x 3.79 tests	£3.22 per test	£1,830.00
Contiguous Tests (PVP/VOT time plus tuberculin)	5 tests per breakdown x 68.9 animals per herd	£3.22 per test per animal	£1,109.30
VO tracing tests	3,481 tests/ 1688 breakdowns = 2.06 tests per breakdown	£36.64 per test	£75.48
PVP tracing herd tests	1,200 tests x 68.9 animals per herd/ 1688 breakdowns = 49 animal tests per breakdown	£3.22 per test per animal	£157.78
Less Salvage Income	7.2 animals per herd	£208.27 per animal	(£1,499.54)
Total Cost to Govt per TB breakdown			£1,865.48

* compensation payments made by DAERA to farmers are not included within these figures. The lost value of animals slaughtered due to bTB (an average of £9,180 per breakdown) is reflected in Table 5.3 as a cost to farm businesses. The average net cost of a breakdown to government is therefore £1,865 + £9,180 = £11,045. The full cost of compensation to DAERA is profiled in Sections 9.2 and 9.3.

Table 5.3: Estimated economic costs of an average TB breakdown (farm cost centre)

Cost Area and Associated Elements	Number of Animals/Tests	Unit Cost (2015/16 prices)	Cost to Farmer per breakdown
Slaughter Value of Animal* + Residual Costs	7.2 animals per herd	£1,617	£11,644.25
Restriction (Administrative costs)	150 animals per herd	£2.02	£305.32
Isolation (Labour Costs)	7.2 animals per herd	£27.44	£197.60
Testing (Labour & Administrative Cost)	3.79 tests per herd	£255.80	£969.50
Contiguous Testing (cost to neighbouring farms)	5 tests per neighbouring herd	£255.80	£1,279.02
VO tracing tests	2.06 tests per breakdown	£31.03 (reflecting 57 minutes input)	£63.94
PVP tracing herd tests	0.71 tests per breakdown	£255.80	£181.62
Total Cost to Farmers per TB breakdown			£14,641.25

* as previously noted, DAERA currently compensates the farmer at full market value. Therefore, the average net cost of a breakdown to farmers is £14,641 - £9,180 = £5,461. The full cost of compensation to DAERA is profiled in Sections 9.2 and 9.3.

5.6 Ongoing Costs of the bTB Programme

5.6.1 Overview

As highlighted by the ‘Status Quo’ option, the current bTB programme represents significant level of expenditure to government (approximately £13.04m excluding compensation payments in 2015). This programme of activity (and its associated expenditure) will continue when TBSPG recommendations are being implemented (i.e. TBSPG recommendations are additional to baseline bTB programme activity), however, a number of these areas of expenditure will vary with the level of bTB incidence and are captured within our estimates of the cost of a bTB breakdown to government.

With this in mind, the ongoing costs of the bTB programme must be adjusted to ensure that double counting does not occur within the economic assessment.

5.6.2 Approach to Assessment of Ongoing Costs

Table 5.4 profiles DAERA 2015 programme costs. This and the previous subsections highlight that compensation, haulier expenses and salvage monies have been included in our analysis of the cost of a bTB breakdown to the farmer and government. Consequently, they are excluded from an analysis of ongoing costs.

Expenditure associated with laboratory analysis for interferon gamma and culture and veterinary/admin staff costs are impacted by bTB incidence rates. Additional expenditure in these areas are provided for within TBSPG recommendations and they are adjusted within our analysis to reflect changes in disease incidence.

The RTA analysis cost identified below is fixed (i.e. it does not change with disease levels) and is part of the ongoing resource budget used to determine the baseline for the programme, however, additional research expenditure is a part of TBSPG recommendation expenditure.

Table 5:4: Summary of Nature of Baseline Programme Costs

Area of Expenditure	Cost (£s)	Included with ongoing programme costs?
Compensation	£15,450,011	No – reflected in cost to farmers (bTB breakdown)
Haulier expenses	£323,913	No – reflected in cost to government (bTB Breakdown)
PVP Tuberculin testing (excluding travel)	£6,393,423	Yes – however, cost of testing incurred in estimated cost of breakdowns is removed from this figure. The balance varies with changes in bTB incidence.
TVO/VOT tuberculin testing (excluding travel)	£1,633,697	As above.
Tuberculin	£617,293	As above
Laboratory analysis for interferon gamma and culture	£657,819	Yes – additional expenditure also included within cost of implementing TBSPG recommendations. These costs vary with disease incidence.
RTA Analysis	£141,000	Yes – additional expenditure also included within cost of implementing TBSPG recommendations. Costs do not vary with disease incidence.
Veterinary and Administrative Staff	£5,808,478	Yes – additional expenditure also included within cost of implementing TBSPG recommendations. These costs vary with disease incidence.
less Salvage monies	-£2,523,440	No – accounted for in cost of breakdown to government
DAERA Sub total	£28,502,194	
AFBI VSD	£2,097,081	
TOTAL	£30,599,275	

Based on the figures presented above, the total 2015 cost to DAERA of tuberculin testing equated to £8,644,413. As identified above, a proportion of the costs of testing are reflected within our estimates of cost of a breakdown to government. For this reason, these testing and tuberculin costs must be adjusted to provide a cost of ongoing testing which is not driven by the event of a breakdown. The main driver of this cost will be the cost of routine testing, which is a required component of the programme.

Table 5.5 identifies that cost of testing due to bTB breakdowns in 2015 was £3.29 million and when this is subtracted from the total cost of testing (£8.64 million), the remainder which forms part of the ongoing DAERA bTB programme, cost £5.35 million.

Table 5:5: Cost of Testing (Due to Breakdowns)

Test Type	Cost	Rationale
Cost of Restricted Herd Test (at baseline levels)	£3,089,040	This utilises the cost of restricted testing per breakdown (£1,830) multiplied by the baseline number of breakdowns (1,688 – refer to Table 4.1) including PVP, VOT and Tuberculin.
Cost of Contiguous Herd Test (at baseline levels)	£1,872,498	This utilises the cost of contiguous testing per breakdown (£1,109.30) multiplied by the baseline number of breakdowns (1,688 – refer to Table 4.1) including PVP, VOT and Tuberculin.
Cost of Tracing Tests (at baseline levels)	£393,743	This utilises the cost of tracing tests per breakdown (£233.26) multiplied by the baseline number of breakdowns (1,688 – refer to Table 4.1).
Total Testing Costs incurred due to breakdown (at baseline levels)	£5,355,281	
Remaining Testing Cost to government @ Baseline (total tuberculin testing cost less costs of breakdown related tests)	£3,289,132	

Table 5.6 provides a summary of DAERA 2015 Programme Costs that are not accounted for within our analysis of breakdown related costs. Please note, the testing costs cited below reflect 2015 bTB incidence levels and will vary in line with changes to disease incidence.

Table 5:6: Summary of Total Annual Ongoing Expenditure

Area of Expenditure	Cost (£s)
Testing cost to government at baseline level of bTB incidence (not breakdown related)	£3,289,132
Laboratory analysis for interferon gamma and culture	£657,819
RTA Analysis	£141,000
Veterinary and Administrative Staff	£5,808,478
AFBI VSD Diagnostic Costs	£2,097,081
Total	£11,993,510

5.7 Summary of Cost Analysis Process

Table 5.7 provides a summary of the cost analysis process and the relationship between key areas of cost and the level of bTB. Costs for both the Status Quo (Option 1) and Implementation of TBSPG Recommendations (Option 2), which vary in direct proportion to the disease level, have been modelled based on DAERA disease projections (refer to Section 5.2)

Option 2 also includes expenditure associated with implementation of TBSPG recommendations, of which, a number vary in directly proportion with disease levels (refer to Section 4.2.3). These have also been modelled based on disease projections. Assumptions underpinning estimates of the cost of implementing relevant TBSPG recommendations are provided in Annexes A – F.

Table 5.7: Summary of Key Areas of Economic Cost and Baseline Data

Status Quo - 2015 Baseline Costs		£	Number of bTB Breakdown	Total Cost (£)	Relationship with Disease Levels
Cost to Government per bTB Breakdown*	1,865.48	Refer to Table 5.1	1,688	3,148,930	Total cost of breakdowns vary in direct proportion to disease level
Cost to Farmers per bTB Breakdown	14,641.25	Refer to Table 5.2	1,688	24,714,430	Total cost of breakdowns vary in direct proportion to disease level
Ongoing bTB Programme Costs**		Refer to Table 5.7		11,993,510	
				39,856,870	
* The value of slaughtered reactors is reflected in the 'Cost to Farmer per bTB Breakdown'. DAERA currently provides compensation to farmers equivalent to the full market value of these animals.					
**Ongoing programme costs include:					
			Testing Costs (not breakdown related)		Fixed
			Laboratory analysis for interferon gamma and culture		Fixed
			RTA Analysis		Fixed
			Veterinary and Admin Costs		Variable - see details below
			AFBI VSD Diagnostic Costs		Variable - see details below
Assumptions relating to Veterinary & Admin Staff Costs & AFBI VSD Diagnostics:					
It is assumed that 25% of Veterinary and Administrative Staff costs and AFBI VSD Diagnostic Costs are fixed. The remainder reduced as follows:					
- when disease incidence has reached 5% – costs are reduced by 25%					
- when disease incidence reaches 3% – costs are reduced by a further 25%					
- when disease incidence has reached 1% – costs are reduced by a further 25%					

5.8 Net Present Cost by Option

Table 5.8 provides a summary of the NPC analysis carried out for each shortlisted option over 40 years, by herd size scenario and using both a 3.5% and 8% discount rate.

Table 5.8 Option NPC by Area of Cost (Costs discounted by 3.5% over 40 years)

Discount Rate	3.50%			8%		
	1	2	3	1	2	3
Herd Scenario						
Option 1 - Status Quo						
Cost of Breakdown	£483,504,597	£467,745,081	£459,637,055	£266,971,198	£258,688,388	£256,113,277
Ongoing Costs	£257,034,983	£257,034,983	£257,034,983	£143,017,969	£143,017,969	£143,017,969
Total Costs	£740,539,580	£724,780,064	£716,672,038	£409,989,167	£401,706,357	£399,131,246
Option 2 - Full Implementation of TBSPG Recommendations						
Cost of Breakdown	£309,110,216	£298,776,544	£294,650,236	£216,588,090	£210,396,976	£208,657,490
Implementation Costs	£145,654,830	£145,654,830	£145,654,830	£90,233,451	£90,233,451	£90,233,451
Ongoing Costs	£206,039,764	£206,039,764	£206,039,764	£126,532,128	£126,532,128	£126,532,128
Total Costs	£660,804,810	£650,471,138	£646,344,830	£433,353,669	£427,162,555	£425,423,069

From a quantitative perspective Option 1, the 'Status Quo' option emerges as the most expensive option across each herd scenario when discounted by a factor of 3.5%. It is the least expensive when discounted by a rate of 8%, which is a result of Option 2 incurring a relatively high level of cost in implementing TBSPG recommendations during the early years of the programme, i.e. when the impact of discounting is less pronounced.

N.B. Discussions with DAERA representatives suggest that Herd Scenario 2 represents the most prudent forecast, as it represents the continuation of observed trends over a 10 year period. A forecast based on the continuation of these trends beyond 10 years is exposed to a greater risk of error.

Table 5.9 profiles the total NPC of key areas of cost associated with the both options utilising Herd Scenario 2 and a discount rate of 3.5%. This highlights that Option 2 delivers a lower cost of breakdowns (to farmers and government) and lower ongoing bTB programme cost due to the reduction in disease. The cost of implementing the TBSPG recommendations (when discounted by 3.5%) is £146 million.

Table 5.9 Option NPC by Area of Cost (Costs discounted by 3.5% over 40 years) – Herd Scenario 2

Variance in Totals	Option 1 (£m)	Option 2 (£m)	Variance - £m (Option 1 – Option 2)
Breakdown Costs - Farmers*	409	260	149
Breakdown Costs - Govt.*	59	39	20
Ongoing Costs	257	206	51
Implementation Costs	0	146	-146
Total Costs (£m)	725	651	74
* as previously noted, DAERA currently compensates the farmer at full market value. The full cost of compensation to DAERA is profiled in Sections 9.2 and 9.3.			

Figures 5.2 and 5.3 illustrate the NPC (using a discount rate of 3.5%) of key areas of cost over the 40 year appraisal period for Option 1 and 2, respectively.

Figure 5.2 highlights that the total annual economic cost of Option 1 ranges from £33.9m in Year 1 to £8.9m in Year 39. The average annual cost over the 40 year period is £18m. The observed reduction in annual NPC for this option (over the 40 year period) is largely due to the application of a 3.5% discount rate.

Figure 5.3 highlights that Option 2 experiences a greater range in total annual economic cost, with a high of £45.1m in Year 2 to a low of £2.3m in Year 40. The average annual cost over the 40 year period being £16m. Whilst the application of the 3.5% discount rate is a factor in the observed reduction in annual NPC for Option 2, the sharper decline in annual NPC is a direct result of a lower projected disease level. Figure 5.3 also highlights that the ongoing bTB programme costs decrease significantly over the 40 years as disease levels decline.

Figure 5.4 illustrates the annual NPC of Option 2 over the 40 year appraisal period compared to that for Option 1 (the Status Quo). This highlights that in 2027 (Year 10), the total annual NPC of Option 2 falls below that of the Status Quo, using a 3.5% discount rate, and that after Year 10, these values continue to diverge, with Option 2 exhibiting the lower cost, as the level of disease continues to decline.

After Year 40, the annual cost of testing will decline further if the herd incidence level remains at 0.1%, as current EU Directives allow for the testing regime to move to triennial and ultimately, four yearly testing, at these levels.

Figure 5:2: Option 1 Forecast Herd Incidence (%) and Economic Costs Levels - Herd Scenario 2

Forecast Herd Incidence (% , Secondary Axis) and Cumulative Expenditure (£, Primary Axis) reflecting Status Quo, 2017 - 2056. Discount rate of 3.5% applied to expenditure figures.

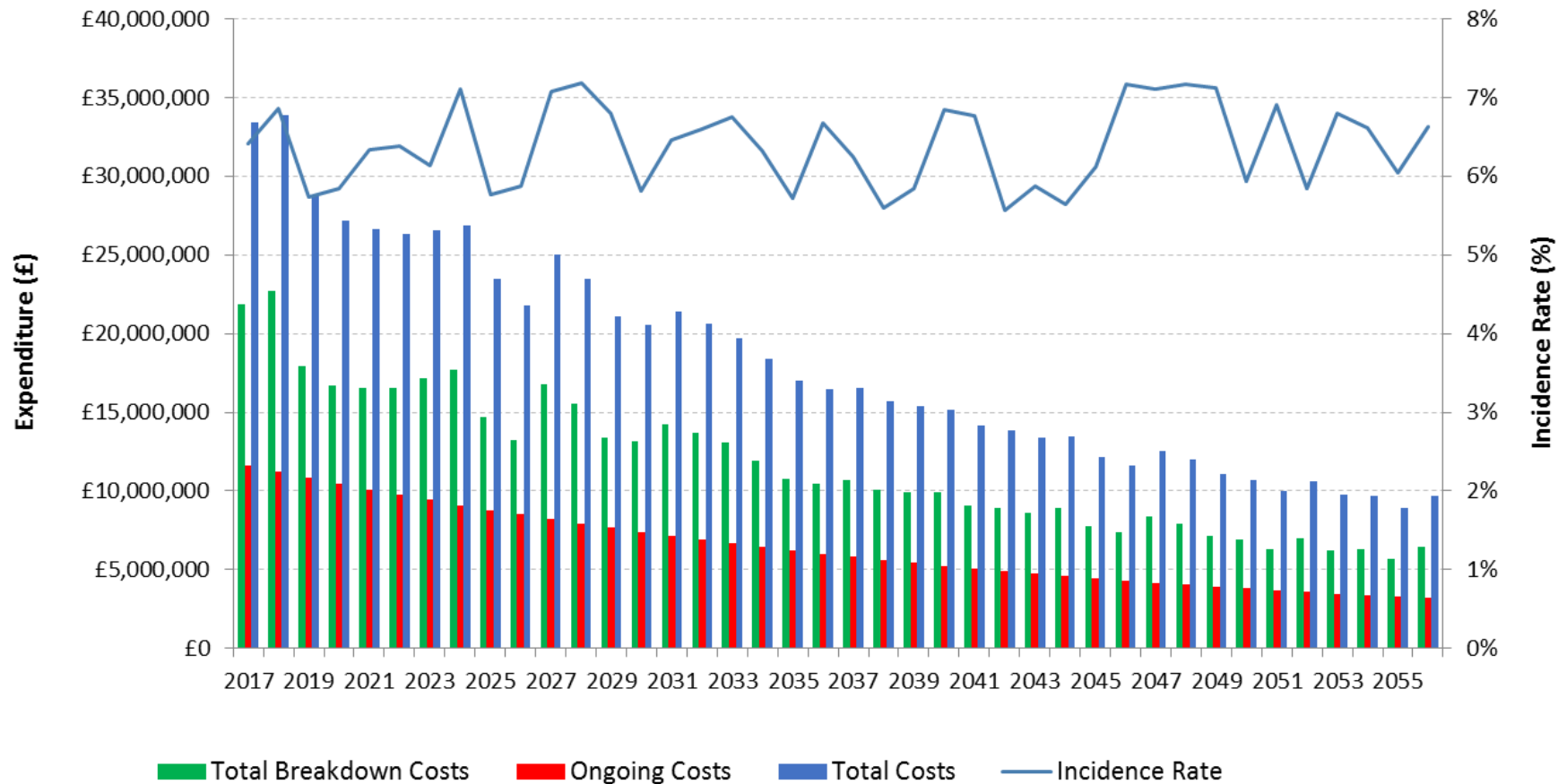


Figure 5:3: Option 2 Forecast Herd incidence (%) and Economic Cost Levels - Herd Scenario 2

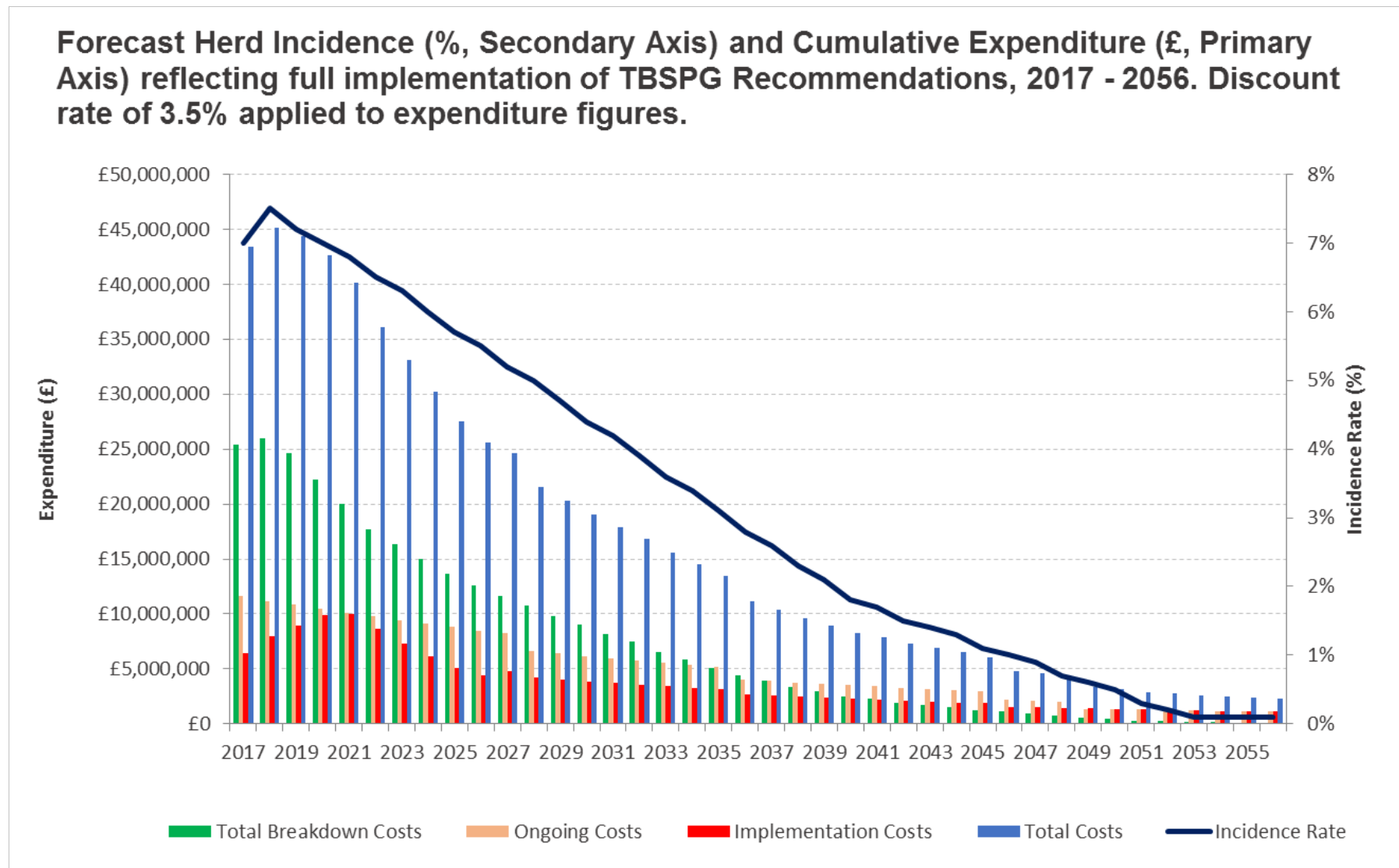
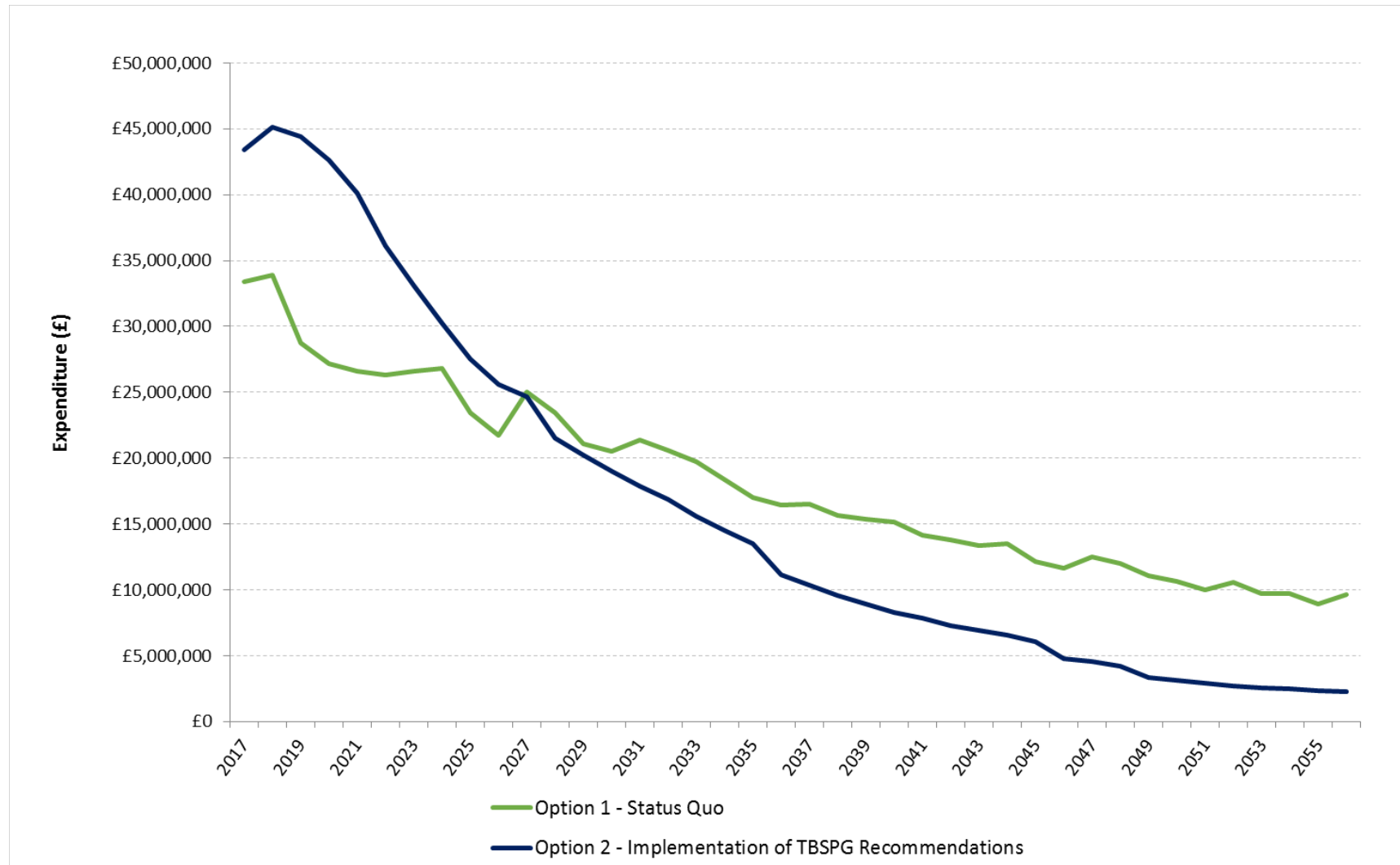


Figure 5.4: Total Annual NPC of the Status Quo compared to Preferred Option (Discount Rate = 3.5%), 2017 - 2056



6 RISK ASSESSMENT

6.1 Introduction

Since an appraisal involves making assumptions about the behaviour of various elements of the project there is a degree of risk and uncertainty involved. The issue of project risk has been assessed by the identification of:

- Key areas of project risk that vary by shortlisted option and their associated risk mitigation strategies;
- Other general areas of risk/uncertainty and associated risk mitigation strategies; and
- Option exposure to risk the profiling of these risks in terms of impact and probability.

Reflecting the risk assessment detailed in Table 6.1, Table 6.3 provides a summary of an assessment of risk by option. The risk assessment process involves estimating the Probability (P) and Impact (I) of each area of risk as it applies to each option and assigning values to these factors whereby:

- Low levels of P and I were assigned values of 1 – 2;
- Medium levels of P and I were assigned values of 3 – 4;
- High levels of P and I were assigned values of 5 – 6.

Table 6.3 identifies the risk score (P x I) for each area of risk for by option and a total risk score for each option. Risk areas receiving higher risk scores are denoted by darker shading.

Table 6.2 highlights that Option 2 represents the option with the greatest exposure to risk. Option 2 represents a higher level of risk than Option 1 across all identified areas of risk.

6.2 Quantitative Risk Assessment

Table 6.1 details key areas of risk associated with implementation of the proposed TBSPG recommendations. These are categorised in terms of risk that are to vary by option and general areas of risk.

Table 6:1: Risks Assessment and Mitigation

Risk	Risk Assessment by Option	
	Probability	Impact
Risks Anticipated to Vary by Option		
Delays in implementation of key programme elements	Option 2, which involves the implementation of a wide range of strategic recommendations, is exposed to potential delays in key elements of the programme. Recommendations relating to badger vaccination/removal are likely to be most contentious and as such are particularly exposed to the risk of delay due to political or legal challenge. Therefore, Option 2 has been rated 'medium/high' in terms of risk probability. The Status Quo option is rated at low risk.	Delays in implementation will have a 'high' negative impact on the programmes ability to achieve the assumed levels of reduction in bTB and ultimately eradication. The Behavioural Appraisal of TBSPG recommendations ³⁰ also highlights that long delays between the launch of recommendations and an implementation are likely to lead to a loss of momentum for change.
Resource costs higher than budgeted	Option 2, which contains badger vaccination/removal interventions are exposed to a higher level of risk in this area due to the contentious nature of the intervention and the complexities associated with its implementation. For example, at the time of writing, DAERA officials are assessing the delivery and cost implications of a range of issues including: <ul style="list-style-type: none"> • The use of cage versus restraints; • The deployment of DAERA versus Contract staff; • Monitoring of interventions; • Potential policing issues; 	Higher costs will challenge the affordability and value for money of interventions and will have medium/high negative impact on programmes ability to achieve the assumed levels of reduction in bTB and ultimately eradication

³⁰ "Behavioural Appraisal of the Recommendations of the TB Strategic Partnership Group (TBSPG)", Dr Philip Robinson, Harper Adams University (12 September 2016)

Risk	Risk Assessment by Option	
	Probability	Impact
	<ul style="list-style-type: none"> IT, GIS and mapping; and Cost of portable devices for use in the field. <p>Therefore, Option 2 has been rated 'medium/high' in terms of risk probability. The Status Quo option is rated at low risk.</p>	
Uncertainty of disease outcomes/reduction	<p>The quantitative assessment of cost and benefit presented within this report is underpinned by projected reductions in bTB (refer to Section 5.2). However, as highlighted by More (2015, paragraph 8):</p> <p>"...it is generally not possible to quantify the relative contribution of different interventions within a successful integrated approach. Nor is it currently possible, with any degree of certainty, to determine the number of interventions that would be required to achieve eradication..."</p> <p>Consequently, there is an inherent risk that the projected levels of reduction in bTB are not achieved. Therefore, Option 2 has been assessed as having medium -high' exposure to the probability of this risk occurring.</p> <p>The 'Status Quo' option is rated at low-medium risk as although the future level of disease incidence is uncertain, the level of disease incidence is not projected to change significantly.</p>	<p>Failure to achieve the projected levels of disease reduction will have a 'high' negative impact on the programmes ability to achieve eradication, it will impact negatively on other key areas of expenditure and will challenge the overall effectiveness/ value for money of the programme. Consequently, the value assigned to the impact associated with this area of risk is this highest impact value allocated across all risk factors.</p>
Negative media coverage (measures re badgers and compensation)	<p>Recommendations relating to changes in compensation levels and badger interventions are likely to be contentious and may create negative publicity. Negative media coverage could undermine wider stakeholder support and/or delay</p>	<p>Negative media attention in itself will have a 'low' negative impact on the programmes ability to achieve the assumed levels of reduction in bTB and ultimately eradication. However, the absence of stakeholder buy-in could delay delivery (see</p>

Risk	Risk Assessment by Option	
	Probability	Impact
	<p>implementation of these elements of the programme. Therefore, Option 2 is rated 'high' in terms of risk probability.</p> <p>The 'Status Quo' option is rated at medium-high risk, as a perceived lack progress in relation to bTB, particularly following the TBSPG report and Brexit vote, is likely to attract significant negative media attention.</p>	<p>below). See Bennett's (2016)³¹ examples of the role of the media in relation to bTB in Great Britain.</p>
Insufficient level of farmer/ farm family buy-in	<p>The Behavioural Appraisal of TBSPG recommendations indicates that gaining farmer buy-in to recommendations relating to herd health management and compensation is likely to be challenging. The Behavioural Appraisal highlights that the knowledge transfer role of private vets will be crucial in relation to herd health management and that badger interventions should help alleviate previous resistance by farmers/ farming groups to support a reduction in compensation rates. Therefore, Option 2 has been rated 'medium' in terms of risk probability in relation to this factor.</p> <p>The 'Status Quo' option is rated 'low' as it requires limited change/associated farmer buy-in to be taken forward.</p>	<p>Failure to achieve farmer/ farming group support of all recommendation will have a 'high' negative impact on the programmes ability to achieve the assumed levels of reduction and ultimately eradication of bTB.</p>
Insufficient level of buy-in from political representatives	<p>As identified above, recommendations relating to changes in compensation levels and badger interventions are likely to be contentious and may create negative publicity. The level of political buy-in will be influenced by lobbyists from both</p>	<p>Failure to achieve political support of all recommendations will have a 'high' negative impact on the programmes ability to secure funding and achieve the assumed levels of reduction/ eradication.</p>

³¹ Bennett, R. (2016) *The political economy of bovine tuberculosis in Great Britain*. OIE Scientific and Technical Review, 36 (1) (In Press)

Risk	Risk Assessment by Option	
	Probability	Impact
	<p>environmental groups and farming groups. However, both members of the DUP and Sinn Féin - the current Executive parties - have previously made public announcements supporting progressive approaches to eradicating bTB. Therefore, Option 2 has been rated 'medium' in terms of risk probability.</p> <p>The 'Status Quo' option is rated at medium risk, as a perceived lack progress in relation to bTB, particularly following the TBSPG report and Brexit vote, is likely to attract negative attention/ opposition from some political representatives.</p>	
Opposition from environmental lobby groups	<p>Option 2, which includes the badger intervention programme is rated 'high' in terms of risk probability, due to an anticipated absence of support from environmentalists for badger removal. Option 1 (the Status Quo) is rated 'low'.</p>	<p>Failure to achieve support from environmentalists for badger interventions will have the potential to have a 'medium - high' negative impact on the programme as a result of potential legal challenge for the element of the programme. Whilst, other recommendations could be implemented in the absence of the badger intervention programme, they are unlikely receive farmer support (refer to above) or achieve the projected level of disease reduction.</p>
Affordability (ability to ensure required level of funding)	<p>Implementation of TBSPG recommendations requires additional funding to be made available by the NI Executive, which in turn, requires political support. Risks relating to funding/affordability increase as the costs of implementation increase. Consequently, the Status Quo option is rated at low risk and Option 2 (implementation of all recommendations) is rated at 'medium'.</p>	<p>Failure to secure an appropriate level of resource to implement the preferred option will have a 'high' negative impact on the programmes ability to achieve target levels of reduction/ eradication.</p>

6.3 General Areas of Risk

Table 6.2 details risk areas that are considered to be ‘general areas of risk’ and are unlikely to vary by option.

Table 6:2: General Areas of Risks and Associated Mitigation

<p>Insufficient level of buy-in from DAERA staff</p>	<p>Many of the TBSPG recommendations involve a change in current DAERA staff practice, not least the proposed multi-tiered and collaborative governance model, which will involve a sharing of power/responsibility and the development of new relationships. Organisational change of this nature inevitably meets some resistance and new structures/ approaches take time to become established. However, it is anticipated that DAERA staff will share a common vision to work towards eradication of bTB irrespective of the option being pursued.</p>	<p>Insufficient buy-in from DAERA staff has the potential to have a medium-high level of impact on effective implementation of the preferred option.</p>
<p>Insufficient level of buy-in from other sector stakeholders (e.g. private sector vets, auctioneers, hauliers)</p>	<p>Many of the TBSPG herd health management and governance recommendations involve a change in current practice by other stakeholders. Change of this nature may meet some resistance, requiring effective change management and communication from DAERA officials to secure buy-in from other stakeholder groups.</p>	<p>Insufficient buy-in from DAERA staff has the potential to have a “medium-high” level of impact on effective implementation of the preferred option.</p>
<p>Impact of breakout of other disease (e.g. FMD)</p>	<p>There is potential (albeit limited) for the outbreak of another infectious disease to dominate DAERA and industry time and resource. If this situation should occur, the focus on bTB would be diverted. That said, given existing biosecurity and control mechanisms in place, this area of risk is considered to be low and therefore all options have been rated as having a ‘low’ level of risk probability.</p>	<p>Diversion of focus and resource away from bTB would have a “high” impact on the effective implementation of the preferred option.</p>
<p>Impact of Brexit (i.e. changes animal health requirements for</p>	<p>The impact of Brexit on trade and future funding of bTB control is not clear and will not be determined until after trade</p>	<p>Although, future trade decisions may affect the economics of the local agri-food sector and/or the future focus of trade policy</p>

international trade)

negotiations have taken place.

There is the potential that NI's trade status with other EU countries will be affected, which could impact on the viability and sustainability of the sector and individual farm enterprises. There is also a possibility that the disease status of the local sector is identified as a key issue in any future trade negotiations.

Furthermore, DAERA's bTB programmes have been part funded in the past by the EC – for example, in 2013 the EC provided £4.46m in co-funding, representing approximately 20% of total programme costs. EU funding arrangements for bTB post Brexit are uncertain.

makers on the prevalence of bTB within NI, it is unlikely to impact negatively on the delivery of the bTB eradication programme and therefore it has been allocated a “low” level of impact.

Table 6:3: Summary of Quantitative Assessment by Option

Risk	Option 1 - Status Quo			Option 2 - Implement all TBSPG recommendations		
Delays in implementation of key programme elements	1.0	5.0	5	4.5	5.0	22.5
Resource costs higher than budgeted	1.0	4.5	4.5	4.5	4.5	20.25
Uncertainty of disease outcomes/reduction	2.5	6.0	15	4.5	6.0	27
Negative media coverage	4.5	2.0	9	5.0	2.0	10
Insufficient level of farmer/ farm family buy-in	1.0	5.0	5	4.0	5.0	20
Insufficient level of buy-in from political representatives	3.0	5.0	15	4.0	5.0	20
Opposition from environmental lobby groups	1.0	4.5	4.5	5.0	4.5	22.5
Affordability (ability to ensure required level of funding)	1.0	5.0	5	3.5	5.0	17.5
			63			159.8

6.4 Risk Mitigation

Table 6.4 below identifies key strategies aimed at minimising key areas of risk.

Table 6:4: Mitigation Strategies by Area of Risk

Risk	Mitigation Strategies/Activities
Risks Anticipated to Vary by Option	
Delays in implementation of key programme elements	Development of a robust implementation programme informed by detailed discussion with all key stakeholders and reflecting agreed level and phasing of funding along with implementation of proposed governance arrangements
Resource costs higher than budgeted	Ongoing monitoring of expenditure and implementation of cost control measures by theme/recommendation.
Uncertainty of disease outcomes/reduction	Rigorous and regular monitoring/review of disease incidence. Development of research projects and scientifically robust monitoring/evaluation processes to assist in the assessment of impact of specific bTB interventions.
Negative media coverage (measures re badgers and compensation)	Development of a robust pre-launch/ launch communications strategy and stakeholder management plan, to assist in the delivery of clear messages to all relevant stakeholder groups. As identified in the Behavioural Appraisal (2015), this strategy should include public engagement that is simple to understand and motivates stakeholders to face challenges to deliver a better legacy in relation to bTB. Review and update of communications strategy/ stakeholder management plan post launch, to support regular communication during programme implementation.
Insufficient level of farmer/ farm family buy-in	
Insufficient level of buy-in from political representatives	
Opposition from environmental lobby groups	
Affordability (ability to ensure required level of funding)	Effective communication of the ‘invest to save’ principle and the anticipated level of savings associated with the Preferred Option to key public and private stakeholders. Confirmation of level and phasing of funding to be secured as early as possible. Development of co-funding models, reflecting ‘beneficiary pays’ principle (refer to Section 9) should be explored to reduce the risk of public sector underinvestment in the eradication programme.
Areas of Generic Risk	
Insufficient level of buy-in from DAERA staff	See above re Communications Strategy/Stakeholder Management Plan
Insufficient level of buy-in from other sector stakeholders (e.g. auctioneers, hauliers)	

Risk	Mitigation Strategies/Activities
Impact of breakout of other disease (e.g. Foot and Mouth Disease)	<p>Development of bTB contingency plan in the event of an outbreak of another infectious disease.</p> <p>Regular liaison with DAERA officials on the status of other diseases and on the emergence of any risk factors indicating increased exposure to other diseases.</p>
Impact of Brexit (i.e. changes animal health requirements for international trade)	Ongoing liaison with political leaders. Review of implications of any future trade negotiations on bTB status and formal review of eradication plan to reflect any significant change in the political and market context.

6.5 Quantitative Assessment of Risk/Uncertainty – Sensitivity Analysis

The issue of monetary project risk is assessed by the application of a sensitivity analysis to each of the project options. This analysis considers the impact of differing scenarios relating to:

- The rate of decline in disease incidence;
- Herd size;
- Farmer and government costs of bTB outbreaks; and
- Cost of implementing TBSPG recommendations.

The range of scenarios considered under each of these headings is profiled below.

6.5.1 Rate of Decline in Disease Incidence

Projections of future bTB levels are fraught with uncertainty because of the complex and multifactorial nature of the disease. In addition, disease projections for Option 2 have to take into account significant programme changes, which introduce a further degree of uncertainty, especially when projections are being made decades into the future.

In recognition of the high degree of uncertainty associated with the bTB projections, we have profiled the impact of the following scenarios on option NPCs:

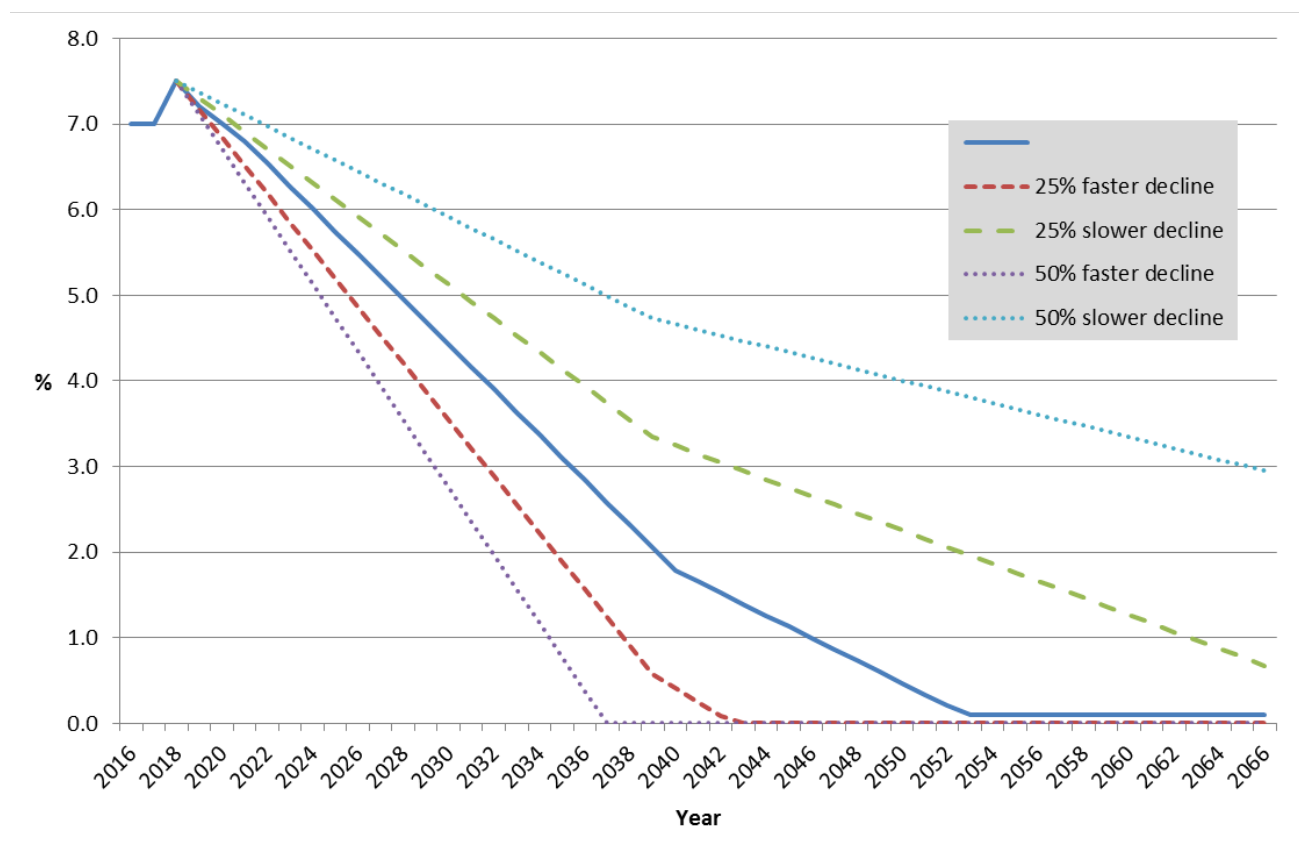
- Scenario 1 – a 25% increase in the rate of decline was applied to the full implementation scenario;
- Scenario 2 – a 25% decrease in the rate of decline was applied to the full implementation scenario;
- Scenario 3 – a 50% increase in the rate of decline was applied to the full implementation scenario; and
- Scenario 4 – a 50% decrease in the rate of decline was applied to the full implementation scenario.

The impact of each scenario on the achievement of eradication is profiled in Figure 6.1, which demonstrates:

- eradication within 21 years with a 50% faster decline;
- eradication within 27 years with a 25% faster decline; and

- a failure to achieve eradication within 50 years with a 25% and 50% slower decline.

Figure 6:1: Disease Reduction Scenarios



6.5.2 Herd Size Scenarios

The number of cattle and average size of herds, coupled with the disease incidence rate will influence the costs and benefits associated with bTB. Consequently, our Net Present Cost calculations are presented using three different herd number/ size scenarios. The scenarios profiled are as follows:

- Scenario 1 – reflecting no change in animal numbers, herd numbers and average herd size over the forecast period. The 2015 baseline represents a scenario where there were 1,652,601 animals, 23,980 herds tested and the average herd test size was 68.9 animals;
- Scenario 2 – using DAERA data, application of trends observed over the period 2005 – 2015 and application of these trends to 2016 – 2025. Given the difficulties in/risk associated with forecasting trends beyond this timeframe, the animal and herd size numbers are then held constant from 2025 to 2046; and
- Scenario 3 – using DAERA data, application of trends observed over the period 2005 – 2015 and application of these trends to the entire forecast period (2016 – 2046).

6.5.3 Variations in Farmer and Government costs associated with bTB breakdowns

The scenarios associated with the cost incurred as a result of breakdowns are as follows:

- Farmer cost of breakdowns increased by 10%;
- Farmer cost of breakdowns decreased by 10%;
- Government cost of breakdowns increased by 10%; and
- Government cost of breakdowns decreased by 10%.

6.5.4 Variations in Cost of Implementing TBSPG recommendations.

The scenarios associated with the cost of implementing TBSPG recommendations are:

- Implementation costs increased by 5%;
- Implementation costs increased by 10%;
- Implementation costs decreased by 5%; and
- Implementation costs decreased by 10%.

6.6 Results of Sensitivity Analysis

Table 6.5 identifies the option exhibiting the lowest NPC in relation to each of the cost based sensitivity analyses, using both a 3.5% and 8% discount rate and reflecting Herd Scenario 2³². Further details of the resulting NPCs under each scenario is provided in Annex J.

Table 6.5 highlights that, irrespective of the scenario profiled, the option with the lowest NPC does not change i.e. Option 2 (implementation of the TBSPG recommendations) continues to exhibit the lowest NPC under each scenario when a 3.5% discount rate is applied, while Option 1 (maintaining the Status Quo) continues to exhibit the lowest NPC under an 8% discount rate.

Table 6.6 summarises the impact of different rates of reductions in disease would have on the NPC of each option and highlights that:

- a faster decline in disease incidence would result in Option 2 (implementation of the TBSPG recommendations exhibiting the lowest NPC across both discount rates);
- a 25% slower decline in disease incidence does not impact on the ranking of options, i.e. Option 2 continues to produce the lowest NPC (using both discount rates); whereas,
- a 50% slower decline in disease does impact on the ranking of options i.e. Option 1 emerges with the lowest NPC (using both discount rates).

Table 6.6 also highlights that the achievement of agreed disease reduction targets, in line with the disease projections and budgets profiled within this report, will be central to achieving value for money

Table 6.5: Results of Cost Based Sensitivity Analyses

³² Representing the application of observed trends to the period 2016 – 2025, with herd animal and herd size numbers held constant from 2025 onwards

	Lowest Cost Option (3.5% Discount Rate)	Lowest Cost Option (8% Discount Rate)
Pre- Sensitivity Analysis	Option 2 - Implement TBSPG Recommendations	Option 1 - Status Quo
Post – Sensitivity Analysis		
Implementation Costs		
Increase by 5%	Option 2	Option 1
Increase by 10%	Option 2	Option 1
Decrease by 5%	Option 2	Option 1
Decrease by 10%	Option 2	Option 1
Breakdown Costs (Farmers)		
Increase by 10%	Option 2	Option 1
Decrease by 10%	Option 2	Option 1
Breakdown Costs (Govt.)		
Increase by 10%	Option 2	Option 1
Decrease by 10%	Option 2	Option 1

Source: PACEC

	Lowest Cost Option (3.5% Discount Rate)	Lowest Cost Option (8% Discount Rate)
25% faster decline in incidence rate	Option 2	Option 2
25% slower decline in incidence rate	Option 2	Option 1
50% faster decline in incidence rate	Option 2	Option 2
50% slower decline in incidence rate	Option 1	Option 1

Table 6.6: Summary of Disease Incidence-Based Sensitivity Analysis

Source: PACEC

7 NON-MONETARY COSTS AND BENEFITS

7.1 Introduction

Not all costs and benefits can be measured in monetary terms, as no market value exists for them. Therefore, in this section we consider the non-monetary costs and benefits associated with each of the short-listed options. A weighting and scoring exercise has been adopted to illustrate in quantitative terms how each option performs against identified non-monetary criteria.

Table 7.2 identifies the criteria used to assess non-monetary costs and benefits, the weightings that have been allocated to each criterion and the rationale for each weighting. These criteria and weightings were derived via discussions with both TBSPG and DAERA representatives.

Table 7.1 details the scores allocated to each option for each criterion and the rationale for score allocation.

This section also presents the results of an initial screening of TBSPG recommendations against sustainable development guidance.

7.2 Summary of Option Scores

As detailed in Table 7.1, based on the assigned weightings and scores, Option 3 is ranked first in qualitative terms, followed by Option 2 and Option 5.

Table 7.1: Summary Table of Option Scores

Criteria	Weighting	Option 1- Status Quo	Option 2- Implementmation of all TBSPG Recommendations
Contribution to improved perception of product quality, enhanced industry reputation and international trade	28	5 (140)	7 (196)
Improvement in animal health	25	0	7 (175)
Improvement in the health and welfare of farm workers and farm families	22	0	7 (154)
Reduction in negative long term impacts on farm businesses	19	0	7 (133)
Enhanced benefits associated with government partnership working with stakeholders	6	0	5 (30)
Total	100	140	688
RANKING		3	1

Table 7:2: Weighting of Criteria

	Criteria and Description of issues being assessed	Weighting	Rationale
1	<p>Contribution to perception of enhanced product quality, improved industry reputation and favourable international trade position</p> <p>As identified within the TBSPG Interim Report, the current TB testing programme provides an essential underpinning to NI’s ability to trade internationally and contributes to the commercial success of NI’s export dependent agri-food sector. It is approved by the EU and meets OIE standards, allowing trade to continue across the EU and further afield, as other countries cannot prevent meat, milk and live cattle imports while approved animal health standards are being met.</p> <p>Eradication of TB would assist international trade as global competition and consumer preferences, demands ever-higher standards for livestock husbandry and food production.</p> <p>It is also anticipated that NI’s bTB status will be under the spotlight and may have implications for trade with EU countries post Brexit.</p> <p>Options that have the potential to achieve a reduction in bTB incidence and therefore contribute positively to the perception of product quality, industry reputation and potentially international trade, score higher than those that have no/limited impact on bTB. The greater the potential reduction in bTB, the higher the score allocated.</p>	28%	<p>The importance of the Agri-Food industry to the NI economy is profiled in Section 3 of this report and is recognised in a wide range of government strategy and policy documents, including the Programme for Government (PfG) 2011-15, the Economic Strategy 2011-15 and the draft PfG (2016-21).</p> <p>These documents highlight that the agri-food sector is a major contributor to the local economy and strategically important to future growth of the economy. The sector includes £1,000 million plus export dependent trade in livestock and livestock product.</p> <p>The industry’s Strategic Action Plan (i.e. the Agri-Food Strategy Board’s “Going for Growth”) has established ambitious growth targets for the year 2020 in relation to sales, employment, sales outside NI and added value. This strategy also recommends TB eradication, in order to strengthen perceptions of the NI agri-food brand.</p> <p>Given the strategic importance of the agri-food sector to the local economy, this criteria has been allocated the highest weighting.</p>

	Criteria and Description of issues being assessed	Weighting	Rationale
2	Improvement in animal health		
	<p>Biosecurity and risk based trading are important in the management of all infectious diseases whether that is BVD, Johne’s disease or bTB. The application of many of the proposed herd health management measures have the potential to reduce cattle exposure to disease other than bTB and improve their health generally.</p> <p>Measures aimed at reducing/eliminating TB within the local badger population has also the potential to improve the health of badgers in the medium to long term.</p> <p>Options that have the potential to achieve a reduction in bTB incidence will contribute positively to improved animal health and will therefore score higher than those that have no/limited impact. The greater the potential reduction in bTB, the higher the score allocated.</p> <p>Options involving the ‘wildlife and vaccination’ interventions (i.e. badger vaccination strategy and strategic removal of badger) provide the potential to improve the long term health of the badger population and therefore score higher than options that do not contain these interventions.</p>	25%	<p>A key goal articulated within the former Department of Agriculture and Rural Developments Strategic Plan (2012-2020) is to “to enhance animal, fish and plant health and animal welfare”. DAERAs stated purpose is to assist the sustainable development of the agri-food, environmental, fishing and forestry sectors of the NI economy, having regard for the needs of the consumers, the protection of human, animal and plant health, the welfare of animals and the conservation and enhancement of the environment. Given the importance of animal health to the performance and competitiveness of the agri-food industry, this criterion has been allocated the second highest weighting.</p>
3	Improvement in the health and welfare of farm workers and farm families		
	<p>Numerous reports have highlighted the negative health impacts associated with bTB on farmers and farm families. For example:</p> <ul style="list-style-type: none"> • Skuce et al (2011)³³ noted that bTB impacts negatively on the welfare of affected farming families; • Michel et al (2010)³⁴ also noted significant risk 	22%	<p>As highlighted above, DAERA’s stated purpose involves assisting the sustainable development of the agri-food industry whilst, among other things, having regard for human health.</p> <p>The delivery of positive</p>

³³ Skuce RA, Allen AR, McDowell SWJ (2011). Bovine tuberculosis (TB): a review of cattle-to-cattle transmission, risk factors and susceptibility.

³⁴ Michel A., et al (2010) Mycobacterium bovis at the animal-human interface: A problem, or not? Veterinary Microbiology 126, 151-159.

	Criteria and Description of issues being assessed	Weighting	Rationale
	<p>for farm workers; and</p> <ul style="list-style-type: none"> A report by the Farm Crisis Network (2009)³⁵ found that bTB caused distress and anxiety, sometimes leading to physical illness, in farmers and their families following a bTB breakdown together with pressures on relationships. <p>Options that have the potential to achieve a reduction in the number of bTB breakdowns and therefore reduce farmer/ farm family exposure to associated negative health impacts will score higher than those options that have no/limited impact on disease incidence. The greater the potential reduction in bTB, the higher the score allocated.</p>		<p>physical and mental health outcomes for farmers, farm workers and farm families is important in terms of contributing to farm enterprise productivity, enhancing the attractiveness of the sector to new entrants and in developing and growing the sector.</p> <p>Given the contribution that farmer/ farm worker health is essential to the performance and competitiveness of the agri-food industry, this criterion has been allocated the third highest weighting.</p>
4	Reduction in negative long term impacts on farm businesses		
	<p>Previous studies³⁶ have highlighted numerous longer-term costs of bTB that impact upon farm businesses e.g. the devaluation of farm businesses, the need for extension of overdrafts/cash flow problems, the postponement of capital investment and the restructuring of farm enterprises.</p> <p>Options that have the potential to achieve a reduction in bTB incidence will contribute positively to increased farm productivity and will therefore score higher than those that have no/limited impact. The greater the potential reduction in bTB, the higher the score allocated.</p>	19%	<p>A reduction in the negative business impacts of bTB on farm enterprises has the potential to contribute positively to the viability and sustainability of these businesses and in doing so, assist in the sustainable development of the wider agri-food industry. Consequently, this criteria has been allocated the 4th highest weighting.</p>
6	Enhance benefits associated with Governments partnership working with stakeholders		
	<p>TBSPG recommendations include provision for a new and radical form of bTB governance for NI, bringing together a range of diverse stakeholders including government officials, farmers, vets, environmentalists, scientist and industry bodies. It is anticipated that these new structures and the</p>	6%	<p>Whilst this potential area of benefit is important, it will have limited impact on the future growth and sustainability of the local agri-food industry. Consequently, it has received</p>

³⁵ 'Stress and Loss: a report on the impact of bovine TB on farming families', The Farm Crisis Network (2009)

³⁶ Bennett (2004) and University of Exeter (2010)

Criteria and Description of issues being assessed	Weighting	Rationale
<p>associated partnership working will enhance the effectiveness of the bTB programme and help deliver a lowering and ultimately, eradication of the disease.</p> <p>In addition to the benefits associated with bTB reduction/eradication, the new/ enhanced structures, relationships and communication channels developed by the TBSPG recommendations could, over time, be utilised to provide communication and obtain stakeholder feedback in relation to a range of non-animal health related issues (e.g. in relation to rural, farm development, countryside management, environmental management, funding opportunities etc), thereby enhancing governments relationship and partnership working with rural stakeholders.</p>		the lowest weighting.

Table 7:3: Qualitative Scoring by Option

Criterion	Basis of Allocating Scores
Contribution to perceived product quality, reputation of industry and international trade	<p>Option 1 (the ‘Status Quo’ option) has been allocated a score of 5, as the current TB testing programme underpins NI’s ability to trade internationally.</p> <p>Option 2 (implementation of all TBSPG recommendations) has been allocated a score of 7, as reduction and eventual eradication of bTB would make a positive contribution to the perception of NI food and in meeting consumer preferences for higher standards of livestock husbandry and food production. Reduction in bTB incidence may also be looked upon favourably by EU countries that GB/NI trades with post Brexit.</p>
Improvement in animal health	<p>Option 1 (the ‘Status Quo’ option) has been allocated a score of 0, as maintenance of the current testing/ control programme will not change behaviours or practice in relation to disease control and will therefore not generate benefits relating to the management/control of other related diseases.</p> <p>Option 2 (implementation of all TBSPG recommendations) includes a wide range of measures that aim to change attitudes, behaviours and practice that aim to improve herd health. If successful, this would mean that risks to animal health from other infectious diseases (as well as bTB) will be reduced. Consequently Option 2 has been allocated a score of 7.</p>
Improvement in the health and welfare of farm workers and farm families	<p>Option 1 (the ‘Status Quo’ option) has been allocated a score of 0, as maintenance of the current testing/ control programme is not expected to deliver a marked change in bTB incidence and consequently comparable numbers of</p>

Criterion	Basis of Allocating Scores
	<p>farmer workers/ families will be exposed to the stress and anxiety caused by bTB outbreaks.</p> <p>Option 2 (implementation of all TBSPG recommendations) has been allocated a score of 7 as it is anticipated that it will deliver a reduction and an eventual eradication of the disease, which will lessen farm family/farmer worker exposure to the stress and anxiety associated with bTB outbreaks.</p>
Reduction in negative long term impacts on farm businesses	<p>Option 1 (the ‘Status Quo’ option) has been allocated a score of 0, as maintenance of the current testing/ control programme is not expected to deliver a marked change in bTB incidence and consequently it will not deliver a significant a reduction in the negative long term business impacts stemming from bTB outbreaks.</p> <p>Option 2 (implementation of all TBSPG recommendations) has been allocated a score of 7 as it is anticipated that it will deliver a reduction and an eventual eradication of the disease, which will reduce/remove the negative long term business impacts stemming from bTB outbreaks.</p>
Enhance benefits associated with government partnership working with stakeholders	<p>Option 1 (the ‘Status Quo’ option) has been allocated a score of 0, as maintenance of the governance arrangements associated with the current testing/ control programme will not deliver improvements in partnership working.</p> <p>Options 2 involves the development of a new and radical form of bTB governance arrangements that aim to enhance partnership working. It is anticipated that these new arrangements will be established in 2017. None of the variations reflected in the ‘do something’ options are likely to impact on the level of additional benefit derived from these structures and consequently all ‘do something’ options have been allocated a score of 5.</p>

7.3 Sustainable Development Screening

Government is committed to ensuring that sustainable development is central to the agenda right across the NI Civil Service.

The goal of sustainable development is to enable people to satisfy their basic needs and enjoy a better quality of life, without compromising the quality of life of future generations. Sustainable Development is therefore not just about protecting the environment and using natural resources in a prudent way, it is about ensuring stable social and economic growth for all. For this reason Sustainable Development is often defined as being based on three interdependent and mutually supporting pillars:

- Social;
- Environmental; and
- Economic.

Guidance issued by DFP in December 2015³⁷ highlights the need to screen all project to identify whether they are likely to have significant sustainability impacts. The following provides an initial high level screening of the TBSPG recommendations.

Table 7:4: Impact Screening for Sustainable Development

Impact screened	Type of Impact (Positive, Negative, None)	Comment
Economic		
Consumers	Positive	Potential positive impact in relation to consumer perceptions of local beef and dairy products, as TBSPG recommendations augment existing livestock husbandry and food production standards.
Infrastructure	None	
Enterprise	Positive	Significant potential for the project to contribute to the growth and sustainability of beef and dairy farm enterprises.
Innovation	Positive	Significant potential for the project to enhance research and development capacity and knowledge transfer in relation to bTB.
Skills	Positive	Significant potential for the project to contribute to improved farmer/farm worker skills (e.g. herd health, biosecurity and disease prevention)
Business / Charities / Voluntary Sector	Positive	Significant potential for the project to contribute to local business involved in the agri-food supply chain through the growth and development of beef and dairy farm enterprises.
Public Expenditure & Public Services	Positive	Potential for budget savings in medium-long term resulting from reduction/ eradication of bTB and improved partnership working with private and third sector stakeholders, potentially leading to more effective communication and policy development processes.
Environmental		
Air Quality	Negative	Disposal of culled badgers through incineration offers the potential to impact on air quality, however this can be mitigated through compliance with current regulatory requirements.
Climate Change	Positive	Research highlights that the impact of bTB on individual animals includes increased mortality, reduced milk yield,

³⁷ FD (DFP) 11/14 “Assessing and Documenting Sustainable Development in Business Cases for Procurement Projects”

Impact screened	Type of Impact (Positive, Negative, None)	Comment
		reduced growth rate, increased metabolic energy requirement, compromised welfare and higher GHG emissions per unit. Recent research in Wales ³⁸ estimates that the elimination of bTB from Wales could have a relatively small but positive impact on GHG emissions (a reduction of 70 kt CO ₂ e per year). Based on this research, it is likely that eradication of bTB in NI would make a contribution to reducing local GHG emissions.
Landscape and Land Use	Positive	Through supporting the development and growth of the agriculture sector, there is potential to sustain the use of land in rural areas for agricultural purposes.
Use of Natural Resources	None	----
Bio-Diversity	Positive	Potential to contribute positively to animal health (cattle and badgers) through the reduction/ eradication of TB.
Noise	None	----
Social		
Crime	Positive	Potential to reduce fraud through the implementation of recommendations relating to changes in compensation, DNA tagging, TB Reactor quality assurance tests and establishment of local DRTs.
Community Safety & Victims	None	-----
Equality/Good Relations	None	-----
Human Rights	None	-----
Health	Positive	Potential to reduce negative health impacts of bTB breakdowns among farm families and farm workers (e.g. stress and anxiety).
Rural	Positive	Potential to contribute to the growth and development of rural enterprises, thereby providing employment in rural areas and sustaining rural communities.

³⁸ "The influence of bovine tuberculosis (bTB) on GHG emissions intensity in Wales – Dr Adrian Williams (Cranfield University, UK)" - http://globalresearchalliance.org/wp-content/uploads/2016/06/Elsinore-Denmark_AHN-Meeting-Report_March-2016.pdf (p.9)

8 SELECTION OF PREFERRED OPTION

Table 8.1 below summarises the results of the Cost: Benefit analysis. This summary identifies that:

- when quantitative economic costs and benefits are considered over a 40 year period, Option 2 (full implementation of TBSPG recommendations) is (c10%) less expensive than the Option 1 (the Status Quo option);
- Option 2 scores considerably higher than Option 1 in terms of non-monetary benefit;
- When an NPC per non-monetary score is considered, Option 2 is ranked highest; and
- Option 2 is exposed to a significantly higher level of risk than Option 1.

Considering the above, on balance, Option 2 emerges as the preferred option, as it offers the potential to achieve the TBSPG's stated objective of bTB eradication, whilst providing greatest value for money (as measured by NPC per non-monetary score).

That said, Option 2 is exposed to significant number of risks that must be successfully mitigated in order for it to deliver in an effective manner. These areas of risk include, but are not limited to: affordability; delays in programme implementation; resource costs higher than budgeted, uncertainty in disease outcomes; negative media coverage; and opposition from environmental lobby groups.

Table 8.1: Monetary and Non-Monetary Results

Option	NPC ³⁹ Over 40 Years (£m)	Ranking	Non Monetary Score	Ranking	NPC per Non Monetary Score (£m)	Ranking	Risk Score	Ranking
Option 1 - Status Quo	£725	2	140	2	5.2	2	63	1
Option 2- Implementation of TBSPG recommendatio ns....	£650	1	688	1	0.9	1	159.8	2

³⁹ Reflecting a discount rate of 3.5%

9 FARMER COMPENSATION, PROGRAMME AFFORDABILITY & FUNDING MODELS

9.1 Introduction

The following section profiles potential levels of compensation paid to farmers, reflecting estimated number of reactors and the impact of TBSPG proposals on compensation. It also discusses issues relating to affordability and future funding levels. N.B. all figures referenced within this section reflect expenditure at current prices.

9.2 Farmer Compensation Levels

TBSPG recommendations include a number of proposals relating to the compensation of slaughtered animals, namely:

- that a cap in compensation levels would be introduced with a maximum of £1,500 for non-pedigree bovine animals and a 20% premium for pedigree bovine animals (to a maximum of £1,800) and that the cap be introduced as soon as practical;
- a herd-keeper will be permitted to receive compensation up to a cap of £3,500 for one pedigree stock bull per year with no carry-over from one year to the next; and
- consideration by TBEP of a further reduction in the level of compensation paid following valuation – TBSPG provided an example of a cap of 75% of the market value of animals. The implementation of a further reduction is not to be put in place until after consideration of progress and circumstances 3 years after the cap is in place.

Utilising the outputs of DAERA disease forecasts for both Option 1 (Status Quo) and Option 2 (Implementation of TBSPG recommendations), we have assessed the impact of a reduction in disease on the compensation levels associated with both options. This assessment reflect three scenarios, namely:

- Compensation levels based on baseline (2015) average (£1,275.17)
- Compensation levels reflecting the introduction of the proposed cap from Year 1 onwards and application of potential savings identified in Table 9.1 below; and for illustrative purposes,
- Compensation levels reflecting the introduction of the proposed cap (Year 1) and a reduction in compensation paid to 75% of market valuation (assumed to be introduced from Year 4 onwards).

Table 9.1 details the number of pedigree and non-pedigree animals on which compensation was paid in 2015, the amount paid for those animals and the savings that would have been achieved if a £1,800 and £1,500 cap had been applied, respectively. Table 9.1 highlights that the application of the proposed cap to 2015 compensation levels, results in an overall saving of 7.3% on the total level of compensation paid.

Table 9.1: bTB 2015 Compensation Payments

Total Compensation Paid in 2015	£15,400,000	
Number of Animals Compensated in 2015	12,098	
Average compensation paid per animal	£1,273	
	Non- pedigree animals	Pedigree animals
Proposed compensation cap	1,500	1,800
Total number of animals compensated	10,554	1,544
Number of animals compensated over proposed cap	1,378	711
Compensation paid over proposed cap	£2,409,460	£2,065,700
Number of animals compensated over cap x cap	£2,067,000	£1,279,800
Savings	£342,460	£785,900
Total savings (pedigree + non pedigree)		£1,128,360
Total savings as a % of total compensation (i.e. as a % of £15.4 m)		7.3%

Source: DAERA

We have utilised the level of savings identified in Table 9.1 to calculate the impact of the proposed cap on future compensation levels. It is acknowledged that this approach is limited, as it assumes that the profile and market value of the animals for which compensation was paid in 2015 will be maintained throughout the entire appraisal period. Given this constraint, the resulting analysis should be considered as highly indicative and treated with caution.

N.B. the impact of a cap of £3,500 for pedigree stock bulls is not captured within this analysis, as the future number of these bulls cannot be estimated with any certainty. It is anticipated that the number of these bulls and resulting impact on compensation levels will be negligible.

Table 9.2 identifies the estimated levels of compensation associated with both Option 1 (the Status Quo) and the Preferred Option, Option 2 (Implementation of TBSPG Recommendations) for each of the scenarios above. This table highlights that:

- when compensation payments for both the Status Quo and the Preferred Option are profiled based on 2015 averages, Option 2 generates c£244 million of savings over the 40 year appraisal period;
- introduction of the proposed cap under Option 2, would result in further savings of c£16 million over the 40 year appraisal period, when assessed against the Status Quo. A further reduction in compensation to 75% of market valuation would generate a further £57 million of savings over 40 years;
- depending on the scenario used, the annual compensation paid under Option 2 at ‘Steady State’ is between £9 - 13 million less than that paid under the Status Quo option.

Table 9.2: Estimated Compensation Payments by Scenario (2016 prices)

	Option 1 (Status Quo)	Option 2					
	At 2015 Average	At 2015 Average	Variance compared to Status Quo	With Proposed Cap	Variance compared to Status Quo	With a proposed Cap at 75% of Market Valuation	Variance compared to Status Quo
Total compensation paid over 40 years	£466m	£222m	£244m	£206m	£260m	£165m	£301m
Annual compensation at Year 40	£13.5m	£126k	£13.4m	£117k	£13.4m	£88k	£13.4m

9.3 Programme Affordability

Table 9.3 details the total cost to government of implementing each option at current prices. This table highlights that over a 40 year period there is a variance of c£205 million in cost between Option 1 and 2, with Option 2 (the Preferred Option) exhibiting the lower cost. **N.B. This cost differential includes projected savings associated with the proposed cap on compensation. It does not include further savings that may be generated through the adoption of payment on the basis of 75% of an animal's market value.**

As presented in Table 9.3 and Figure 9.1, the annual cost of implementing the Preferred Option (Option 2) ranges from a £39 million in Year 4 to c£8.5 million in Years 39- 40. The delivery of TBSPG recommendations will require additional funding in the early years of the programme, before significant cost savings can be achieved later in the programme period via a reduction in disease incidence.

Figure 9.1 also highlights that in c2028, the total cost to government of implementing TBSPG Recommendations, including compensation payments, will fall below the total cost of maintaining the Status Quo (Option 1).

Table 9.3 Total Cost to Government – Status Quo compared to Preferred Option (at 2016 prices)

	Option 1 (status Quo)	Option 2 (Implementation of TBSPG Recommendations)	Variance
Total programme cost to government over 40 years (excluding compensation)	£589m	£644m	-£55m
Compensation paid over 40 years ⁴⁰	£466m	£206m	£260m
Total Cost over 40 years	£1,055m	£850m	£205m
Average annual costs over 40 years	£26m	£21m	£5m
Range in annual costs over 40 years	£28m - £24m	£39m - £8.5m	

⁴⁰ Compensation levels associated with Option 2 reflect the introduction of the proposed cap only. The Status Quo reflects no change to existing compensation arrangements.

Figure 9.1: Total Cost to Government (including compensation) – Status Quo compared to Preferred Option (at 2016 prices), 2017 - 2056

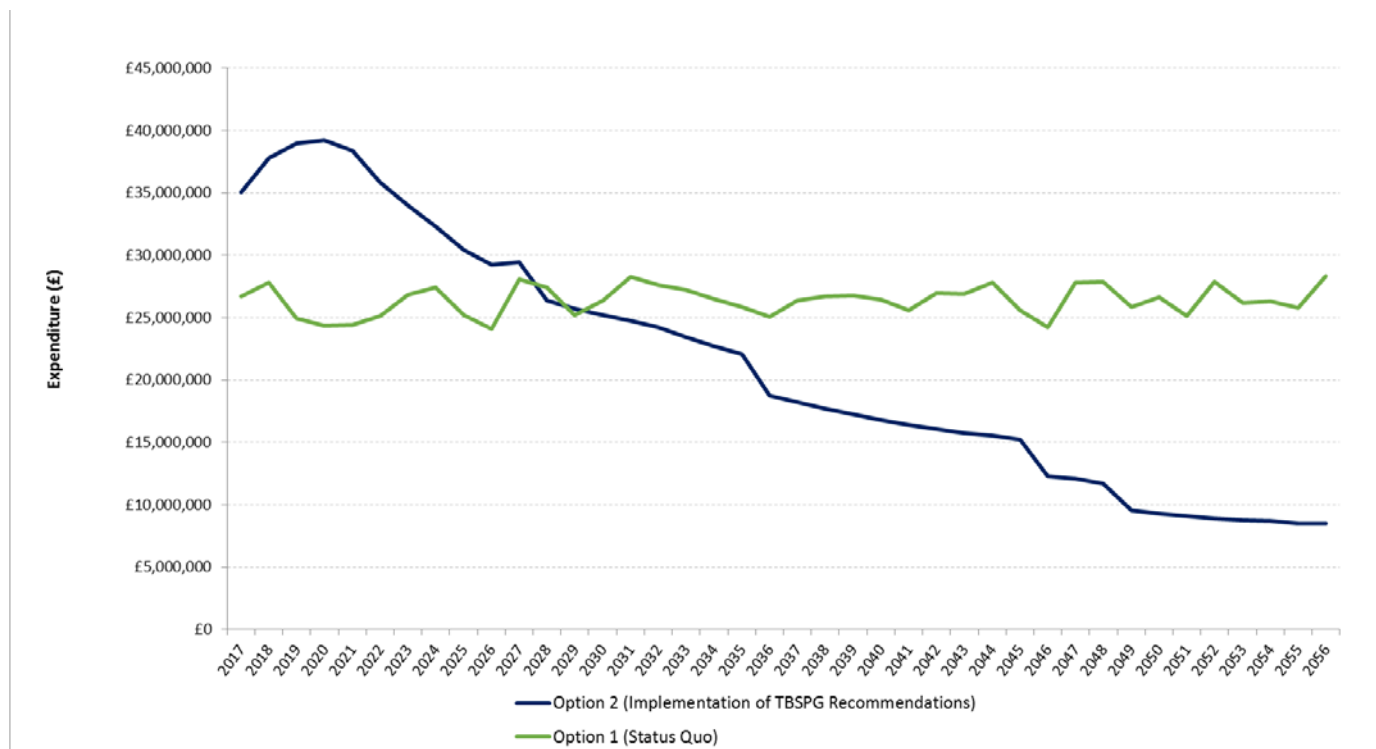


Figure 9.1 and Table 9.4 identify that at Year 40, the Preferred Option exhibits a significantly lower annual programme cost than the Status Quo - c£8.5 million compared to £28 million - a difference of £19.5 million.

If the Status Quo option was to be pursued and bTB herd incidence levels remained static at c6.63%, this higher level of annual cost would be incurred each year ad infinitum. Continuance of disease levels at this rate would pose a number of significant risks, particularly in relation to future trading arrangements post-Brexit, where NI's current rate of bTB may have a detrimental impact on any potential future trade deals.

It is projected that the Preferred Option will deliver:

- a bTB herd incidence rate of less than 0.1% by 2053 (Year 37). The Status Quo option is projected to result in a herd incidence level of 6.63% by 2056 (Year 40). The 2015 baseline was 7%;
- a reduction in the number of bTB herd breakdowns. The Preferred Option is projected to result in c22 herd breakdowns by 2053 (Year 37), the Status Quo option is projected to result in c1,461 herd breakdowns by 2056 (Year 40). The 2015 baseline was 1,688 breakdowns; and
- based on current EU directive requirements, a move from annual herd tests to biennial testing by 2049 (Year 33). This less onerous testing regime will incur less cost from Year 33 onwards if the herd incidence level is maintained at 1% or less. Further savings will be accrued when herd incidence levels of <0.2% and <0.1% are achieved, allowing for triennial testing and

testing on a four year basis, respectively. Based on current disease projections, the savings resulting from herd incidence rates of <0.2% and <0.1% will occur after Year 40.

Table 9.4: Steady State Costs (at 2016 Prices)⁴¹

	Status Quo (Year 40)	Implement Recommendations (Year 40)	Variance
Incidence Rate	6.63%	0.10%	6.53%
No. of Breakdowns	1,461	22	1,439
Net Cost to Govt. (incl. salvage but not compensation)	2.61	0.05	2.55
Ongoing Costs	11.99	4.17	7.82
Implementation Costs	0.00	4.20	-4.20
Total Costs	14.60	8.42	6.17
Compensation	13.51	0.12	13.39
Total Govt. Cost	28.11	8.54	19.57

9.4 Funding Models

The extent to which any eradication programme is both successful and affordable depends to a significant degree on the appropriate sharing of costs between the public sector and industry. Cost sharing is a complex and sensitive issue, and beholden to strongly held subjective arguments. For that reason, the appraisal has undertaken desk research into the cost sharing experiences of other jurisdictions so that the eradication programme in NI can benefit from both good practice resulting from successful interventions, and key lessons from interventions that have not led to successful programmes. It is important here to make the distinction between successful outcomes in terms of cost sharing arrangements i.e. stakeholder agreement, workable financing arrangements in place etc. and successful outcomes in terms of reducing disease incidence. The ideal is obviously positive outcomes in terms of both cost sharing and disease reduction, however the focus of this section is on understanding successes and learning regarding cost sharing arrangements.

This section is structured based on three case studies as follows:

- ROI (2000 onwards);
- Australia (1970–1997); and
- New Zealand (1987 onwards);

Annex K provides details on each case study under the headings of: Intervention context; Management and governance; Responsibility and cost sharing arrangements; and Outcomes.

This section focuses on the ‘Responsibility and cost sharing arrangements’ associated with the eradication/control programmes implemented by each jurisdiction.

⁴¹ Reflecting Herd Scenario 2

9.4.1 Republic of Ireland

The Bovine TB Eradication Programme in the Republic of Ireland is currently run by the Department of Agriculture and has been operational in some form since 1954.

In 2008 the dairy industry contributed €3.2 million towards the eradication programme's costs via compulsory disease levies. Industry groups also supported the government's research programme through the voluntary dairy research levy (€1.2 million in funds in 2004)⁴². However, as of 2015, less than one fifth of the government's dairy levies are used for expenditure on the control of animal diseases. The financing arrangements of the programme are outlined in the Department of Agriculture, Food & the Marine (DAFM) programme specification for 2016–18:⁴³

- Sampling – all costs borne by the Department, with its staff administering the samples. The samples are sent to the testing laboratories.
- Testing – “*bulk of SICTT*” testing is done by private vet practitioners, with costs borne by farmers. Some tests are conducted by staff employed by Department. Arrangements are split between ‘department pay’ and ‘farmer pay’ schemes. Farmers pay for one test per annum with the government paying for the remainder. The Department pays for all the tuberculin costs.
- Compensation – payments are delivered via the On Farm Market Valuation Scheme to farmers who suffer TB cases. Farmers who are in breach of disease control regulations (e.g. the Diseases Eradication Schemes rules, EU law) have deductions of up to 100% of compensation. The costs of the compensation scheme are borne by the Department.
- Badger Vaccination – Department bears the cost of vaccination and provides vaccination.
- Other – Department bears the costs in transport of badger carcasses to labs, some supervision activity and pays the private operatives who shoot the badgers.

9.4.2 Australia

Australia launched the Brucellosis and Tuberculosis Eradication Campaign (BTEC) in 1970 as part of the country's aim to reduce risks to public health and to protect the country's cattle from health risks. The programme has been successful in eradicating bovine TB from the country; on 31 December 1997 Australia declared freedom from bovine TB.

Over the BTEC programme between 1970 and 1997, the costs were approximately \$840 million for operational expenditure.

In 1984–85 there was \$62 million in funding for the BTEC programme, with cost shares split as follows: industry, \$26 million; national government, \$16.5 million; state governments, \$19.4 million.

In February 1988 a cost-sharing agreement was reached such that industry would fund 50% of the programme, with the national government contributing 20% and the state governments contributing 30%⁴⁴. Cost-sharing agreements based on the ‘beneficiary pays’ principle is now the norm for

⁴² SJ More, 2008, ‘A case for increased private sector involvement in Ireland's national animal health services’, *Irish Veterinary Journal* 61(2), pp. 92–100

⁴³ DAFM, 2015, ‘TB Programme 2016 to 2018’, pp. 44–46

⁴⁴ SJ More, B Radunz, & RJ Glanville, 5 Sep 2015, ‘Lessons learned during the successful eradication of bovine tuberculosis from Australia’, *Veterinary Record* 177 pp. 224–232

animal health programmes in Australia, e.g. Emergency Animal Disease Response Agreement (EADRA). The table below is an outline of the categories of EADRA cost-sharing since 2002.

Table 9.5: Cost-sharing arrangements in Australia’s EADRA

Cost-sharing category	Disease carriers	Government share	Industry share
Category 1: Public benefits only	Australian bat, rabies	100%	0%
Category 2: Public benefits greater than private benefits	Foot-and-mouth disease, sheep and goat pox	80%	20%
Category 3: Proportion of public to private benefits is roughly equal	African swine fever, lumpy skin disease	50%	50%
Category 4: Private benefits are greater than public benefits	Aujeszky’s disease, equine influenza	20%	80%

Source: More, Radunz & Glanville 2015

9.4.3 New Zealand

Cases of bovine TB had been falling since the late 1970s in New Zealand, following the introduction of an intensive possum control programme in 1972 and more frequent testing of cattle. Significant changes to pest control programmes from 1987 and the range of new policy measures is credited with leading to a major reduction in bovine TB cases.

The New Zealand government’s funding has remained stagnant in the last 10 years, owing to the improvement in outcomes, but it continues to reaffirm the societal benefits of government support. The TB control programme is managed by a non-government organisation.

The move to a cost-sharing model began in 1987, with the government decreeing that farmers fund 48% of the national TB control programme via the cattle slaughter levy. The farmers’ proposed share of costs would increase to 67% within three years. The new funding model prompted industry to lobby central government to increase funding for the national programme and as a consequence the government increased its contribution to NZ\$3 million per year in 1989, which was the highest government contribution for 12 years.

Table 9.6 shows the progression in funding for New Zealand’s TB control programme between 1985 (before the change in funding model) and 2010⁴⁵. Both government and industry funding increased exponentially between 1991 and 2005: the total funding for the TB control programme rose from NZ\$19.4 million to NZ\$81.3 million over the period.

Table 9.6: Income for New Zealand’s national TB control programme

⁴⁵ PG Livingstone *et al*, 2015, ‘Development of the New Zealand strategy for local eradication of tuberculosis from wildlife and livestock’, *New Zealand Veterinary Journal* 63(1), pp. 98–107

	1985	1991	1995	2000	2005	2010
Central and local government (NZ\$ m)	4.3	5.9	11.2	26.0	36.0	34.1
Levies and Industry funding (NZ\$ m)	3.3	13.5	21.5	26.2	45.3	44.9
Total funding (NZ\$ m)	7.6	19.4	32.7	52.2	81.3	79.0
Industry share of funding	43%	70%	66%	50%	56%	57%

Source: Livingstone et al 2015

The current national programme, has \$250 million in funds committed over 5 years between 2016 and 2020, with \$150 million sourced from industry⁴⁶. Hence the total funding peaked around 2005 and has gradually fallen, reflecting the programme’s previous success in reducing bovine TB levels.

9.4.4 Case Study Applicability to Northern Ireland

The findings from the in-depth case studies on the ROI, Australia and New Zealand, as well as a more general overview of international experience, is distilled in this section by key themes.

The OECD has reviewed international livestock epidemic management policies and has identified key characteristics for successful cost-sharing schemes and assessments on what the proper incentives are for industry in compensation schemes.⁴⁷

- Cost-sharing schemes should be mandatory rather than voluntary, so that all stakeholders who contribute to the overall disease risk have financial input in the compensation schemes;
- All parties who pay levies into a compensation scheme should be able to receive the benefits of a cost-sharing scheme in the event of an outbreak;
- Cost-sharing schemes should cover the direct losses that result from a disease outbreak and the schemes should structure levies according to risk levels e.g. the extent of biosecurity measures at a farm. There are adverse incentives when farmers bound by movement restrictions are worse off than farmers who undertake culling, although in the context of NI this will be lesser because of policies not entailing the need for restriction zones;
- Prevention measures should be incorporated into cost-sharing schemes ; and
- Stakeholder engagement is critical to cost-sharing schemes so that there is a greater ownership by industry and sharing the burden of disease control, while facilitating positive changes in behaviour.

Table 9.7 offers a summary of the main factors that enabled bTB eradication programmes to have successful outcomes in the case studies, with an assessment of their applicability to the context of NI. In essence, both industry co-funding and joint governance are the main enabling factors that could be applied to NI. These policies would give strong ownership of the bTB eradication programme to stakeholders. In terms of governance, proposals to establish an industry-led, non-

⁴⁶ See <http://www.tbfree.org.nz/governance-and-funding.aspx>

⁴⁷ F Alleweldt, 2013, 'Cost sharing in compensation schemes for livestock epidemics': In 'Lifestock disease policies: Building bridges between science and economics', *OECD*, pp. 151–156

governmental organisation have faced political issues in the UK and would be bound by more regulation (e.g. at the EU level) than Australia or New Zealand.

Table 9.7: Enabling factors of successful programmes and their applicability to Northern Ireland

Enabling factors	Case study detail and comparison to NI	Applicability
<p>Political support for eradication scheme (from the public and policymakers)</p>	<p>New Zealand and Australia had strong political support for eradication programmes due to the main vectors being possums, whereas the ROI and NI have political issues surrounding the eradication of bTB from badgers (the main vector).</p> <p>The ROI's case study shows that progress in badger vaccination and in the reduction of TB within the badger population, may help to reduce the political issues of bTB eradication in badgers.</p> <p>There is also recognition of the need for the ROI and NI to co-operate on animal health policy, with the island of Ireland seen as the most appropriate epidemiological unit for policymaking. Since 2010 there has been an All-Island Animal Health & Welfare Strategy but there has been no formal co-ordination on bovine TB eradication beyond a Working Group format⁴⁸.</p>	<p>Medium</p>
<p>Industry is favourable to a co-funding model</p>	<p>New Zealand and Australia required an industry co-funding model, through the 'beneficiary pays' principle, to propel progress in the eradication programmes. The industry contributions were over 50%. The new funding model in New Zealand prompted industry to increase its funding exponentially, which the government then felt the need to match.</p> <p>There is appetite from industry in NI for the eradication programme, as it is a beneficiary. Lessons from the case studies point to the need for government and industry to reach a governance structure that gives industry a degree of ownership, through committees and strategy formulation. New Zealand's government-led model in the late 1970s saw a huge fall in funding for eradication and the consequences were an increase in bTB incidence, so the current executive-led model in NI and the ROI has funding risks in the future.</p>	<p>Medium/high</p>
<p>Farmer-led body independent of government / joint governance structure</p>	<p>New Zealand and Australia programme models had a farmer-led body responsible for the programme. In the case of New Zealand it is an NGO independent of government. This setup was seen as critical to the ability for there to be a long-term strategy (e.g. clear targets</p>	<p>High – for initial groundwork to create a joint governance structure</p>

⁴⁸ DAFM, 2010, 'All-Island Animal Health & Welfare Strategy'

Enabling factors	Case study detail and comparison to NI	Applicability
	<p>specified at the outset of a multi-year strategy).</p> <p>In NI the current eradication programmes are part of the remit of government and there is not currently a political agenda to create a separate, independent agency. A truly independent setup would also need high levels of industry co-funding as a prerequisite in order to have policy formulation more independent of government restructuring. There also needs to be a co-ordination of activity with the ROI government for eradication to be achieved.</p> <p>In January 2010 the UK government presented the Draft Animal Health Bill, which proposed the creation of an industry-led non-governmental body (the Animal Health Organisation) that would take over animal health policy powers from Defra. The bill was criticised for not having clear provisions on how devolved agriculture policies would be affected and it did not address cost-sharing issues. Cost-sharing was described by critics as crucial to develop “a coherent animal health management environment”⁴⁹.</p>	<p>(Low for a setup that mirrors the NGO format in NZ)</p>

Implementation of the preferred option offers the potential to eradicate bTB and, in doing so, deliver a significant level of monetary and non-monetary benefit to key stakeholders. The development of a co-funding model to support its implementation (utilising the ‘beneficiary pays’ principle) would make a significant contribution to the management of risks associated with public sector underinvestment (due to restricted public sector finances). As identified in Section 6 this is a significant risk factor given the scale and long term nature of the investment required, i.e. **£850 million (an average of c£21 million) over 40 years at 2016 prices.**

The establishment of a co-funding model is consistent with the new governance arrangements proposed by the TBSPG, which aim to create a shared ownership of the bTB Programme among stakeholders. It would also help reinforce positive behaviours and farm management practices that support efforts to control and eventually eradicate the disease.

⁴⁹ G Madley *et al*, 2010, ‘Defining Animal Health and Welfare: Consultation on the Draft Animal Health Bill 2010’, Coventry: University of Warwick