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Implementation of improvements to the National Livestock Identification System for sheep and goats

Decision Regulation Impact Statement

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About this Decision RIS

The purpose of this Decision Regulation Impact Statement (Decision RIS) is to recommend a preferred option for improving the National Livestock Identification System for sheep and goats. The Decision RIS follows the public release of the Consultation RIS and incorporates stakeholders' views and comments received during the eight-week stakeholder consultation process.

This Decision RIS identifies the nature of the problem to be solved and explains the rationale for the preferred option. It also assesses the costs and benefits of all the options under consideration.

This Decision RIS follows the guidelines of the Council of Australian Governments (COAG) in the Best Practice Regulation Guide. It has been approved for release by the Office of Best Practice Regulation.

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Summary

This Decision Regulation Impact Statement (Decision RIS) was prepared as part of a process agreed by the former Standing Council on Primary Industries (SCoPI) to examine options for improving the current National Livestock Identification System (NLIS) for sheep and goats.

The NLIS for sheep and goats was created in 2006 to enhance Australia's capacity to identify and trace livestock from property of birth to slaughter or export. Such capacity is important for managing biosecurity, food safety, market access and animal welfare risks. The NLIS was developed to meet the National Livestock Traceability Performance Standards (NLTPS) endorsed in May 2004 by the former Primary Industries Ministerial Council (PIMC).

Traceability is defined as the proportion of animals that can be successfully traced between defined points in the supply chain or over time. The current NLIS for sheep and goats is mob-based. It relies on arrangements based on visual identification, coupled with documentation recording movements of mobs of animals. Approaches to meeting the standard vary across jurisdictions.

In 2011 the former PIMC noted that the NLIS for sheep and goats does not enable tracing of animals to the standard required by the NLTPS. The former PIMC established a working group to consider the feasibility of electronic identification devices for sheep and goats. The PIMC Working Group on NLIS (Sheep & Goats) reported that no insurmountable technical barriers existed to implementing an electronic NLIS for sheep and goats but a substantial investment of resources and funding would be needed from all jurisdictions.

Before jurisdictions make a decision on the preferred option to improve identification and traceability of sheep and goats, the likely impacts of the proposed changes must be assessed in the form of a RIS. The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) was asked to prepare this Decision RIS.

This paper (known as a Decision RIS) outlines the method and sources of data used to conduct the analysis; assesses the costs and benefits of selected options for improving traceability; and recommends a preferred option based on a set of standard assumptions. This Decision RIS draws heavily on the Consultation RIS released on 11 October 2013 and feedback provided by stakeholders during the eight-week consultation period in late 2013. ABARES prepared this Decision RIS in accordance with Office of Best Practice Regulation (OBPR) guidance.

Options for improving the National Livestock Identification System

In this Decision RIS, the existing mob-based system is used as the baseline against which alternative options are considered. Three options to improve traceability in the existing NLIS were proposed in the Consultation RIS and are considered here:

- Option 1: Enhanced mob-based system—enhancement of the existing mob-based system through improvements in the existing business rules.
- Option 2: Electronic identification (EID) system—the EID of animals, with exemptions for sheep and goats sold directly from their property of birth to abattoirs or export depots.
- Option 3: EID system without exemptions.

Enhancements to the existing mob-based system (Option 1) aim to improve the traceability of sheep and goats through the supply chain. In 2010 the Centre for International Economics (CIE 2010) identified two improvements that would enhance the mob-based system. These changes are improving the accuracy and rate of completion of movement documentation (such as national vendor declaration forms) and improving rules for verification and compliance with the NLIS for sheep and goats. The costs and benefits of these improvements are included in Option 1. The extent to which these improvements need to be applied will vary between each state and territory as a result of the differing approaches to implementing the NLIS currently and current levels of compliance.

An accredited NLIS EID tag (Option 2 and Option 3) contains a microchip that the manufacturer encodes with a unique identification number to be linked to the producer's property identification code (PIC). The number is uploaded to the NLIS database along with the tag's NLIS number through use of electronic scanners along the supply chain from farm to abattoir or live export of the animal. When an animal with its own unique identification code is moved to a different location in the supply chain its EID tag is scanned and the consignee uploads movement forms. Records are then available for each animal in the NLIS database. It is envisaged that livestock would have only one EID tag attached during their life and tags would only be replaced if lost or faulty.

Stakeholder consultation

ABARES received feedback on the Consultation RIS during an eight-week period from 11 October to 6 December 2013. A total of 108 submissions were received.

The majority of stakeholders who made submissions opposed the options involving EID. The most common reason provided was the cost to producers. Stakeholders who supported options with EID generally did so because of positive animal welfare and productivity outcomes.

A large number of submissions were a form letter from stock and station agents, expressing opposition to EID and support for Option 1. Producers were the second largest contributor of submissions. The majority of producers who made submissions expressed opposition to EID and favoured either improving the current NLIS or leaving it unchanged. Some producers did advocate the use of EID, although not necessarily a mandatory system, because of the productivity gains they had seen through their own use of the technology. Industry bodies generally opposed options involving EID, for much the same reasons as producers: the cost and complexity to be borne by producers. Animal welfare and veterinary bodies supported EID on the basis of its potential for increased individual care of animals and decreased need for animal handling.

Detailed submissions were received from the Victorian, New South Wales, Queensland, Western Australian and South Australian agriculture departments, which provided a variety of views and considerable analysis of the issues.

A number of submissions provided feedback on assumptions used in the analysis, including the assumed EID tag prices and other costs of implementation. Where possible these comments have been incorporated into the analysis of impacts.

During the stakeholder consultation process a number of additional options for improving the current NLIS were proposed. These included microchipping of animals, mandatory transaction tagging as used in Western Australia, and mandatory installation of digital camera technology in abattoirs to read visual tags.

Microchipping was not considered in this paper because the costs of implementation are considerably higher than those for an EID system. Transaction tagging was not considered because it has been noted that transaction tagging can compromise traceforward (tracing an animal from its property of birth to its current location), with adverse consequences for overall traceability.

The third option, digital camera technology in abattoirs, may generate labour savings in abattoirs and is effectively a hybrid between a visual mob-based system and an EID system. This option was not considered in this paper because of limited information around the potential costs and benefits of implementing such a strategy.

Framework of assessment

The approach

To evaluate the options considered in this Decision RIS, the incremental benefits and costs associated with each, relative to the current system, are estimated. With respect to benefits, improved traceability could reduce the consequences of a number of potential risks, including those associated with biosecurity and food safety; and could improve productivity, market access and animal welfare relative to the current system. Incremental benefits arise from the ability to rapidly and accurately trace animals and take timely action to eliminate or contain risks or to gain from other benefits, such as improved animal management and productivity on farm. The total incremental benefits of an option are the sum of benefits arising from all potential risk reductions, taking into account the likelihood of those risks occurring, and improvements to productivity, trade and animal welfare.

The NLIS is a national system and this assessment has been undertaken at a national level. However, the relative costs of implementation of the options, and potential benefits, will vary between jurisdictions depending on their current level of traceability.

In all cases, estimates of present values of costs and benefits over a 25-year period are reported in annual terms. Present values are calculated using a 7 per cent discount rate (the standard government rate determined by the Office of Best Practice Regulation).

Refining the assumptions

The quantitative results estimated in this Decision RIS are based on currently available information. Identifying a single 'standard' scenario is difficult given uncertainty around many of the costs and benefits of implementing improvements to the NLIS. Feedback received during the public consultation process did not resolve the uncertainty around values for these factors.

The analysis in this Decision RIS is divided into two parts. The first part, the standard analysis, estimates the costs, benefits and net benefits of each option under a standard set of assumptions. The assumptions fall into three categories; traceability, costs of implementation, and benefits. The standard set of assumptions incorporates variation in two key parameters:

- EID tag prices
- effect of increased traceability on the impacts of a Foot and Mouth Disease outbreak.

The second part of the analysis, the sensitivity analysis, explores the implications of changing the remaining key assumptions. These are:

- the feasible level of traceability under Option 1

- the current level of traceability
- labour costs under Option 1
- infrastructure and labour costs under options 2 and 3
- impacts of an FMD outbreak
- productivity benefits from the use of EID.

The sensitivity analysis also presents estimates of implementation costs across jurisdictions and explores the effect of changing labour costs and EID tag prices over time.

Values for standard assumptions and the sensitivity analysis have been derived from a number of sources. These are:

- a workshop held with jurisdictions in May 2013
- published reports by CIE (2010), PWC (2010) and the PIMC Working Group on NLIS (Sheep & Goats)
- feedback from the Consultation RIS process.

Traceability

Current traceability level

The incremental benefits that can be achieved under an improved NLIS depend on the additional traceability achieved by each option. In this Decision RIS the current traceability is assumed to average 90 per cent based on discussions with jurisdictions and feedback received during the consultation phase. This represents a national average across the individual traceability standards relevant to sheep and goats, noting that some jurisdictions may currently achieve higher levels and others lower levels of traceability. For example, evidence from past saleyard audits suggests that the prevalence of inaccurate or incomplete movement documentation is lower in New South Wales than other jurisdictions, suggesting a higher level of traceability than the national average.

Target traceability levels

For the purposes of evaluating the costs and benefits of options to improve traceability, it is necessary to clearly define the levels of traceability in the short term and in the long term that would meet the NLTPS. Lifetime or long-term traceability refers to the ability to determine all locations where a specified animal has been resident during its life and the location of all susceptible animals that resided concurrently with a specified animal at any time during the specified animal's life. Given the lack of information about lifetime traceability, only the potential costs and benefits of short-term traceability have been considered in this Decision RIS.

The NLTPS for short-term traceability state that it must be possible, within 24 hours, to determine the locations where a specified animal was resident during the previous 30 days and to determine the locations of all susceptible animals that resided concurrently and/or subsequently on any of the properties on which a specified animal has resided in the past 30 days. A workshop held with most states and territories in May 2013 agreed that the target level of traceability for sheep and goats is 98 per cent for short-term tracing.

The estimates of impacts presented in this Decision RIS are based on the achievement of a 98 per cent level of short-term traceability under each of the three options. However, feedback received during the workshop with jurisdictions and during the eight-week consultation period, suggests that there is considerable uncertainty around the capacity of Option 1, the enhanced mob-based system, to achieve this target level of traceability.

New South Wales Department of Primary Industries submitted evidence of high compliance rates under the current mob-based system in New South Wales saleyards and suggested that a short-run traceability target of 98 per cent could be achieved with improvements to the current system.

Victoria's Department of Environment and Primary Industries expressed concerns that a short-run traceability target of 98 per cent cannot be achieved under an enhanced mob-based system—citing non-compliance, human error and practical issues around verification activities in saleyards as major impediments.

To understand the implications of Option 1 failing to achieve a short-run traceability target of 98 per cent, this Decision RIS considers a lower achieved level of traceability of 95 per cent as part of the sensitivity analysis.

Costs of implementation

The cost of implementing each option to obtain the target level of short-term traceability of 98 per cent was estimated by taking into account the additional labour, materials and capital requirements relative to the current system. The analysis includes labour costs for all options to achieve the target levels of traceability, and equipment and tag costs for the two EID options. The equipment for the EID options (such as software and scanners) is assumed to be required at all key points in the supply chain, including farms, saleyards, abattoirs and export premises. Costs for each option are calculated based on the estimated number of sheep and goats going through the supply chain.

In estimating the costs of the different options, ABARES drew on data provided in the PIMC Working Group report on NLIS (Sheep & Goats) (2012), the CIE (2010) report and the PricewaterhouseCoopers (PWC 2010) report; information and data from various state departments of agriculture; submissions received during the stakeholder consultation process; and ABARES survey data.

Labour costs under an enhanced mob-based system

Under the enhanced mob-based tracing option, Option 1, implementation costs on a per sheep basis were drawn from CIE (2010), which provided the most recent estimates comparable with ABARES' approach. The CIE estimates take into account the additional costs of compliance, verification and enforcement of the business rules proposed to achieve a short-run traceability level of 98 per cent. The verification procedures and changes to the business rules proposed by CIE (2010) are presented in the appendix of this Decision RIS.

Victoria proposed additional changes to the business rules to improve traceability under option 1, such as the mandatory upload of pdfs of National Vendor Declaration Forms to the NLIS database and more extensive verification procedures in saleyards, compared to those recommended by CIE (2010). The costs of these additional changes to the business rules and verification procedures have not been formally costed in this Decision RIS but are accounted for in the sensitivity analysis.

Labour and infrastructure costs under an EID system

Under the EID options, labour costs were drawn from PWC (2010). These costs were comparable with the range of estimated costs presented in the PIMC Working Group report (2012). Infrastructure costs were based on the outcomes of a survey conducted by the Livestock Saleyards Association of Victoria which formed the low-end estimates in the PIMC Working Group report (2012) and considered the best available estimates. Four EID tag prices are considered as part of the standard set of assumptions; $0.80, $0.90, $1.30 and $1.60. These four prices cover the range of values discussed at a workshop with jurisdictions prior to the release of the Consultation RIS, and submissions received during the eight-week public consultation period.

Lifetime traceability

Prior to the release of the Consultation RIS, jurisdictions agreed on a target level of lifetime traceability of 95 per cent. While the costs and benefits of achieving this level of lifetime traceability have not been directly estimated in this Decision RIS, there is evidence to suggest that the activities undertaken under options 2 and 3 may be sufficient to achieve this target level of traceability. That is, there would be no costs in addition to those estimated in this Decision RIS under options 2 and 3 to meet the target level of lifetime traceability. However, during the public consultation phase little information was provided on the additional costs or benefits associated with achieving a 95 per cent level of lifetime traceability under Option 1. As such, although there may be cost implications of doing so, these are not included in the estimates presented in this Decision RIS.

Benefits of increased traceability

Improvements in the NLIS may have a number of benefits, including a reduction in the impacts of livestock disease outbreaks or food safety incidents; and improved animal welfare, productivity and market access. Given the uncertainty around many of these benefits, this Decision RIS only quantifies the benefits of reduced impacts of a potential foot-and-mouth disease (FMD) outbreak (core and sensitivity analysis) and productivity improvements through the use of EID technology on farm (sensitivity analysis only). The remaining benefits are discussed qualitatively.

The approach used in the standard analysis is to assume that a target level of short-run traceability of 98 per cent is attained under each option and to evaluate the costs of achieving that level of traceability for each option. Because the estimated benefits are the same for each option, the analysis, therefore, investigates the cost-effectiveness of each option. However, it remains important to evaluate the benefits of improving traceability to ensure it is worthwhile, relative to the existing system.

Biosecurity benefits

Increasing traceability levels in the sheep and goat industries is expected to generate gross benefits primarily in the form of cost savings attained by reducing the potential impacts of pest and disease outbreaks.

Benefits from improvements in short-term traceability are expected to accrue mainly in reductions in the potential impact of rapidly moving diseases such as FMD, while the additional benefits from better lifetime traceability would be expected to come mainly from mitigating the costs of slow-moving diseases such as scrapie.

Of the potential biosecurity benefits, in this analysis ABARES has only quantified the effects of reducing the length and, therefore, consequences of an FMD outbreak through improved

traceability. Even for FMD, there is uncertainty around the estimated benefits from increased traceability stemming from the varying estimated costs of an FMD outbreak and the extent of reduced impacts as a result of enhanced traceability.

In this analysis, it is assumed that similar levels of traceability would yield the same biosecurity benefits, regardless of the NLIS option taken to achieve those traceability levels. Based on discussions with jurisdictions, it is assumed that a one percentage point improvement in traceability results in a reduction of 1 per cent, 2 per cent or 3 per cent in the impact of a disease outbreak. The low figure (1 per cent) is consistent with that used by PWC (2010) while the high figure (3 per cent) is equal to the average rates for options 1 and 3 used by CIE (2010).

Under the standard set of assumptions the impacts of an FMD outbreak on the Australian economy are $52 billion (ABARES 2013). This estimate is based on a large multi-state outbreak scenario where all states except Western Australia and Tasmania are affected. In the sensitivity analysis, the implications of a lower estimated impact of $17 billion (Matthews 2011) are also considered.

Producer productivity from electronic identification

Electronic identification can enable full monitoring of individual animals, providing productivity benefits from information such as monitoring of live weights, wool production or drug application.

Electronic identification has a clear advantage in this respect. However, the relatively low level of voluntary adoption of the technology suggests that productivity benefits may not be sufficient to offset the current cost of the technology. If an EID system became mandatory, productivity benefits would still be relevant to assessing the effect of the options.

Given the uncertainties around the uptake of individual animal identification technology (in addition to EID tags) potential productivity benefits are considered in the sensitivity analysis but are not included in the standard assumptions.

Animal welfare

Under the current Exporter Supply Chain Assurance System (ESCAS) for exports of live sheep and goats, a mob-based accounting system is used to trace animals through the supply chain to final slaughter. As the ESCAS system is already based on a mob-based approach, it is not expected that Option 1 would add much benefit to the existing system. Similarly, as direct-to-live exports are excluded under Option 2, significant additional animal welfare benefits are unlikely to be realised from this option compared with the current system. Therefore, the enhanced animal welfare benefits under ESCAS are most likely to be associated with Option 3.

However, there may be animal welfare implications from activities undertaken to improve traceability within Australia. A number of submissions received from animal welfare and veterinary bodies asserted that the ability to trace individual sheep and goats, and reduced handling, under an EID system would improve animal welfare outcomes. However, other submissions noted that additional handling of animals under an EID system, as a result of rescanning sheep, could adversely affect animal welfare.

Food safety

Knowing where a food product can be found in the supply chain enables sources of a food safety incident (such as those associated with chemical residues or microbial hazards) to be quickly traced. Tracing can reduce food safety related costs by allowing identification of products for

rapid and effective recall, investigation to prevent recurrence, and management of at-risk animals.

Under the current mob-based system, animals can be traced back where records are complete. After-slaughter tracing of sheep and goats depends on matching documentation with slaughter sequence and transferring information to the carcass. Aligning documentation with animal identification is improved through using electronic tags (FSANZ 2009).

Electronic tags also allow animals from particular populations with diseases or defects to be identified when not directly consigned to an abattoir. This can allow inspection to be tailored to the spectrum and prevalence of hazards, enhancing risk-based meat hygiene programs and improving food safety (FSANZ 2009).

Feedback received from stakeholders suggests that the current NLIS is adequate in terms of food safety and that any improvements to the system will be likely to have negligible benefits.

Market access

The European Union—which accounted for around 9 per cent of Australia's lamb exports in 2011-12—has a compulsory EID system in its domestic supply chain. While the European Union does not require EID tags be applied to sheep or goats sent directly from their property of birth to slaughter in Australia, authorities or importers could require equivalence in tracing of sheep and goats in the future, which could limit Australia's access to this high-value market. However, some stakeholders noted that exports to the European Union are not a major driver of industry profits and that the likelihood of these restrictions being put in place is uncertain.

Analysis based on standard assumptions

Summary of standard assumptions

Table S1 summarises the standard assumptions and justification for key parameters. Under the standard set of assumptions, variation in EID tag prices and the assumed effect of increased traceability on FMD impacts are considered. All other parameters are fixed.

Table S1 Standard assumptions

Key parameter	Assumed value(s)	Explanation
Initial level of traceability	90%	Agreed to by jurisdictions in a workshop prior to the release of the Consultation RIS.
Feasible level of traceability	98% for all options	Agreed to by jurisdictions in a workshop prior to the release of the Consultation RIS.
Labour costs for an enhanced mob-based system	Based on per sheep labour costs estimated by CIE (2010)	CIE (2010) provided the most detailed estimates comparable with ABARES' approach.
Labour costs for EID systems	Based on per sheep labour costs estimated by PWC (2010)	This is a high value relative to CIE (2010), which assumed that there would be no additional labour costs associated with EID, but is comparable with the range of estimates presented in the PIMC Working Group report (2012).
Infrastructure costs for EID systems	Based on low-end estimates considered in the PIMC Working Group report (2012)	The low-end infrastructure cost estimates reflect the outcomes of a survey conducted by the Livestock Saleyards Association of Victoria and are considered to be the best available estimates.

Table S1 Standard assumptions *continued*

Key parameter	Assumed value(s)	Explanation
EID tag prices	$0.80, $0.90, $1.30 and $1.60	These four EID tag prices cover the range of values discussed at the workshop with jurisdictions prior to release of the consultation RIS, and received in submissions afterwards.
Impacts of an FMD outbreak on the Australian economy	$52 billion (ABARES 2013)	The most recent estimate of the potential impacts of an FMD outbreak.
Reduction in FMD impacts from 1% increase in traceability	1, 2 and 3 percent	A range consistent with CIE (2010) and PWC (2010) is considered given the uncertainty around the relationship between traceability and disease impacts.
Potential on-farm productivity benefits from the use of EID technology	$0	Use of EID for productivity purposes is limited in the cattle industry and uptake in the sheep and goat industry is highly uncertain.

Sources: ABARES, CIE (2010), PIMC Working Group (2012), PWC (2010), and stakeholders' feedback received through the public consultation process

Estimates of costs under standard assumptions

Table S2 presents estimates of the annual costs of implementing each of the three options under the standard cost assumptions (Table S1). Option 1 represents the lowest cost option under any EID tag price. The estimated cost of achieving 98 per cent traceability in the short term under the enhanced mob-based option is $11.4 million a year. In contrast, the EID option is estimated to cost between $16.4 million and $35.9 million a year with exemptions and between $23.3 million and $54.1 million a year without exemptions. The range of costs under each EID option is the result of different EID tag prices, ranging from $0.80 to $1.60.

Table S2 Estimated annual implementation costs of each option, under the standard assumptions

	Tag cost ($m)	Labour cost ($m)	Capital/infrastructure cost ($m)	Total cost ($m)
Option 1	0	11.4	0.0	11.4
Option 2				
—tag price of $0.80	11.0	3.2	2.3	16.4
—tag price of $0.90	13.4	3.2	2.3	18.8
—tag price of $1.30	23.1	3.2	2.3	28.6
—tag price of $1.60	30.4	3.2	2.3	35.9
Option 3				
—tag price of $0.80	17.3	3.7	2.3	23.3
—tag price of $0.90	21.2	3.7	2.3	27.2
—tag price of $1.30	36.6	3.7	2.3	42.6
—tag price of $1.60	48.1	3.7	2.3	54.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
Source: ABARES estimates

Table S2 also provides a breakdown of costs by capital and infrastructure, annual EID tag costs and labour costs. Under Option 1 all costs are associated with labour, while in the remaining options labour makes up 7 to 19 per cent of total costs, depending on the option and assumed EID tag price. Under Option 2 and Option 3, tag costs contribute the largest share of costs, accounting for between 67 and 89 per cent of the total estimated costs a year. For the EID options, about 4 to 14 per cent of total costs are associated with capital and infrastructure.

The costs of compliance for key stakeholders in the supply chain are estimated to vary between the three options (Table S3). The compliance costs associated with Option 1 are estimated to total $4.0 million across various businesses. In addition to these costs, state departments and agencies are estimated to bear costs of $7.4 million for auditing and verification activities undertaken as part of an enhanced mob-based system. Most of the costs under options 2 and 3 are associated with purchasing EID tags at the farm gate. For example, assuming a tag price of $0.80, Option 2 is estimated to impose a total cost on businesses of $16.4 million and Option 3 a cost of $23.3 million, with the majority of these costs occurring at the farm gate. The 'true' burden of these compliance costs may be shifted across the supply chain. This has not been analysed in this Decision RIS because of a lack of data.

Table S3 Estimated annual implementation costs of each option along the supply chain, under the standard assumptions

Cost	Farm gate ($m)	Saleyards ($m)	Abattoirs ($m)	Exporters ($m)	Government ($m)	Total ($m)
Option 1	1.1	2.1	0.8	0.0	7.4	11.4
Option 2						
—tag price of $0.80	11.7	2.6	1.9	0.2	0.0	16.4
—tag price of $0.90	14.2	2.6	1.9	0.2	0.0	18.8
—tag price of $1.30	23.9	2.6	1.9	0.2	0.0	28.6
—tag price of $1.60	31.2	2.6	1.9	0.2	0.0	35.9
Option 3						
—tag price of $0.80	18.1	2.6	2.5	0.2	0.0	23.3
—tag price of $0.90	21.9	2.6	2.5	0.2	0.0	27.2
—tag price of $1.30	37.3	2.6	2.5	0.2	0.0	42.6
—tag price of $1.60	48.9	2.6	2.5	0.2	0.0	54.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
Source: ABARES estimates

Estimates of benefits under standard assumptions

Table S4 summarises the potential biosecurity benefits of improving the NLIS under the standard assumptions (Table S1). These benefits are based on estimates of the reduction in expected annual costs of an FMD outbreak.

Expected annual costs of an FMD outbreak are assumed to be $780 million. These are calculated using (1) estimated costs of $52 billion (calculated in NPV terms over a 10 year period) in the event of an actual FMD outbreak (ABARES 2013) and (2) an assumed probability of an FMD incursion per year of 1.5 per cent, equivalent to the average of the range assumed by CIE (2010), and seems reasonable given that Australia has been free of FMD for more than 100 years.

Table S4 Biosecurity benefits from improved traceability, under the standard assumptions

Reduction in FMD impact from improved traceability [a] (%)	Present value of benefits ($m)	Annualised benefit ($m)
1	702.2	60.3
2	1 356.5	116.4
3	1 965.7	168.7

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. Impacts of an FMD outbreak are assumed to be equal to $52 billion over 10 years.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Measures of relative performance of alternative options under standard assumptions

Net present value (the present value of benefits minus costs), or NPV, is used to compare NLIS options in this Decision RIS. Given that all options are assumed to provide the same biosecurity benefits under the standard set of assumptions, the relative economic performance or impact is determined by the extent of differences in their implementation costs. That is, the lowest cost option will be the most economic option. However, to determine whether the implementation of an option is worthwhile, estimates of benefits also need to be considered.

Table S5 shows the NPVs of the three options under the standard assumptions (Table S1). These estimates are equal to the difference in total costs presented in Tables S2 and S3 and the benefits presented in Table S4.

Table S5 Estimated annualised net present values of options ($m), standard assumptions

Option	Reduction in FMD impacts from improved traceability [a] (%)		
	1	2	3
Option 1	49	105	157
Option 2			
—tag price of $0.80	44	100	152
—tag price of $0.90	41	98	150
—tag price of $1.30	32	88	140
—tag price of $1.60	24	81	133
Option 3			
—tag price of $0.80	37	93	145
—tag price of $0.90	33	89	142
—tag price of $1.30	18	74	126
—tag price of $1.60	6	62	115

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent and impacts of an FMD outbreak are assumed to be equal to $52 billion over 10 years. The total industry infrastructure cost is $10.6 million spread over a five-year period.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Option 1 has the highest NPV and is, therefore, the preferred option, regardless of EID tag price or the assumed effect of increased traceability on FMD impacts. However, all three options are

estimated to have a positive NPV, regardless of EID tag price or the assumed effect of increased traceability on FMD impacts

Sensitivity analysis

Changing the standard assumptions

In addition to variations in EID tag prices and the effect of increased traceability on FMD impacts, the implications of varying assumptions around traceability, costs, and benefits were assessed. Table S6 summarises alternative values for key parameters considered in the sensitivity analysis. The rationale for these alternative values is discussed below and the full range of estimated NPVs for each option presented.

Table S6 Alternative values for key parameters considered in sensitivity analysis

Key parameter	Standard assumption	Sensitivity analysis
Initial level of traceability	90%	Values of 85% and 95% are considered in the sensitivity analysis to account for jurisdictional differences.
Feasible level of traceability	98% for all options	A lower level of 95 per cent under Option 1 is also considered because of uncertainty around the feasibility of achieving 98 per cent.
Labour costs for an enhanced mob-based system	Based on per sheep labour costs estimated by CIE (2010)	Higher labour costs (double the CIE estimates) are considered in the sensitivity analysis that encompasses high-end estimates considered by PWC (2010).
Labour costs for EID systems	Based on per sheep labour costs estimated by PWC (2010)	Higher labour costs (double the CIE estimates) are considered in the sensitivity analysis.
Infrastructure costs for EID systems	Based on low-end estimates considered in the PIMC Working Group report (2012)	Estimates presented by PWC (2010) and CIE (2010) were considered 'high' by the PIMC Working Group report but are assessed in the sensitivity analysis.
EID tag prices	$0.80, $0.90, $1.30 and $1.60	Same as standard assumptions
Impacts of an FMD outbreak on the Australian economy	$52 billion (ABARES 2013)	A lower value of $17 billion, estimated by Matthews (2011), is considered in the sensitivity analysis.
Reduction in FMD impacts from 1% increase in traceability	1, 2 and 3 percent	Same as standard assumptions
Potential on-farm productivity benefits from the use of EID technology	$0	Productivity benefits of up to $160 million (in net present value terms) are considered in the sensitivity analysis.

Sources: ABARES, CIE (2010), PIMC Working Group (2012), PWC (2010), and stakeholders' feedback received through the public consultation process

Feasibility of achieving 98 per cent traceability under Option 1

To account for uncertainty around the feasibility of achieving 98 per cent short-run traceability under Option 1, and to illustrate the sensitivity of the results to this assumption, the full analysis considers a lower feasible level of traceability of 95 per cent. A lower level of feasible traceability under Option 1 reduces the biosecurity benefits associated with an enhanced mob-based system.

It also reduced the costs associated with implementation of this option. The analysis indicates that the feasible level of traceability under Option 1 is a critical assumption that affects the preferred option under a range of EID tag prices and assumptions about the effect of increased traceability on FMD impacts.

Lower feasible levels of traceability under options 2 and 3 are not considered in this Decision RIS. However, because a lower feasible level of traceability reduces the benefits of implementing an EID system, Option 1 would remain preferred when all options are assumed to achieve the same, but lower, level of traceability.

Initial level of traceability

To account for uncertainty around the national average level of current short-term traceability, the full analysis considers initial levels of traceability equal to 85 per cent and 95 per cent nationally. A lower level of current traceability results in larger biosecurity benefits associated with achieving a short-run traceability target of 98 per cent for all three options. The costs of Option 1 are assumed to increase commensurately. A lower level of initial traceability only affected the preferred option at bottom range EID tag prices ($0.80).

Labour costs under an enhanced mob-based system

With regards to implementation costs, the full analysis considers higher labour costs under Option 1 by doubling those assumed by CIE (2010). These estimates are considered high and are above higher end estimates presented in an earlier report by PWC (2010) and feedback received during the eight-week public consultation process. Increases in the assumed implementation costs of Option 1, combined with a lower level of initial traceability, result in Option 2 being the preferred option for almost all tag prices and assumed effect of increased traceability on FMD impacts.

Higher labour and infrastructure costs under options 2 and 3

Higher potential infrastructure costs under options 2 and 3 are also considered in response to feedback received through the eight-week public consultation process. The higher infrastructure costs are above the high-end estimates presented in the PIMC Working Group report and originally estimated by PWC (2010). Higher labour costs for EID were also considered. As Option 1 is the preferred option under the standard assumptions, increasing the costs of implementation has no effect on the preferred option but renders options 2 and 3 economically unviable under a number EID tag prices and assumptions about the effect of increased traceability on FMD impacts.

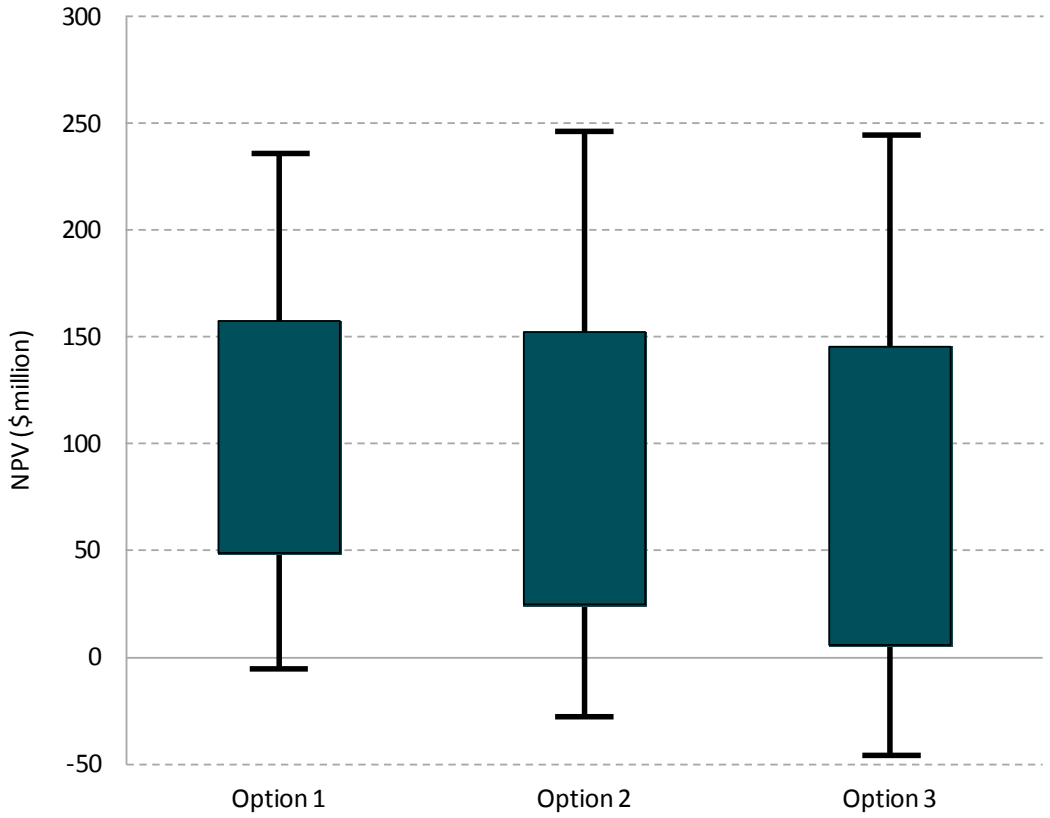
Impacts of an FMD outbreak and productivity benefits

The full analysis considers lower estimates of the impacts of an FMD outbreak and potential productivity benefits from the use of EID technology on farm. Lower estimates of the impacts of an FMD outbreak are taken from Matthews (2011) and assumed to be equal to $17 billion over 10 years. Productivity benefits of up to $160 million, in present value terms, are derived from previous work undertaken by PWC (2010b). When considered in isolation of one another, productivity benefits and lower estimates of the impacts of an FMD outbreak had little to no effect on the preferred option.

Full range of estimates

Figure S1 shows the full range of estimates of annualised NPV under the three options. The solid bars reflect variation in NPV under the standard traceability, cost and benefit assumptions. This range is associated with different EID tag prices and assumptions about the effect of increased traceability on FMD impacts.

Figure S1 Full range of estimated annualised net present values



Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The total industry infrastructure cost is spread over a five-year period. The solid bars reflect the range of estimates of annualised NPV under the standard traceability, cost, and benefit assumptions.
Source: ABARES estimates

There is considerable overlap in the estimates of NPV for the three options. However, the minimum estimates of annualised NPV for the three options differ significantly. The minimum estimates for all three options are based on a scenario in which the initial level of traceability is 95 per cent and, for options 2 and 3, EID tag prices are $1.60. The maximum estimates for all three options are based on a scenario in which the initial level of traceability is 85 per cent. For options 2 and 3 EID tag prices are $0.80 and the maximum productivity benefits are achieved for all tagged sheep.

Estimates of implementation costs by jurisdiction and traceability

While the recommendations in this Decision RIS are based on a national-level analysis, the costs and benefits of implementation differ across jurisdictions. Estimates of implementation costs by jurisdiction are calculated using estimates of sheep and goat movements by jurisdiction and per sheep/goat costs at the national level (Table S7).

In the case of Option 1 (enhanced mob-based system), the current level of compliance is assumed to proportionally affect the per sheep/goat costs of implementation. That is, jurisdictions with higher rates of compliance would incur smaller costs, on a per sheep/goat basis, to achieve the target levels of traceability. Estimates of implementation costs are presented for three potential levels of current traceability: 85, 90 and 95 per cent.

Table S7 Estimated annual implementation costs by jurisdiction, various levels of current traceability

Option/cost	NSW a ($m)	Vic. ($m)	Qld ($m)	WA ($m)	SA ($m)	Tas. ($m)	NT ($m)	Aust. ($m)
Option 1								
—85% initial traceability	7.6	5.2	0.6	2.5	2.5	0.2	0.006	18.6
—90% initial traceability	4.7	3.2	0.4	1.5	1.5	0.1	0.004	11.4
—95% initial traceability	1.8	1.2	0.1	0.6	0.6	0.0	0.001	4.3
Option 2								
—tag price of $0.80	6.7	4.0	0.8	1.8	2.6	0.4	0.0	16.4
—tag price of $0.90	7.8	4.6	0.9	2.0	3.0	0.5	0.0	18.8
—tag price of $1.30	11.9	6.8	1.5	2.9	4.6	0.8	0.0	28.6
—tag price of $1.60	15.0	8.4	2.0	3.6	5.8	1.1	0.0	35.9
Option 3								
—tag price of $0.80	8.6	5.4	1.0	4.6	3.2	0.6	0.0	23.3
—tag price of $0.90	10.0	6.1	1.2	5.4	3.7	0.7	0.0	27.2
—tag price of $1.30	15.8	9.3	1.9	8.5	5.9	1.2	0.0	42.6
—tag price of $1.60	20.0	11.7	2.5	10.9	7.5	1.5	0.0	54.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. Lower traceability increases the costs of implementing Option 1 and increases the biosecurity benefits for all three options. The total industry infrastructure cost is $10.6 million spread over a five-year period.
a Includes the ACT.
Source: ABARES estimates

Table S8 presents a summary of the lowest cost option for each jurisdiction based on the estimates in Table S7. Table S8 illustrates that the lowest cost option can differ across jurisdictions. For example, Option 2 is the lowest cost option in Victoria and Western Australia under an EID tag price of $0.90 and current level of traceability of 85 per cent, while Option 1 is likely to be the lowest cost option in other states. These differences are solely the result of differences in the number of sheep and goats moving through specific points in the supply chain.

Table S8 Lowest cost option by jurisdiction, various levels of current traceability

Initial traceability	EID tag price	NSW[a]	Vic.	Qld	WA	SA	Tas.	NT	Aust.
85%	$0.80	2	2	1	2	1	1	1	2
	$0.90	1	2	1	2	1	1	1	1
	$1.30	1	1	1	1	1	1	1	1
	$1.60	1	1	1	1	1	1	1	1
90%+	$0.80	1	1	1	1	1	1	1	1
	$0.90	1	1	1	1	1	1	1	1
	$1.30	1	1	1	1	1	1	1	1
	$1.60	1	1	1	1	1	1	1	1

Note: The lowest cost options are based on the estimates in Table S7.
a Includes the ACT.
Source: ABARES estimates

Differences in the current level of traceability have a significant effect on the lowest cost option. Under higher levels of current traceability (90 per cent or higher) Option 1 is the lowest cost option in all jurisdictions.

Changes in labour and technology costs over time

A further analysis with respect to changing labour costs and EID tag prices over time revealed that there may come a time when an EID system represents a lower cost option than an enhanced mob-based system. Therefore the chosen option should be further reviewed in the future.

Recommendations

The analysis highlights a range of uncertainties around key assumptions that can have a significant impact on the preferred option.

On the basis of the standard set of assumptions, derived through discussions with jurisdictions, published research and feedback on the consultation RIS, this Decision RIS **recommends** that the NLIS be improved through enhancing the current mob-based system. An enhanced mob-based system is recommended over an EID system because:

- an enhanced mob-based system is estimated to have the highest net present value under the standard assumptions relating to the costs and benefits of implementing the three options.
- an enhanced mob-based system is estimated to have a positive net present value for a greater range of assumed costs and benefits than options 2 and 3.

This recommendation should be considered in the context of the uncertainties in the potential costs and benefits of improving traceability under the various options. In particular, assumptions around the current level of traceability, the feasible level of traceability under Option 1, EID tag prices and implementation costs of all options affect the preferred option.

As part of implementation, this Decision RIS **recommends** that further work be undertaken at the state level to clarify the appropriate values for initial traceability and implementation costs under all options.

A critical uncertainty is the level of traceability that can be achieved under an enhanced mob-based system. Three jurisdictions consider that the standard assumption that a 98 per cent level of traceability can be achieved under an enhanced mob-based system, is feasible. Two jurisdictions consider this is infeasible and other jurisdictions did not express a view on this issue. If it is assumed that an enhanced mob-based system can achieve a maximum level of traceability of 95 per cent, then the preferred outcome would be option 2 – an EID system with exemptions for sheep and goats sold directly from their property of birth to abattoirs or export depots.

Because of the uncertainty around the feasible level of traceability under an enhanced mob-based system, this Decision RIS **recommends** that traceability levels under an enhanced mob-based system, if implemented, be monitored and evaluated.

In addition, the costs of implementing the alternative options may change over time with changes in labour and capital costs. This could change the relative performance and feasibility of the three options. As a result, this Decision RIS **recommends** that the costs and benefits of transitioning from a mob-based system to an EID system be reviewed within five years. A full

assessment of the different options would be assisted if one or more jurisdictions were to adopt an EID system on a trial basis over this period.

1 Introduction

In October 2012 the former Standing Council on Primary Industries (SCoPI) agreed that the former Department of Agriculture, Fisheries and Forestry (DAFF) should prepare a regulatory impact statement (RIS) to assess the options for improving the current National Livestock Information System (NLIS) for tracing sheep and goats through the supply chain. The Department asked the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) to prepare the RIS.

The primary function of a RIS is to inform government decision making. This RIS has been completed in line with the Council of Australian Governments Best Practice Regulation guidelines. The process involves a RIS for consultation and a RIS for decision makers (Council of Australian Governments (COAG) 2007).

The first stage of this process was to prepare a Consultation RIS. In preparing the Consultation RIS, ABARES consulted relevant state and territory agencies and the Office of Best Practice Regulation. The consultation included a workshop on 17 May 2013 with participation from most relevant state and territory agencies to review the data, information and assumptions. ABARES released the Consultation RIS for public comment between 11 October and 6 December 2013.

The COAG guidelines for the RIS require the Decision RIS to provide a comprehensive account of each component and to include 'a consultation statement, a recommended option and a strategy to implement and review the preferred option' (Department of Finance and Deregulation (DOFD) 2012). This Decision RIS evaluates the costs and benefits of each option to improve the current NLIS for sheep and goats.

This Decision RIS presents estimates of the costs of compliance for all three options for each stage of the supply chain, providing insight into the potential burden placed on businesses. However, since changes to the NLIS system will come about through amendments to state legislation (specifically the Stock Disease Acts), and not changes in Commonwealth legislation, no offsets have been provided in relation to this proposal.

While the methodology used in this Decision RIS remains largely unchanged from the Consultation RIS, stakeholder feedback is incorporated into the sensitivity analysis and has informed ABARES's understanding of the potential benefits of improving traceability.

The remainder of this report provides background information (Chapter 2); an outline of the problem (Chapter 3); objectives of government action (Chapter 4); discussion of options to improve traceability of sheep and goats (Chapter 5); impacts of implementing the options (Chapters 6 and 7); a summary of information and views provided as part of the consultation process (Chapter 8), and recommendations on the preferred option and way forward (Chapter 9).

2 Background

National Livestock Identification System

The NLIS is Australia's system for identifying and tracing livestock. The system plays a key role in ensuring cattle, sheep and goats in Australia can be traced from property of birth to slaughter or export in the event of a threat to biosecurity, meat safety, product integrity or market access.

SAFEMEAT—a partnership between the livestock industries and the state, territory and Australian governments—developed the NLIS for sheep and goats in January 2006 to meet the National Livestock Traceability Performance Standards (NLTPS). The NLIS for sheep and goats was introduced in 2006 as a mob-based system whereby visually readable ear tags and a movement documentation system were used to trace animals. In 2008, recording of mob-based movements on the NLIS was introduced to enhance the traceability system and enable movement records to be quickly accessed through a central database. Uploading of property-to-property movements on the database has been rolled out since 2010 but the method of implementation varies across jurisdictions. The NLIS database is operated by NLIS Limited, a wholly owned subsidiary of Meat and Livestock Australia. A transfer of the database to Animal Health Australia is currently being negotiated.

National Livestock Traceability Performance Standards

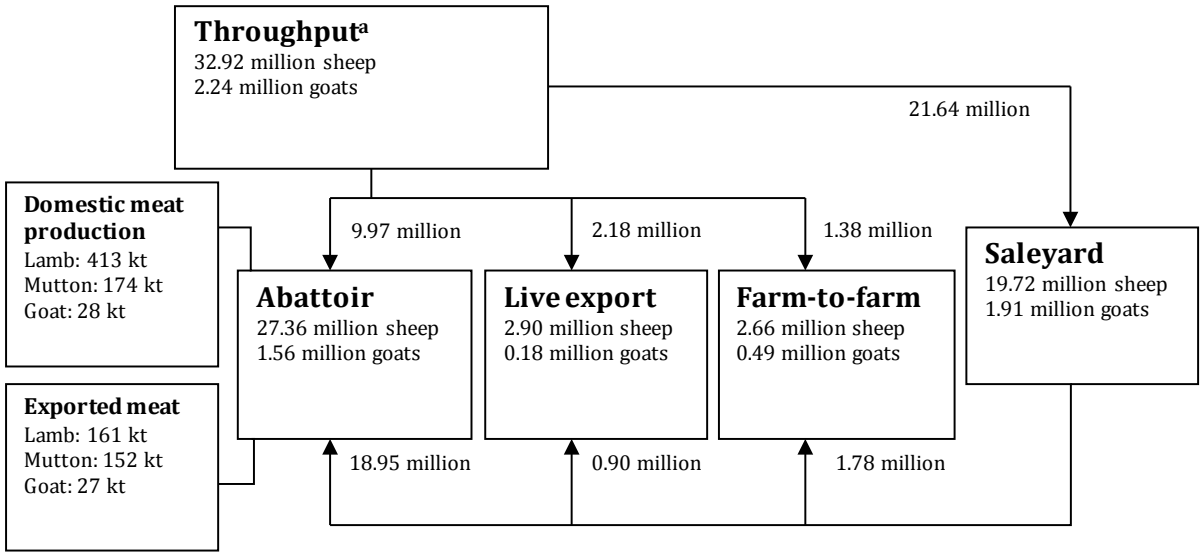
The NLTPS, endorsed in May 2004 by the Primary Industries Ministerial Council (PIMC), outlines the requirements and timeframes for livestock to be traced quickly and reliably if needed (Appendix A).

Sheep and goats are covered by sections 1 and 3 of the NLTPS. Section 1 describes the standards for tracing recent movements, such as for an outbreak of a highly contagious disease like foot-and-mouth disease (FMD), and Section 3 outlines lifetime traceability requirements.

To conform to the NLTPS, movements of sheep and goats to and from farms, saleyards, abattoirs and export depots need to be traceable. In estimating the costs of implementing various options for improving the NLIS, ABARES estimated the average number of sheep moving through the supply chain each year during the 2007–08 to 2011–12 period. Based on ABARES estimates, approximately 33 million sheep were moved per year and 2.24 million goats sold between 2007–08 and 2011–12 (Figure 1). The majority of sheep and goat movements were from farms to saleyards to abattoirs (18.95 million) but direct movements from farms to abattoirs were also significant (9.71 million).

The movements of sheep and goats by state and territory are detailed in Table 1. In Australia 29 million sheep and goats are slaughtered in abattoirs each year. The large sheep-producing states of New South Wales and Victoria are estimated to slaughter on average 60 per cent of Australia's sheep and goats throughput each year, with Victoria the largest processor. Victoria's share is approximately 40 per cent at roughly 11 million animals. Additionally 42 per cent of transactions through Australian saleyards occur in Victoria. New South Wales follows with the second largest volume of animals through the supply chain, at 27 per cent of Australia's saleyard transactions and 26 per cent of abattoir slaughters. Western Australia and South Australia also have large numbers of animals moving through abattoirs, averaging 14 per cent and 16.5 per cent respectively. South Australia also supplies a large number of sheep and goats to saleyards each year, with approximately 74 per cent of the state's throughput moving through this path.

Figure 1 Number of sheep and goats moving through the supply chain, annual average 2007–08 to 2011–12



Note:
a Throughput is defined as the average number of animals directly sold off farms that move through the supply chain each year. Throughput only accounts for the first movement of sheep and goats sold directly off farms and does not include the number of animals sold onward from saleyards.
Sources: ABARES estimates adapted from CIE 2010. Data from ABARES 2012a; ABS 2012a; DAFF 2012; Foster forthcoming.

Table 1 Sheep and goat numbers moving through the supply chain, by state (annual average 2007–08 to 2011–12)

Jurisdiction/ Supply chain	Throughput[b] (million)	Saleyard (million)	Abattoir (million)	Farm to farm (million)	Live exports (million)
NSW[a]	12.85	9.93	7.33	1.24	0.10
Vic.	8.73	5.67	11.09	0.61	0.47
Qld	0.93	0.58	1.28	0.22	0.06
SA	8.06	2.69	3.95	0.60	2.17
WA	4.10	2.66	4.66	0.40	0.28
Tas.	0.48	0.09	0.61	0.07	0.001
NT	0.01	0.008	0.006	0.002	0.001
Australia	35.15	21.63	28.92	3.15	3.08

Note: Total numbers of animal movements for each route of the supply chain correspond to the description provided in Figure 1.
a Includes the ACT.
b Throughput is defined as the average number of animals moving through an individual state's supply chain each year. Throughput only accounts for the first movement of sheep and goats sold directly off farms and does not include the number of animals sold onward from saleyards.
Source: ABARES estimates

New South Wales accounts for the highest number of farm-to-farm transactions at 39 per cent of total transactions. However, farm-to-farm transactions account for a relatively small percentage of total movements each year. South Australia is estimated to account for the overwhelming majority of Australia's live sheep and goat exports each year. South Australia exported approximately 2.2 million animals on average per year between 2007–08 and 2011–12, or 70 per cent of Australia's total. Victoria is estimated to be the second largest live sheep and goat

exporter, accounting for 15 per cent of total exports, followed by We
stern Australia with 9 per cent. Tasmania, the Northern Territory and the Australian Capital Territory have very small sheep and goat supply chains in comparison to other Australian jurisdictions.

National Livestock Identification System operations, summary by jurisdiction

The summaries below were provided by jurisdictions and are not based on an assessment by ABARES (see Appendix B for details).

New South Wales

Mob-based NLIS is based on visual tags, movement documentation and recording on the NLIS database. New South Wales is the only jurisdiction reporting a high level of traceability (above 90 per cent) being achieved with the current mob-based NLIS.

Compliance activities are undertaken at saleyards by Livestock Health and Pest Authority (LHPA) inspectors. Any tagging non-compliance is instructed to be corrected and there are later re-inspections to check compliance. The more intensive compliance work has occurred more frequently at sheep sales from May 2013.

Occasional audits at saleyards are done in conjunction with Department of Primary Industries (NSW DPI) regulatory staff and rural crime inspectors, such as in Operation Shepherd in 2011. NSW DPI conducts quarterly desktop monitoring of NLIS compliance of every sheep saleyard and every sheep abattoir and sends each saleyard or abattoir a performance report. The reports on saleyard compliance are also sent to LHPA so that inspectors can follow up on poor performance.

Victoria

In audits of the operation of the NLIS (Sheep & Goats) in the supply chain, Victoria continues to find compliance issues, in particular those related to the accuracy of information in national vendor declarations (NVDs). Victoria has proposed changes to the NLIS business rules to increase the traceability of the mob-based system.

Victoria does not require recording of property-to-property movements because, as other states have found, it is extremely difficult and resource intensive to monitor and enforce producer compliance.

Victoria is already progressing electronic identification of sheep and goats. It has attractively priced EID tags, scanning infrastructure in abattoirs and a saleyard sector that is willing to implement an EID system for sheep and goats.

Queensland

The current operation of NLIS (Sheep & Goats) in Queensland still finds non–vendor bred lines of sheep and goats that have incomplete travel documents. These documents lack ‘other property identification codes’ (PICs), which is vital information for tracing. The percentage of non–vendor bred NVDs can be around 33 per cent at each sale, but Queensland is working on reducing this number. At the start inspectors would sometimes find 80 per cent of non–vendor bred NVDs without other PICs filled in.

Property-to-property movements are impossible for Queensland inspectors to monitor other than through roadside interceptions or leads from saleyard consigned lots and going back to properties to audit such movements on the NLIS database.

South Australia

NLIS (Sheep & Goats) commenced in South Australia in 2006 and operates entirely in accordance with nationally agreed business rules. The only variation from the business rules is the timeframe for database notification—reduced to two days from seven days for movements associated with shows, other livestock events and live export depots.

Primary Industries and Regions South Australia (PIRSA) actively undertakes compliance monitoring and enforcement at virtually all sheep sales. Systematic audits conducted at three saleyards during 2012 consistently showed tagging compliance at 99 per cent, and movement documentation compliance at 97 per cent overall and around 85 per cent for non–vendor bred consignments. Monitoring of property-to-property movements for mob-based database compliance began in July 2013, recognising that compliance with this aspect of the system is limited relative to other key sectors. A strong correlation still exists between ongoing participant/system performance and PIRSA's compliance efforts.

The main ongoing issues limiting performance of the current system relate to the completeness of movement documentation accompanying non–vendor bred sheep in particular, and incorrectly identified adult (pre-2006) sheep. To date virtually no saleyards are routinely using emergency tags, and none have adequate checking and verification procedures. Consequently, much non-compliance is escaping detection.

Western Australia

Sheep being consigned from their property of birth are required to be fitted with a year colour tag embossed with the brand or PIC registered to the owner of the property, or a radio frequency identification (RFID) tag registered to the property of consignment on the NLIS database before they leave that property.

Sheep being consigned from a property that is not their property of birth are required to be fitted with a pink post breeder tag or RFID tag. All movements of sheep are required to be recorded on the NLIS database as a mob-based movement unless an RFID is fitted, in which case there is an option to transfer those devices on the database instead of as a mob-based movement.

It is the responsibility of the receiver of animals to ensure that the database transfers are made; however, operators of saleyards, abattoirs and export depots are required to make the necessary transfers into and out of their premises. All movements of sheep are required to be accompanied by a valid waybill (or national vendor declaration/waybill). Because of the requirement for mandatory transaction tagging, only the PIC or brand of the property of consignment is required to be written on the waybill.

Tasmania

The Tasmanian sheep and goat industry is slightly different in nature compared with other states. The industry is characterised by relatively simple movements of animals, a high proportion of small- to micro-holdings and a high proportion of movements direct to slaughter; and interstate movements are generally one way—to Victoria.

NLIS (Sheep & Goats) in Tasmania is based on visual tags with paper mob-based movement documentation. Presently there is no requirement to upload sheep and goat information to the NLIS database, although some saleyards or processors may do so. This is a major point of difference with other states.

Adoption of a full mob-based system for sheep and goats in Tasmania has been delayed, primarily because of the uncertainty surrounding the final form of NLIS (Sheep & Goats). Three regional departmental officers attend between 85 per cent and 90 per cent of saleyard sales. Monitoring and auditing from an NLIS systems perspective is presently negligible. Improvements required to bring the present system in line with the basic NLIS mob-based system are:

- mandatory reporting to the NLIS database, including scanned vendor declarations and movement records
- ongoing extension and communications
- better compliance procedures, processes and guidelines
- implementation of processes and agreements with industries—for example, saleyards
- increased jurisdictional monitoring and auditing of producer, saleyard and processing compliance, with an emphasis on (a) monitoring and auditing of producers, saleyards and processors through the NLIS database and (b) an improved system to detect and respond to property-to-property non-compliance.

Northern Territory

The Northern Territory currently uses a mob-based movement recording system for sheep and goats. All sheep and goats are required to be identified with an approved NLIS transaction tag identifying the PIC before movement off a property. A completed Northern Territory waybill must accompany the livestock and the original document must be handed to the receiving property owner on delivery. All subsequent movements to properties require an additional transaction tag attached to the animal prior to movement, except that if sheep or goats are moving from a property to agistment, show or service then a further transaction tag is not required to be attached, providing the ownership does not change and the animals are returning to the origin property.

The Northern Territory has a small population of sheep and goats and no abattoir or saleyard for these species. The department monitors compliance at annual shows.

3 Statement of the problem

Meeting National Livestock Traceability Performance Standards

Traceability of sheep and goats is important in reducing the risk from a number of threats to industry, including:

- Biosecurity—outbreaks in Australia's population of sheep and goats of endemic or exotic diseases such as anthrax, blue tongue, ovine Johne's, foot-and-mouth, scrapie, screw-worm flies and sheep and goat pox. These can have devastating effects on not only the sheep and goat industry but also the cattle and pig industries. The rapid and reliable tracing of sheep and goats plays a significant part in emergency disease response. The faster the animals are traced the greater the chance of controlling the disease outbreak and so minimising its economic and social effects.

- Food safety—incidents such as detection of contaminants beyond acceptable standards and presence of pathogens in meat products can impose costs including trade restrictions, reduced consumption, product recalls, business disruption and increased costs of standard enforcement. Tracing of animals is an important aspect of minimising the trade effects of contamination and ensuring no recurrence of such events.

- Market access—traceability builds market reputation and confidence in Australia's sheep and goat products, thereby enabling maintenance or expansion of market access. The European Union could impose restriction on imports of Australian sheep and goat meat based on Australia falling short of the EU's standard of animal identification or on lack of confidence in the Australian system. An audit conducted by the European Commission in 2008, found that traceability levels for sheep and goats in Australia at that time were well below that required by the EU from countries exporting sheep meat.

Traceability may also improve:

- Animal welfare—animal identification and traceability are likely to be key elements in any future approach to providing assurance on animal welfare outcomes for Australian livestock exports (Matthews 2011) and can assist prosecution in animal welfare cases.

- Farm productivity—individual tagging of sheep and goats can enable full monitoring of individual animals and realise productivity benefits from use of data on live weights, wool production and lambing.

Based on current information, there is uncertainty about the adequacy of the current NLIS for sheep and goats in meeting the traceability requirements of the National Livestock Traceability Performance Standards (NLTPS). Furthermore, implementation of the current system and its performance varies by state and territory.

In September 2009 the 17th Primary Industries Standing Committee (PISC) meeting reported that the NLIS for sheep and goats did not enable tracing of animals to meet standards required in the NLTPS (SCoPI 2012). Results from a number of studies have demonstrated the inadequacy of the current system:

> In August 2007 exercise Sheepcatcher was undertaken nationally across all jurisdictions except the Northern Territory and the ACT to evaluate the performance of existing mob-based NLIS for sheep and goats against the NLTPS. Results showed that the NLIS did not enable complete tracing

of animals (or their cohorts) to the standard the NLTPS required. The main defects were in the ability to trace cohorts' whole-of-life and the considerable number of staff needed (mainly from saleyards, abattoirs and stock agents) to locate and interpret the paperwork collected in the NLIS to facilitate tracing of sheep at that time (AHA 2007b).

In April 2012 following improvements to the mob-based system, which included establishing an NLIS database, the New South Wales Department of Primary Industries conducted exercise Tuckerbox. The aim of the exercise was to test the mob-based tracing system for sheep and goats and compare it to the electronic identification (EID) NLIS for cattle. It was concluded that the mob-based NLIS for sheep and goats could be used to quickly trace the movements of mobs of sheep within and out of New South Wales (NSW DPI 2012a). However, the exercise did not assess the whole-of-life traceability requirements of the NLTPS.

It was also generally agreed by stakeholders, through the public consultation process, that the current NLIS system is inadequate (see Chapter 8 for more information).

Problems with the current system

The problems with the current system are in two broad categories:

- The potential for human error/non-compliance with the current business rules
- Shortcomings of the business rules and their application across jurisdictions.

The potential for human error/non-compliance

The importance of accurate movement documentation

In a response scenario, governments and industry rely on the NLIS database to quickly and efficiently locate thousands of potentially infected sheep and goats. The database includes information provided by vendors and buyers on NVDs. For the current mob-based system to work reliably, vendors need to provide consignees (saleyards, abattoirs and agents) with an accurate mob-based movement record (such as an NVD or transported stock statement). Uploads of mob-based movement files supplied to the NLIS database must account for transfer of all sheep and goats.

In order to meet the NLTPS the NLIS database and accompanying paper records must provide enough information to accurately trace the journey of any sheep or goat in Australia from their property of birth to their final property of residence. If information in the NLIS database is inaccurate and/or incomplete it is of limited value for traceability purposes (Britt 2012). If there are errors on the NLIS database, such as recording an invalid PIC, then a mob-based movement has effectively not been recorded, and traceability will be compromised. In the event of an exotic disease or food safety emergency, Australia will struggle to respond quickly and effectively using a system that contains incomplete and/or inaccurate information.

Information gaps or inaccuracies in the NLIS database are more likely to hinder lifetime traceability than short-term traceability because of the larger number of mob-based movements involved. That is, to satisfy sections 3.1 and 3.2. of the NLTPS the animals of interest must be traced back to every residence during their lifetime (NLTPS section 3.1) and the current location of every animal that has ever come into contact with them (NLTPS section 3.2). As an animal is likely to have resided on more properties during its lifetime than in the past 30 days, lifetime traceability implicitly involves a large number of livestock movements. Each of these movements must be accurately recorded and uploaded to the database in order to achieve lifetime traceability.

Evidence of specific issues

The results of several studies have revealed a number of specific issues that lead to inaccurate and/or incomplete information of mob-based transfers. These issues are largely the result of human error or non-compliance. They include:

- missing or unreadable tags on sheep or goats
- failure to record additional PICs on NVDs for non–vendor bred mob-based movements
- difficulties with accurately reading and writing property identification codes (PICs) on NVDs (including transcription errors)
- failure to upload information to the NLIS database accurately and/or in a timely manner.

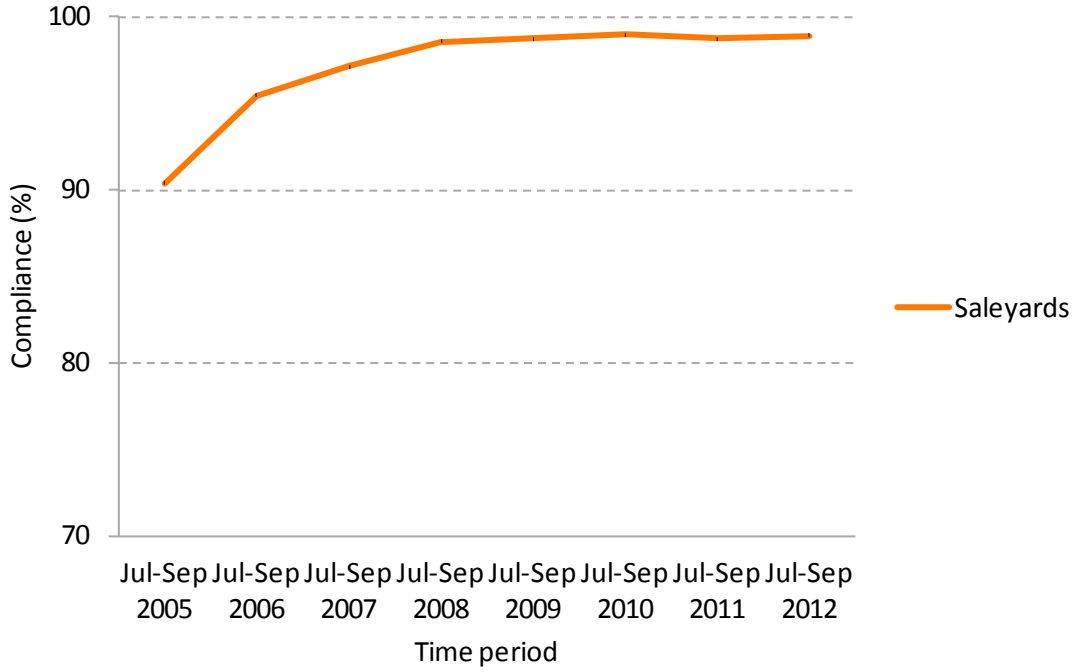
Exercise Sheepcatcher in 2007 showed that data were incorrectly transcribed or wrongly reported in 13 per cent of sampled records across Australia. Similarly, despite improvements to the system, problems with reliable and accurate transcription of PIC numbers persist in Victoria. A recent audit of Victorian sheep saleyards indicated that 60 per cent of NVDs for non–vendor bred consignments had one or more PICs with transcription errors (Britt 2013b). Transcription errors in other jurisdictions may differ from those in Victoria. The Livestock Saleyard Association of Victoria also claims it is not practical to conduct the checking needed and to correct errors likely to be commonly encountered in a busy sheep saleyard as this would create significant logistical delays on sale days (McDonald 2013, letter to Vic. DPI dated 25 February 2013).

In New South Wales, despite mandatory requirements to upload data to the NLIS database, results from Exercise Tuckerbox in 2012 still showed data gaps and delays in uploading livestock movement data (SCoPI 2012). Likewise Operation Shepherd, which the NSW DPI conducted across New South Wales in 2011, showed that 113 of 3396 NVDs (3.3 per cent) had incorrect or incomplete information. This was reduced to 2 per cent after the operation (Bell 2011).

A NSW DPI report (2012c) completed for fourth quarter 2012 provides recent compliance measures for the cattle and sheep and goat NLIS in New South Wales (Figures 2 and 3). Measures were estimated through a desktop audit of each database and are calculated as the per cent compliance of information stored in the database with NLIS requirements. A range of variables—data uploaded from NVD forms—are used to estimate compliance with the NLIS. For example, in the sheep and goat NLIS, such variables include valid and traceable 'to PIC' and 'from PIC', an upload of data on a NVD form within the required deadline, or an image upload. Compliance measures for the sheep and goat NLIS and the cattle NLIS could differ as the variables assessed would differ between the mob-based and the EID system. This report indicates that completeness of NVD and compliance with the NLIS remains an issue in New South Wales.

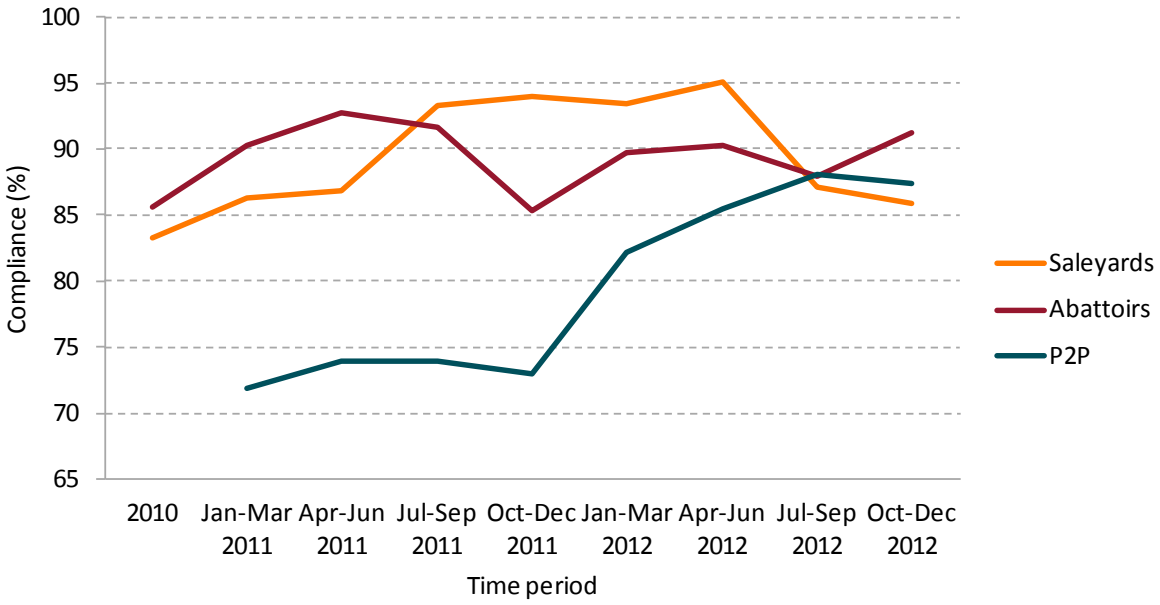
Data show that saleyard compliance with the cattle NLIS in New South Wales—where cattle have an individual electronic identification system—is high and stable at about 99 per cent (Figure 2). In contrast, Figure 3 shows that overall compliance for saleyards, abattoirs and agents trading sheep and goats is lower and more variable than compliance measures estimated for saleyards trading cattle. Compliance measures for saleyards trading sheep and goats varied between a low of 83 per cent in 2010 and a peak of 95 per cent in 2012 (NSW DPI 2012c).

Figure 2 Compliance measures for the cattle NLIS in New South Wales saleyards



Note: NSW DPI has provided lifetime traceability 'at and after saleyard' for cattle. Traceability information is omitted from this figure since compliance for cattle and for sheep and goats is being compared, not traceability.
Source: NSW DPI 2012b

Figure 3 Compliance measures for the sheep and goats NLIS in New South Wales



Note: P2P = property to property.
Source: NSW DPI 2012c

Additionally NSW DPI (2012c) estimates that the completeness of NVDs for sheep transactions at saleyards in New South Wales was about 90.8 per cent, with about 69 per cent of mob information uploaded within two days and 97.5 per cent within seven days. In contrast, for all cattle transactions at saleyards 99.4 per cent of NVDs were valid, 95.1 per cent of NVDs were uploaded to the database within two days and 99.7 were uploaded within seven days.

More recent information provided by NSW DPI indicates that there has been an improvement in compliance in saleyards and abattoirs but a decrease in compliance for property-to-property transfers since 2012. Compliance for sheep is estimated to be in the range of 85 and 95 per cent across the supply chain.

Recent Aus-Meat audits of saleyards found that in Carcoar (New South Wales) saleyards 27 per cent of NVDs were inaccurate and in Wagga Wagga (New South Wales) 16 NVDs out of an unspecified total were identified as incomplete (Aus-Meat 2012a, c). In Dublin (South Australia) 45 per cent of NVDs were identified as incomplete (Aus-Meat 2012b). Of the incomplete NVDs in Wagga Wagga, 68 per cent (11 out of 16) related to livestock being declared as non–vendor bred with no additional PICs recorded, representing 2640 head of sheep (Aus-Meat 2012c). In Dublin 14 per cent of the sample did not correctly list additional PICs (Aus-Meat 2012b).

Shortcomings of the current business rules and their application across jurisdictions

The NLIS for sheep and goats is directed by the NLIS (Sheep & Goats) National Business Rules (NLIS 2012a), which outline stakeholder roles and responsibilities and identification, documentation and verification requirements. These rules form the basis for introducing harmonised legislation in each jurisdiction and adopting codes of best practice by industry. Various stock Acts and supporting regulations support the requirements in each jurisdiction.

Operation of the system and provision of resources in jurisdictions differ despite nationally agreed business rules and implementation timelines (Appendix B). Differences in implementing the NLIS for sheep and goats across jurisdictions are likely to result in differences in traceability through the supply chain. This may create difficulties in effectively tracing animals in the event of a biosecurity or food safety incident.

While state and territory legislation forms the regulatory framework for the NLIS, levels of application of existing visual identification arrangements across jurisdictions vary (PIMC Working Group report 2012). In New South Wales, South Australia and Western Australia, movement of sheep or goats between properties must be recorded on the NLIS database. In Victoria NLIS recording of property-to-property movements of sheep and goats is not mandatory and in Queensland it is voluntary with an industry expectation to record (MLA 2012b). Failure to include property-to-property movements in certain jurisdictions can result in gaps in the NLIS database and compromise traceability for Australia as a whole.

Requirements for identification also differ between jurisdictions. For example, in Western Australia tags are printed with the property brand (equivalent to a PIC), and post-breeder brand tags for each subsequent property must be added to the animal's ear. PICs other than the consignor's PIC and the destination PIC are not required to be listed on Western Australian NVD forms. In other jurisdictions the option for sheep not born on the property is to use a post-breeder tag (essentially as a transaction tag). If a post-breeder tag is not used when trading sheep the vendor must list all PICs on the NVD (NSW DPI n.d.). Failure to include all PICs on an NVD form creates problems for traceforward (tracing an animal from its property of birth to its current location), compromising overall traceability.

The case for government intervention

The proposed form of government action is adoption by jurisdictions of an improved NLIS for sheep and goats with the intent to legislate this system in each jurisdiction. The improved

national system would be applied uniformly across jurisdictions and address the issues with human error, non-compliance and shortcomings in the business rules outlined above.

If improvements to the NLIS for sheep and goats were to be adopted and implemented industry wide, state and territory governments would need to take on a legislative role as it is unlikely that such a system could be implemented without a requirement for mandatory compliance. In economic terms, this would represent a market failure. Through tracing, the NLIS for sheep and goats aims to reduce the risks associated with industry-specific public goods, including biosecurity, food safety and market access.

The goat and sheep industry would not to a sufficient extent voluntarily reduce the risks associated these public goods through improvements to the NLIS because of two economic characteristics of a public good: non-rivalry and non-excludability. A public good is non-rivalrous when consumption of the good does not diminish the quantity available for consumption by others. A public good is non-excludable when it is impossible, or very costly, to exclude any individual or firm from consuming the good once it is supplied. In this case, the public goods are biosecurity, food safety and potential market access benefits.

These economic characteristics mean individual producers, or any agents in the supply chain, can 'ride for free' on others providing the service, so the industry is unlikely to undertake an optimal level of investment in providing the good (that is, investment in livestock tracing NLIS). Consequently, resources are not allocated optimally.

A further characteristic of these public goods (biosecurity, food safety and market access) is that many of the benefits from these goods can be directly and fully apportioned to a specific industry or industries. For example, the sheep and goat industry directly benefits from the reduced biosecurity and food safety incidents and improved market access that result from a well-functioning NLIS. It is also likely that there would be some wider benefits to other production industries from a well functioning NLIS for sheep and goats, and it would be desirable over time for all animal industries to adopt a similar approach.

On its own, the existence of a market failure does not justify government intervention since intervention is not without cost. The cost of any intervention needs to be weighed against the potential public (as opposed to private) benefits in deciding whether intervention is justified. Also, the question of who bears the cost of that intervention is relevant and relates to the private benefit from intervention versus the public benefit. Some of the benefits considered in this report, such as biosecurity, may have both private and public benefits.

4 Objectives

The objectives of government action are to ensure that risk to the sheep, goat and wider livestock industries can be managed for:

- biosecurity (pest and disease control)
- food safety
- market access.

PIMC introduced the NLIS for sheep and goats in 2006 to manage these types of risks and meet the NLTPS (PIMC 2006)—although animal welfare and productivity have since been improved as well.

The options for changes to existing policies seek to provide improved risk management within a more efficient framework. The system needs to be efficient in terms of the timeliness of decisions and actions, the resources required and the regulatory burden placed on industries, while seeking to provide whole-of-life traceability for all sheep and goats in accordance with the NLTPS.

5 Options for tracing sheep and goat movements

This Decision RIS assesses three options to improve the traceability of animals through the supply chain, relative to the baseline. They are:

- Option 1: Enhanced mob-based system—enhancement of the existing mob-based system (the baseline) through changes in the current business rules; assuming full implementation from 2014.
- Option 2: Electronic identification (EID) system—EID of animals, with exemptions for sheep and goats sold directly from property of birth to abattoirs or export depots; assuming the option is phased in from 2014 and fully implemented by 2018.
- Option 3: EID system without exemptions; assuming the option is phased in from 2014 and fully implemented by 2018.

Changing the implementation date is not expected to change the relative cost of each option significantly.

Based on discussion with jurisdictions and feedback received during the consultation phase, it is assumed that the current NLIS system achieves a 90 per cent level of short-term traceability and all three of the proposed options are capable of achieving 98 per cent short-term traceability. Further details around the basis of these assumptions and how they are used to estimate the impacts of increased traceability are in Chapter 6.

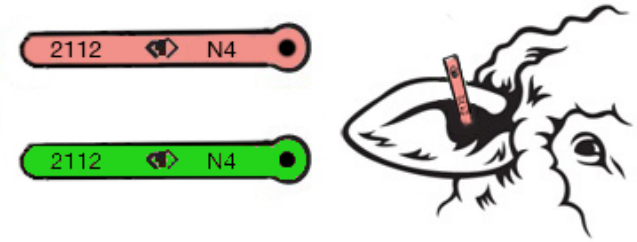
Baseline

For this Decision RIS the baseline is the current mob-based system, which includes all improvements and modifications to the NLIS for sheep and goats since it was implemented in January 2006 (NLIS 2012a).

The baseline system for sheep and goats consists of visual tags and mandatory movement records (typically paper-based forms subsequently entered into the NLIS database) to track the mob-based movements of livestock. Recent compliance levels following improvements to the National Business Rules completed in June 2012 are also accounted for in the baseline with the voluntary use of EID systems. As such, information stored in the database enables tracing at mob level.

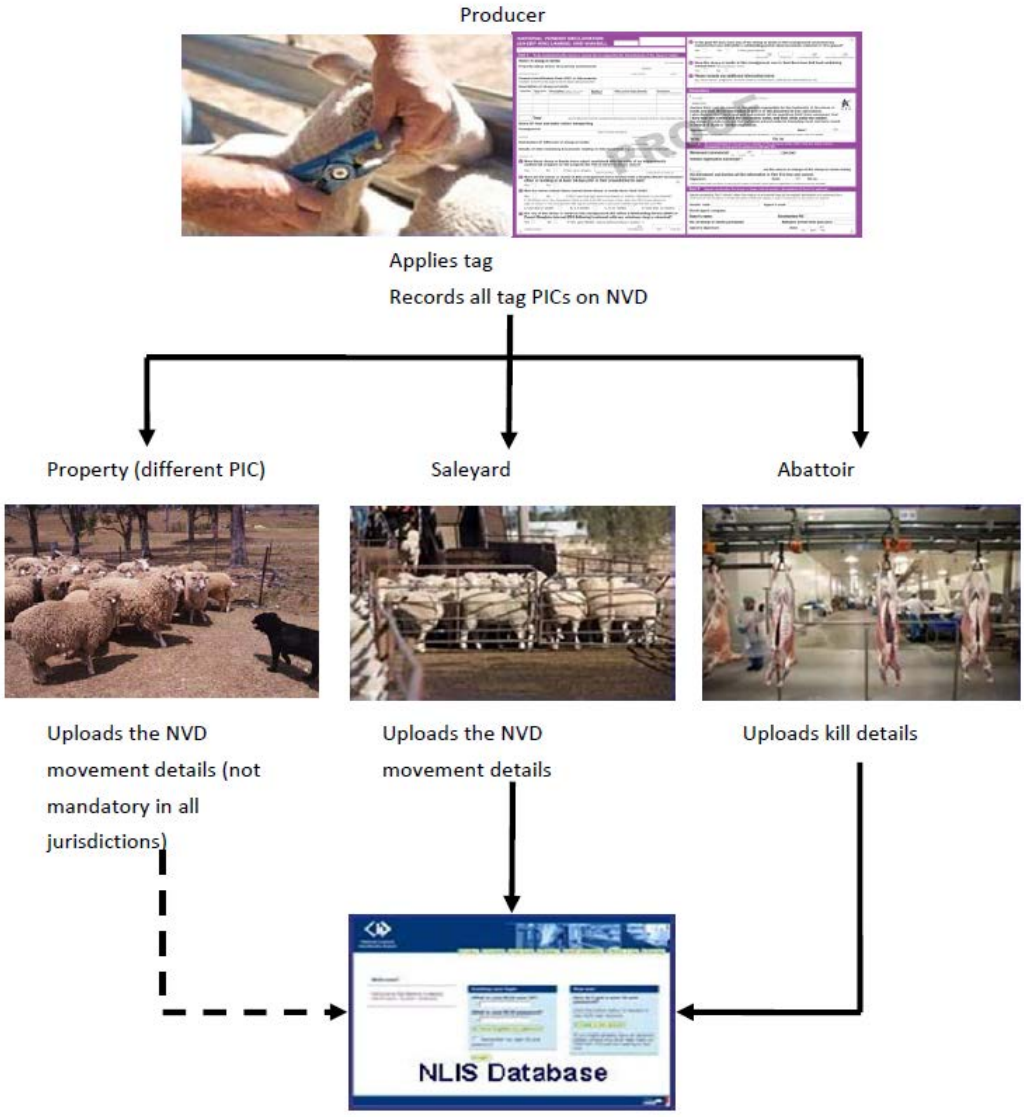
In the baseline the National Business Rules require that all sheep and goats sold (unless exempt) must (1) have an approved NLIS ear tag (Figure 4), (2) be accompanied by a completed movement record and (3) have their movement recorded on the NLIS database (for which there are no exemptions). Together, it is these three pieces of information that facilitate tracing of sheep and goats at the mob-based level through the supply chain. Potential movement records include a national vendor declaration (NVD) and waybill (Figure 5) or a transport stock statement. The NVD is preferred as it collects all information for tracing livestock (MLA 2012b).

Figure 4 Visual NLIS tags: birth year colour-coded breeder tag and pink post-breeder tag



Source: Vic. DPI (2010b)

Figure 5 Use of the national vendor declaration/waybill in the supply chain



Source: Adapted from MLA 2013a, b

Two types of visual tags may be used on sheep and goats in this system: breeder tags and post-breeder tags (Figure 4). Breeder tags, attached to livestock at their property of birth, display the PIC and are colour coded for the animal's year of birth. Post-breeder tags are pink and are used on livestock that have lost their breeder tags (for example, when leaving a property that is not their place of birth) and for stock born in transit. Breeder and post-breeder tags should never be

removed and cannot be re-used. Livestock from Western Australia carry both breeder and post-breeder tags.

Animals exempt from tagging include:

- dairy goats transferred property to property only
- rangeland (feral) goats sent directly to an abattoir for slaughter through a depot (but when retained for farming in a depot they must be tagged)
- slink lambs sent to the knackery
- sheep and goats moved to properties with the same PIC (NLIS 2012a).

These tagging exemptions apply for all options outlined in this RIS.

All exemptions are detailed and defined by the NLIS (Sheep & Goats) National Business Rules. An exemption for property-to-property movements of dairy goats is an interim measure that is expected to be replaced with a more permanent form of identification (NLIS 2012a). While feral goats sent directly to an abattoir through a depot do not require a tag, depots must update movement records on the NLIS database.

Movement records must be completed when livestock are sold and moved through the supply chain. An NVD and waybill is used to record:

- the PIC of the property from which livestock are sold
- the PIC number on breeder tags if different from the seller's PIC
- the PIC of the property, saleyard or abattoir to which the livestock have been sold
- the number of animals sold
- the NVD serial number
- the date of transfer
- whether the animals were vendor bred
- some animal health information
- export requirements.

For all transactions it is the vendor's responsibility to complete the movement record which is provided to the consignee to lodge information in the NLIS database. In property-to-property transactions the consignee may be a selling agent or the property manager and it is their responsibility to complete and lodge information on the NLIS database. In sales to abattoirs and saleyards it is the responsibility of these facilities to lodge the NVD forms (MLA 2012b; PIMC Working Group report 2012). When live exports are sold to a depot it is the responsibility of the depot operator to update the NLIS database, unless the livestock were purchased from a saleyard (NLIS 2012a).

Operation at the state and territory level

It is assumed under this baseline that all jurisdictions have identical levels of traceability. However, as discussed in Chapter 2 and Appendix B, the implementation of the NLIS varies between jurisdictions and consequently so does the level of traceability. The implications of changing the baseline level of traceability are considered in the analysis.

New South Wales reported high compliance and traceability in the current system. In New South Wales the Livestock Health and Pest Authority undertakes compliance activities at saleyards, where half of sales occur. It conducts intensive compliance inspections on sheep sales where pens with non–vendor bred or mixed lines or untagged sheep are targeted. It also conducts audits at saleyards in conjunction with rural crime inspectors. New South Wales believes that compliance and tagging rates could improve to 98 or 99 per cent. Bell et al. (2013) reported that the NLIS for sheep and goats based on mobs is capable of tracing FMD and meeting national tracing standards using the NLIS database.

Unlike New South Wales, Victoria and Queensland have identified problems with the current system, particularly relating to the accuracy of the NVDs which affect the traceability of sheep and goats. Victoria advised that for the current NLIS to achieve at least 98 per cent traceability for some elements of the NLTPS considerable checking and verification of the traceability of sheep and goats would be required at each point of the supply chain. Improving the current NLIS in Victoria and other jurisdictions producing and marketing sheep and goats would reportedly require significant additional resources compared with New South Wales.

Option 1: Enhanced mob-based system

Enhancements to the mob-based NLIS system aim to improve traceability of sheep and goats through the supply chain. CIE (2010) recommended two improvements to the business rules: improvements in the accuracy and completion of movement documentation (such as NVD forms) and improvements in rules for verification and compliance with the NLIS system. The costs and benefits of these improvements are included in Option 1.

To maximise traceability several aspects of the NLIS for sheep and goats need to be monitored for compliance. These are:

- NVD forms must be completed accurately and with legible handwriting.
- Information on NVD forms should be entered in the NLIS database as it is given on the NVD form, within the set deadline. Human error during data upload will reduce traceability but cannot be eliminated.
- Formal deadlines are one to two days for saleyards, two days for abattoirs and seven days for properties and other sectors.
- If information/data in an NVD form is not uploaded to the database a copy of the completed form should be scanned into the NLIS database.
- Missing or non-readable tags need to be replaced with accredited tags, preferably by the seller to maintain traceability.
- Avoid slaughter of animals without tags (CIE 2010).

Where the baseline system produces traceability values that are less than 100 per cent there is room for improvement in traceability, but at a cost. Additionally it is understood that the enhancements would vary by jurisdiction because of the differences in how they operate their existing mob-based systems.

To improve traceability of the current mob-based NLIS (Sheep & Goats) system, modifications to the business rules and enhancements to the operating system are needed. Examples are the removal of transaction tagging for non-vendor bred sheep and goats and mandatory verification procedures by producers, saleyards, processors and exporters. A guide to what activities could be undertaken to improve verification and compliance in the current mob-based system is detailed in CIE (2010) and Appendix C.

A number of submissions received during the public consultation phase included recommendations on compliance activities that could be used to improve the current NLIS to meet the NLTPS. These are summarised in Chapter 8.

Option 2: Electronic identification with exemptions

In Option 2, sheep and goats transferred from their property of birth to abattoirs or exported live are exempt from wearing electronic identification (EID) tags but must have visual tags and be accompanied by movement documentation. Livestock EID tags are needed for all other transactions.

As the current NLIS system to trace sheep and goat movements uses visual tags and mandatory movement records—with voluntary use of EID tags—limited information is available on applying an EID system for these livestock movements. Background information on EID options for this RIS was sourced from recommendations provided by the PIMC Working Group report (2012) and the current NLIS for cattle.

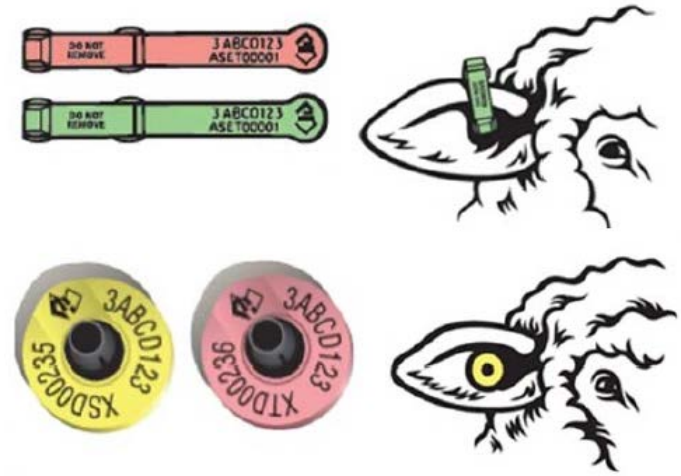
As for the baseline, in an EID system vendors would be required to apply tags to all sheep and goats and complete movement documents for all livestock when they are sold or transferred (MLA 2012a). However, the difference is that each tag would individually identify sheep and goats in the NLIS database.

Two types of accredited NLIS EID tags (Figure 6)—breeder tags and post-breeder tags—may be used for animals sold through the non-exempt pathways and born after the date of implementation for this option:

- EID breeder tags must be attached to livestock upon departure from their property of birth.
- EID post-breeder tags are applied in a similar manner to visual post-breeder tags (as described in the baseline above).
- Animals born before the implementation date or sold through an exempt pathway would display visual tags.

An accredited NLIS EID tag contains a microchip encoded by the manufacturer with a unique number, called the radio frequency identification (RFID) number. On purchase, this number is linked to the producer's PIC and this information is uploaded to the NLIS database along with the tag's NLIS number. The NLIS number is physically displayed on the EID tag (MLA 2012a) and can be read using electronic scanners or visually (Figure 7). The electronic tag RFID standard was introduced in December 2008 (NLIS 2012b).

Figure 6 Electronic NLIS tags: breeder tags (green year-of-birth tag and yellow button tag) and pink post-breeder tags



Source: Vic. DPI 2010c

Figure 7 Electronic scanners, handheld scanners and panel reader

Note: Panel reader is set up with scale indicator and three-way drafting system.
Source: Vic. DPI 2010a

When livestock are moved to a location with a different PIC their EID tag is scanned and the consignee (the buyer, for a property-to-property transfer, or the operator of a saleyard or abattoir) uploads the movement forms; records are then available for each animal in the NLIS database. By allocating an individual NLIS number to each tag (or animal), there is no need to collect information on the livestock's property of birth, as it is stored in the database under the NLIS identification number. While the EID system allows for a reduction in the quantity of information collected it is likely that other parts of the NLIS database would have to be monitored in order to maximise traceability.

Livestock would only have one EID tag attached during their life and tags would only be replaced if lost or faulty. Tags may also be removed during carcass processing (PIMC Working Group report 2012).

Use of EID tags in this option would require eventual phasing out of visual-based tags in pathways where electronic tags are not exempt (PIMC Working Group report 2012). In this study it is assumed that all sheep and goats born after the implementation date and sold through non-exemption pathways would have an EID tag.

Option 3: Electronic identification without exemptions

For Option 3, an EID system without exemptions, all sheep and goats sold from their property of birth would be required to have an accredited EID tag instead of the visual breeder tags used in the baseline. Unlike Option 2 this means sheep and goats transferred from their property of birth to abattoirs or exported live would be required to wear an EID tag. Implementation of this option would require eventual phasing out of all visual tags, which may be implemented by applying EID tags on animals born after the implementation date for this option (PIMC Working Group report 2012).

Guidelines for operating this option are described earlier in Option 2: Electronic identification with exemptions.

Other options arising from the consultation process

Mandatory transaction tagging, initially suggested by Victoria as another option, is not assessed in this Decision RIS. Transaction tagging is the application of a pink post-breeder ear tag whenever an animal is consigned from a property that is not their property of birth. Animals have one year-of-birth tag and a pink tag for each time they are sold. All tags must remain with the animal through its life (Department of Food and Agriculture Western Australia 2012). In Western Australia, transaction tagging is mandatory for the mob-based system. In New South Wales, Victoria, South Australia and Tasmania transaction tagging is not required.

Previous work by PricewaterhouseCoopers (PWC 2010) and the Centre for International Economics (CIE 2010) did not consider mandatory transaction tagging a viable option. While it improves traceback, use of transaction tags can compromise traceforward where the PICs of previous owners' properties are recorded on tags only and not in the database, making it difficult to trace animal cohorts sold by these properties. PWC (2010) estimated that an option combining mandatory transaction tagging with the enhanced mob-based system would result in higher cost of implementation and lower traceability than would be realised under an enhanced mob-based system alone.

During stakeholder consultation, the only other identification option suggested was microchipping, where microchips are implanted under the skin of the animal. Two submissions suggested that microchips should also be acceptable under the NLIS where producers choose to use them. These cannot be removed as ear tags can be and, where the animal has a very delicate ear, may be more comfortable for the animal. They are, however, considerably more expensive than EID ear tags and, as such, have not been costed in this Decision RIS.

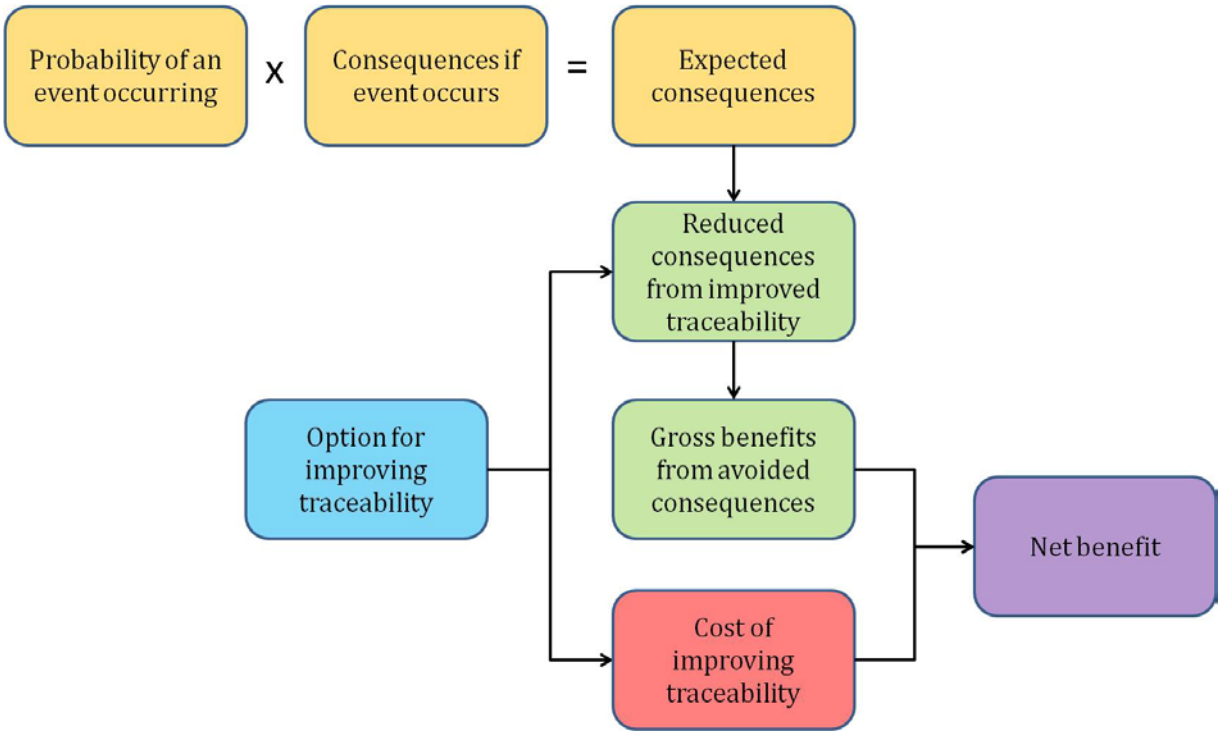
6 Framework of assessment

To evaluate alternative options for identifying and tracing sheep and goats, the likely costs and benefits associated with each option relative to the current system need to be estimated. Improved traceability relative to the baseline system could:

- reduce the consequence of a number of potential risks, including those associated with biosecurity, food safety and potential market access restrictions
- improve productivity and animal welfare.

Incremental benefits arise from the ability to rapidly trace animals and take timely action to eliminate or contain the risk or to gain from other benefits (as listed above). The total incremental benefits of an option is the sum of benefits arising from reductions in all potential risks, taking into account the likelihood of those risks occurring, and improvements to productivity, trade and animal welfare. The framework for estimating the benefits from improving the NLIS for sheep and goats is illustrated in Figure 8.

Figure 8 Framework for estimating the costs and benefits



Source: ABARES

Refining the assumptions

The quantitative results estimated in this Decision RIS are based on currently available information. Identifying a single 'standard' scenario is difficult given uncertainty around many of the costs and benefits of implementing improvements to the NLIS. There are uncertainties around appropriate values for key parameters relating to traceability, the costs of implementation, and benefits of implementation.

The major sources of uncertainty associated with **traceability** are:

- *The current national average level of traceability*. The current level of traceability determines the benefits of achieving a given target level of traceability and costs of implementing Option 1.

- *The feasible level of traceability provided by each option*. Limited evidence exists to demonstrate feasible traceability under any option. The assumed feasible level of traceability determines the benefits of implementing each option, and the costs of implementing Option 1.

The major sources of uncertainty associated with the **costs** of implementation are:

- *EID tag prices.* Tag costs are a significant portion of the costs of Options 2 and 3 and quoted retail prices vary between jurisdictions.

- *Labour and infrastructure costs.* Implementation costs of all options are based on previous estimates presented in CIE (2010), PWC (2010), and the PIMC Working Group (2012). Estimates vary across studies and the precise activities needed to achieve a given level of traceability under Option 1 are uncertain.

The major sources of uncertainty associated with the **benefits** of implementation are:

- *The benefits directly attributable to an increase in traceability*. The benefits from an increase in traceability depend on the relationship between changes in traceability and the reduced costs of a disease outbreak. This relationship is uncertain.

- *The size of likely consequences*. The size of potential benefits would also depend on the magnitude of the total cost (or effect) of all pest and disease, food safety, animal welfare and any other effects that an improvement in traceability is thought to reduce. No reliable estimate of total expected cost exists that could be attributed to all these threats.

Feedback received during the public consultation process (see Chapter 8) could not resolve the uncertainty around values for these factors. For this reason, a range of estimates reflecting the plausible range of values for these factors is presented in this report.

The analysis in this Decision RIS is divided into two parts. The first part, the 'standard' analysis, estimates the costs, benefits and net benefits of each option under a standard set of assumptions. The standard assumptions incorporate variation in two key parameters:

- EID tag prices

- effect of increased traceability on FMD impacts

The second part of the analysis, the sensitivity analysis, explores the implications of changing the remaining key assumptions:

- the feasible level of traceability under Option 1

- the current level of traceability

- labour costs under Option 1

- infrastructure and labour costs under options 2 and 3

- impacts of an FMD outbreak

- productivity benefits from the use of EID.

In addition to considering different values for these parameters, the sensitivity analysis presents estimates of the costs of implementation by jurisdiction and examines the implications of changing labour and technology costs over time.

Traceability

Traceability, as used here, refers to the proportion of the animal population that could be successfully traced within a specified period. Required periods of time denoting successful tracing are given in the NLTPS (Appendix A), which comprises various elements each with specific traceability requirements. A single traceability parameter is obtained by averaging traceability levels realised across the individual standards applicable to sheep and goats.

In analysing traceability in sheep and goats under different systems of identification, previous studies (CIE 2010; PWC 2010) used results obtained from Exercise Sheepcatcher (AHA 2007b) as an initial reference for assumptions and projections made to infer likely levels of traceability that could be achieved under different options, and to construct a baseline against which the options could be compared. Each option was assumed to achieve a different level of traceability, all of which were higher than the assumed baseline.

Current traceability level

No clear undisputed evidence of the average level of traceability across all the standards applicable to sheep and goats currently exists. Based on discussions with relevant state and territory agencies and submissions received in response to the Consultation RIS, this Decision RIS assumes that the average traceability of the current system is 90 per cent, noting that some jurisdictions may be above and others below this figure. Some submissions received during the public consultation phase suggested that the average level of traceability might be lower than this.

The implications of changing the assumed level of current traceability are assessed in the sensitivity analysis, in Chapter 7, by considering current levels of short-term traceability of 85 and 95 per cent. Assuming a lower (higher) level of current traceability increases (decreases) the estimated biosecurity benefits of achieving a short-term traceability of 98 per cent and increases (decreases) the costs of implementing Option 1.

Target traceability levels

Two approaches can be used to evaluate the costs and benefits of alternative options.

- The first approach is to identify the maximum level of traceability that could be achieved with each option and then evaluate the costs of implementing that option and the benefits associated with that level of traceability. While it is possible that the level of traceability that could be achieved under each option may differ, a problem with this approach is that it implies that lower levels of traceability for some options are considered acceptable under the NLTPS.

- The second approach is to assume a given level of traceability needs to be attained (such as 98 per cent) and then evaluate the costs of achieving that level of traceability for each option. This approach is appropriate when it is technologically feasible to achieve the assumed level of traceability for each option.

Following discussions with jurisdictions and feedback provided through the consultation process, this Decision RIS uses the second approach in the standard analysis. In doing so, it assumes that there are no technological impediments to any option achieving a 98 per cent level of short-term traceability (standards 1.1 and 1.2 of the NLTPS).

When the level of traceability is assumed to be the same for each option, the biosecurity, food safety and market access benefits are expected to be similar and the analysis becomes largely one of investigating the cost-effectiveness of each. However, the benefits are still estimated to ensure that it is worthwhile proceeding with any option. This approach is more consistent with the NLTPS, which implies a given (high) level of traceability.

Stakeholder feedback received during the public consultation phase expressed general support for assuming a feasible level of short-term traceability of 98 per cent across all three options. It was noted that estimating the benefits of improved traceability is inherently complex, with many of the potential impacts (such as animal welfare and reduced impacts of FMD) being difficult to quantify and value. As such, a cost-effectiveness analysis was considered by most respondents to be appropriate.

No information on assessing the costs or benefits of lifetime traceability (standards 3.1 and 3.2 of the NLTPS) was provided during the consultation phase. As such, the costs and benefits of achieving a 95 per cent level of lifetime traceability have not been considered.

Feasible level of traceability under an enhanced mob-based system

Some stakeholders suggested that some or none of the options could reach the 98 per cent target. For example, Victoria's Department of Environment and Primary Industries have expressed concerns that a short-run traceability target of 98 per cent cannot be achieved under an enhanced mob-based system—citing non-compliance, human error and practical issues around verification activities in saleyards as major impediments. In contrast, the New South Wales Department of Primary Industries has submitted evidence of high compliance rates under the current mob-based system in New South Wales saleyards—suggesting that a short-run traceability target of 98 per cent could be achieved with improvements to the current system.

However, it has been noted that measurements of current compliance and traceability may provide little indication of the level that could potentially be achieved as many states have not fully committed to a mob-based system (see Chapter 8 for stakeholder feedback on Issue 1).

To understand the implications of Option 1 failing to achieve a short-run traceability target of 98 per cent, this Decision RIS considers a lower achieved level of traceability of 95 per cent as part of the sensitivity analysis. A lower level of feasible traceability under Option 1 reduces the estimated benefits of improved traceability and assumed costs of implementation.

Because of a lack of information on the cost or benefits of lifetime traceability under each option, it is uncertain what these additional costs might be. For this reason, the estimated costs of implementing Option 1 under the standard assumptions (Chapter 7) only include the costs of meeting the target short-run levels of traceability.

Feasible level of traceability under an EID system

Using the performance of the current electronic NLIS for cattle as an indicator of the feasible level of traceability under an EID system for sheep and goats, 98 per cent short-term traceability and 95 per cent lifetime traceability could potentially be achieved by options 2 and 3. Traceability for the current electronic NLIS-C (NLIS for cattle) is estimated at 97 per cent in the short term and is smaller for lifetime traceability (F Dixon [Department of Agriculture and Food

Western Australia] pers. comm., 4 June 2013). However, results from Exercise Cowcatcher II, an auditing exercise involving the tracing of 300 tags across multiple jurisdictions in 2007, suggest that information recorded on the NLIS-C database from scanning EID tags can achieve extremely high levels of both short-term and lifetime traceability (Table 2). While these results imply that the timeframes specified in the NLTPS were not met, CIE (2010) has noted that refinements made to the NLIS-C system since 2007 mean that these timeframes are likely to be met from now on.

Table 2 Results from Exercise Cowcatcher II

Standard	No. of tags to be traced	Proportion traced within 24 hours	Proportion traced within 48 hours
1.1	300	96.7	100
1.2	300	90	100
2.1	300	–	98.7
2.2	30	–	96.6
2.3	30	–	96.6

Note: Standards 1.1 and 1.2 have a 24-hour deadline. Standards 2.1 and 2.3 for cattle are equivalent to standards 3.1 and 3.2 for sheep and goats but have a deadline of only 48 hours as opposed to 14 days and 21 days in the case of sheep and goats.
Source: AHA 2007a

Based on this evidence it is expected that options 2 and 3 presented in this RIS will meet both the 98 per cent short-term and 95 per cent lifetime traceability standards set out in the NLTPS. That is, the implementation of options 2 and 3 are sufficient to achieve both the short-term and lifetime target levels of traceability. Associated costs for implementing options 2 and 3 are presented in Chapter 7.

Table 3 summarises the levels of traceability for each option that are assumed in this report.

Table 3 Assumed levels of traceability

Option	Assumed short-term traceability (%)	Assumed lifetime traceability[a] (%)
Baseline	90	90
Enhanced mob-based system	98	–
EID with exemptions	98	95
EID without exemptions	98	95

Note:
a There is sufficient indication that lifetime traceability levels of 95 per cent or higher may be achieved using EID. However, the level of lifetime traceability achievable under an enhanced mob-based system is uncertain. The benefits of increasing lifetime traceability are not considered in the estimated impacts in Chapter 7.

Costs of implementation

In estimating the costs of the different options, ABARES has drawn on data provided in recent work by the PIMC Working Group on NLIS (Sheep & Goats), the CIE (2010) report and the PWC (2010) report and on information and data from various state departments of agriculture and ABARES survey data. The main cost components in the mob-based and electronic systems are described here.

Option 1: Enhanced mob-based system

As this option aims to achieve high compliance with the existing system, cost estimates are made for all additional activities associated with meeting full compliance, and are based on the costs of verification and auditing activities required to increase accuracy of information on animal movements within the system. As such, the estimates cover only the annual operational costs of labour.

Cost estimates for Option 1 are drawn from CIE (2010). Specifically the costs of implementation are calculated using (1) the per-sheep costs of enforcement, verification and compliance activities derived from CIE (2010), and (2) ABARES estimates of the number of sheep and goats moving through the supply chain (see Chapter 2).

Of the two reports estimating the costs of an enhanced mob-based system (CIE 2010 and PWC 2010), CIE (2010) estimates were preferred by ABARES. Specifically, CIE (2010) assessed the costs of increasing short-term traceability from 88 per cent to 98 per cent while PWC (2010) estimated the costs of increasing traceability from 57 to 80 per cent. Higher labour costs for Option 1 are considered in the sensitivity analysis by doubling the per-sheep costs drawn from CIE (2010). These higher per-sheep labour cost estimates encompass estimates by PWC (2010) and are to be viewed as extreme.

Table D2 in Appendix D outlines the key assumptions around labour costs under Option 1. The specific activities associated with these costs are derived from CIE (2010) and presented in Table C1 in Appendix C.

During the consultation phase Britt (2013a) provided a detailed description of proposed mandatory procedures for verification and compliance activities to increase the traceability performance of the mob-based system of sheep and goat identification to a level that would meet the NLTPS requirements (Table C2 in Appendix C).The verification procedures proposed by Britt (2013a) were more extensive than those assumed by CIE (2010). The additional costs associated with implementing Victoria's proposed procedures have not been formally costed in this Decision RIS but are accounted for in the sensitivity analysis by doubling the assumed labour costs drawn from CIE (2010).

Options 2 and 3: Electronic systems

The EID systems for sheep and goats would involve two significant types of costs: (1) capital or equipment costs, and (2) ongoing costs. Capital or equipment costs include initial investment in equipment at abattoirs, saleyards, export premises and a small proportion of farms. Only 20 per cent of Australia's sheep producers are estimated to require electronic tag scanning equipment (PIMC Working Group report 2012). Ongoing costs include the annual costs incurred by producers in purchasing EID tags and labour costs along the supply chain.

Labour costs for options 2 and 3 are drawn from PWC (2010). These costs were comparable with the range of estimated costs presented in the PIMC Working Group report (2012).

Estimates of the capital cost for industry are based on low-end estimates presented in the PIMC Working Group report (2012). The estimates include infrastructure costs for abattoirs, live export premises, saleyards and a small proportion of farms in Australia. The capital cost for farms has taken into account the estimate of the PIMC Working Group (2012) that 80 per cent of the sheep flock is 'closed'. Therefore, only 20 per cent of Australia's sheep producers are predicted to require EID tag scanning equipment. A conservative capital cost has been estimated as a result of the assumption that many sections of the supply chain may have existing

equipment. However, the analysis in Chapter 7 explores the implications of using the high-end estimates of infrastructure costs presented in the PIMC Working Group report (2012).

The largest ongoing cost for options 2 and 3 is the cost of electronically tagging all animals moving through the supply chain. These estimates have been based on a range of electronic tag costs. It is anticipated that tag recycling may reduce the cost of tags following introduction of an EID system. The current cost estimates have not accounted for tag recycling.

For the Consultation RIS three alternative prices for electronic tags were considered: $0.80, $0.90 and $1.30. These prices were agreed by PISC representatives in anticipation that EID tag prices may fall in the future if large quantities are produced. Since then, new information has been provided (NSW DPI submission) suggesting that that current EID tag prices are as high as $1.65 in some parts of Australia (See Issue 12 in Chapter 8). In response to this new information, this Decision RIS includes a fourth possible EID tag price equal to $1.60. These four prices cover the range of current EID tag prices across Australia and potential changes in future EID tag prices expected by jurisdictions.

In terms of labour costs, the PIMC Working Group (2012) identified activities that would no longer be necessary with the EID system.

- Vendors would no longer need to visually copy PIC numbers from breeder tags onto NVD forms.
- Stock agents, saleyards and processors would no longer have to transcribe breeder PICs from NVDs to the movement record.
- Transaction tagging, practised in Western Australia, would no longer be needed.

However, implementation of an EID system for sheep and goats would result in a range of additional verification and compliance measures. For example, additional costs may be incurred to detect tags scanning incorrectly and to replace missing, lost and non-readable tags. Therefore, on the whole it is anticipated that the cost associated with verification activities would increase marginally from the baseline.

Increases in the cost of verification are based on per-sheep labour cost estimates presented by PWC (2010). These estimates are conservative relative to the CIE report (2010), which assumed that there would be no additional labour costs associated with EID over the current mob-based system, and comparable to the range of estimates presented in the PIMC Working Group report (2012). Feedback received during the public consultation phase suggested that labour costs for options 2 and 3 could be much higher than those assumed by PWC (2010) (see Issues 5 and 12 in Chapter 8). The analysis in Chapter 7 therefore explores the implications of doubling the per-sheep labour costs for options 2 and 3 presented in PWC (2010).

Table D3 in Appendix D outlines the key cost assumptions used in the analysis of options 2 and 3.

Benefits of implementation

Benefits of improving the NLIS would mainly take the form of savings attained by reducing the potential consequences or costs of pest and disease outbreaks. However, there may also be cost savings from mitigating food safety / product integrity issues and market access restrictions. Improvements to farm productivity and animal welfare are also potential benefits from improved traceability and animal identification.

Table 4 summarises the benefits considered and how they are estimated in this Decision RIS. The remainder of this section describes in some detail the potential benefits and how they have been estimated.

Table 4 Estimation methodologies for benefits from improved traceability in this Decision RIS

Benefit	Estimation methodology
Biosecurity	Reducing the risk of animal diseases is the primary benefit of improved traceability. The expected impacts of an FMD outbreak are estimated assuming an 8% improvement in short-term traceability under the standard assumptions. Different degrees of improvement are considered in the sensitivity analysis. A range of potential sensitivities of impact reduction to improvements in traceability are considered.
Productivity	Productivity benefits are considered in the sensitivity analysis only. Productivity only improves under EID options. Estimates are based on PWC (2010) estimates for Victoria which were extended to all producers in all jurisdictions.
Animal welfare	Uncertainty around the relative animal welfare implications of the three options is unresolved and are not estimated.
Food safety	Stakeholders agree that the current NLIS has been adequate and that food safety incidents relating to sheep and goats are uncommon. As such, the benefits from improving traceability are likely to be minimal and are not estimated.
Market access	The probability of the EU imposing restrictions is unlikely and profits from exports to the EU are not a significant driver of industry profitability. Therefore, the costs of market access restrictions are not estimated.

Biosecurity benefits

Improvements in the NLIS for sheep and goats are expected to generate benefits through management of endemic diseases, such as anthrax, blue tongue and ovine Johne's, and exotic diseases such as FMD, scrapie, screw-worm flies and sheep and goat pox. Therefore, improvements in the NLIS for sheep and goats would generate savings through better management of a range of diseases. To estimate these savings the expected impact of disease must be estimated and the reduction in this cost from improved traceability calculated.

Estimates of costs of sheep and goat diseases

Outbreaks in Australia of endemic diseases in sheep and goats can have devastating effects on industry and be costly to contain. For example, it is estimated that in Australia ovine Johne's disease—a wasting disease that affects sheep—costs $4.4 million annually through lost productivity and additional on-farm costs (Sackett et al. 2006). Periodic outbreaks of anthrax in Australia affecting sheep and cattle have resulted in industry losses from control costs and market access restrictions ranging from $1 million to $15 million (PWC 2010). Similarly it is estimated that if new strains of blue tongue emerged in Australia causing disease and mortality as seen overseas, vaccination would cost about $1 per sheep, with additional costs from reduced production and increased disease control costs (PWC 2010). Some incursions could affect industries beyond the sheep and goat industry. For example, exotic diseases like FMD—which affects all cloven-hoofed animals—could cost Australia up to $52 billion (in 2012–13 prices; ABARES 2013) over 10 years in the event of an outbreak.

Estimating the biosecurity benefits of improved traceability

Ideally, calculating the biosecurity benefits of improved traceability would include the benefits of reduced impacts of all diseases affecting sheep and goats. However, for simplicity and a lack of necessary data, the analysis has considered only FMD. FMD represents potentially the most

significant biosecurity threat in terms of total impact. While the probability of an FMD outbreak is low, estimates of the potential impact are sufficiently large to make FMD one of the most significant biosecurity threats to the Australian livestock industry. Also, standards 1.1 and 1.2 of the NLTPS were designed with an FMD outbreak in mind.

Table 5 presents estimates of the expected annual costs of an FMD outbreak based on the two estimates of the impacts of an FMD outbreak and the probability of incursion.

Table 5 Range of potential foot-and-mouth disease costs used in the analysis

FMD costs over 10 years ($m)	Incursion probability	Expected annual costs ($m)
17 00[a]	0.015	255
52 000[b]	0.015	780

Note:
a Productivity Commission 2002 quoted in Matthews 2011.
b ABARES 2013.

Given the uncertainty surrounding the magnitude of the consequences, two values for the consequences of a foot-and-mouth outbreak have been included in the analysis. Under the standard assumptions the impacts of an FMD outbreak are assumed to be $52 billion (ABARES 2013). These impacts are the most recent estimates of the potential implications of an FMD outbreak but assume that market access is severely restricted, and that the disease has spread to all states except Western Australia and Tasmania. In the sensitivity analysis, a lower estimated impact of $17 billion over 10 years (2012-13 prices) is considered. These estimates are drawn from PWC (2002), and quoted in Matthews (2011), and are based on optimistic assumptions about the time taken to regain market access.

Australia has not had an FMD outbreak for well over a century (DAFF 2013b; Fox 2010), putting the annual probability of incursion at less than 0.01. In a submission to the Productivity Commission, Prowse (2006) assumed a probability of incursion of 0.005, or once in every 200 years. It is generally agreed, however, that increases in volumes of goods and numbers of people entering Australia every year would have caused the annual probability of incursion to increase. CIE (2010) assumed an FMD outbreak is likely to occur once or twice in a 100-year period—that is, with a range of annual probability of incursion of 0.01 to 0.02. In this analysis an assumed incursion probability of 0.015, equivalent to the average of the range assumed by CIE (2010), was used in estimating the expected annual consequence of an FMD outbreak.

Researchers express considerable uncertainty about the magnitude of the benefits that could be attributed to improvements in traceability. PWC recognised that the relationship between increases in traceability and resulting benefits was not linear but applied benefit estimates as if the relationship was linear, such that a given percentage improvement in traceability would yield a similar percentage increase in benefits. CIE assumed that a one percentage point improvement in traceability under the enhanced mob-based system would yield a 1.83 per cent increase in benefits. A one percentage point improvement in traceability under the EID with exemption option was assumed to yield a 3.74 per cent benefit, and under the EID with no exemption option was assumed to yield a 3.95 per cent benefit. CIE argued that this reflected better prospects for successful zoning under the EID options.

In this analysis it is assumed that a given level of traceability would yield similar benefits regardless of the approach taken to achieve those traceability levels. Based on discussion with jurisdictions, it is assumed that a one percentage point improvement in traceability results in a reduction of 1 to 3 per cent in the impact of an FMD outbreak, using estimates on rates used by

PWC (1 per cent) as a lower bound and the average of the rates for Option 1 and Option 3 used by CIE (about 3 per cent) as an upper bound.

Present values are calculated from annual benefits assumed to accrue over a 25-year period using a discount rate of 7 per cent (details of the results are in Appendix E).

An improvement in traceability in one type of disease-susceptible animal is expected to reduce the overall consequences of disease by a certain proportion. If the same level of improvement occurs in more than one animal type, a larger percentage reduction in disease consequence is expected. As the aim of this analysis is to investigate benefits from improvements in traceability of sheep and goats only, traceability of other livestock species is assumed to remain unchanged from present levels. Therefore, annual total benefits accruing to the whole livestock sector and the Australian economy are the savings in expected annual costs from improvements to traceability of sheep and goats.

Animal productivity benefits

Arguments have been made that the EID systems could raise productivity through improved efficiency in day-to-day operations as well as through selection of animals based on a wide range of beneficial genetic attributes. A number of submissions received during the consultation phase support this, giving examples of on-farm benefits of using EID technology (Chapter 8).

In considering productivity benefits, it should be recognised that EID technology has been available for producers on a voluntary basis for some time. A degree of uptake, dictated by the market and producers' understanding of the likely costs and benefits, has already occurred on a limited scale.

The relatively low level of voluntary adoption of the technology by sheep producers suggests that productivity benefits are not adequate to offset the cost of the technology. In the case where the EID system becomes mandatory, productivity benefits—while considered alone may not offset the systems costs—are still relevant to assessing the outcome of the proposed options.

Estimating animal productivity benefits associated with EID

PricewaterhouseCoopers (PWC 2010b) suggested that the collection of more precise stock data by EID could allow for improved performance measurement, thereby facilitating the identification of both superior and inferior performers. Producers then may use this information in management practices and increase profitability. However, the report also highlights the fact that such gains would only be viable for farms with more than 1 000 head for sheep and lamb farmers, and more than 500 head for merino wool producers.

It also noted that in estimating the net present value (NPV) of EID implementation, the assumptions regarding inputs—including wage rates, cost of equipment and discount rate—significantly affect the outcome of the analysis. Because of this, they present three scenarios—'optimal', 'most likely' and 'conservative'—for state-wide aggregated NPVs over 10 years for Victoria. The 'most likely' outcome is deemed to be around $53 million for businesses with more than 1 000 sheep, but those with 500 or fewer sheep will experience a loss of around $200 000. The estimated annual total labour savings for a farm with 2 000 sheep which conducts five weighing sessions is $5 785.

The Victorian Government believes there is significant potential in the use of EID systems to achieve benefits which more than recover the cost of implementation. At the same time, it is acknowledged that there is a degree of uncertainty in attributing these benefits to the EID system specifically, as it is difficult to predict the level of potential productivity gains in the case

where EID was not implemented. It is also noted that non-monetary benefits were omitted from the PWC analysis, and variations between farms' ability to achieve productivity gains were also uncertain.

In their submission to the Consultation RIS, the Department of Environment and Primary Industries in Victoria (2013) attributed a number of potential productivity gains—with given estimations of the monetary values of perceived benefits—to the use of EID technology, based on four producer case studies. The main forms of savings were:

- Nutrition cost savings: primarily in the form of reduced supplementary feed costs, earlier detection of weight loss and quicker responses to underperformers; total savings estimated at $36 000 per year per farm, the equivalent of $18 per sheep tagged.
- Reproduction rate gains: improved management practices linked with EID use for detection of early reproduction of prime lamb; benefits estimated up to $28 000 per year per farm, the equivalent of $14 per sheep tagged.
- Time savings: time savings of up to two weeks per year were reported for merino prime lamb, as a result of labour savings; however, only two surveyed producers reported achieving time savings.

The submission from Mike Stephens & Associates (2013) to the Consultation RIS provided some details regarding costs of using EID as well as their estimates of benefits gained where implementation has taken place. The emphasis here is on the increase in efficiency of management in regard to reproduction, growth in lamb weight, and culling. While this submission reports substantial returns from the use of EID, it should be noted that such results have not been assessed.

For lamb producers, Mike Stephens & Associates estimated that using EID to assist in the culling of poor performers, sourcing of future genetics and targeting specific markets, could achieve reductions in feed costs of $3.43 per lamb for a 10 kg increase in live weight. Similarly improved management by wool producers is estimated to achieve a greasy fleece weight increase of 0.5 kg per ewe; assuming a market value of $8.50 per kilogram, this translates to an increased income of $4.25 per ewe per year.

While some producers already adopting the EID have reported observed productivity improvements, there is insufficient evidence to conclude that such gains will be experienced by every adopter. At the same time, however, there is scope to improve further on management performance as more data is gathered and their uses refined. At present, the extent of this potential is still speculative, and it will only become evident after more comprehensive and wider adoption.

Furthermore, while the estimates given by the abovementioned submissions suggest significant productivity benefits from using EID technology, they are often extrapolated from observations of selected producers who have already adopted the EID on a voluntary basis. It is possible that they did so because their operations were better positioned to take advantage of the technology and it is speculative to claim that some highly positive results can be replicated across the industry.

In addition to this, the fact that not all farm sizes will benefit from investing in EID is likely to be a discouraging factor for smaller producers; if the aim is to have a uniform system throughout Australia, the incentive structure for EID adoption may prove problematic.

In light of these considerations, potential animal productivity benefits from EID technology are not considered under the standard assumptions but are considered in the sensitivity analysis.

For the sensitivity analysis two potential values of net productivity benefits—$80 million and $160 million—over a 25-year period are considered. These figures are based on the original PWC (2010b) estimate of $53 million for the state of Victoria alone, and derived by adjusting for differences in the assumed EID tag costs and discount rates used in the analyses, and extrapolating out to all producers in all states. The two values correspond to two different rates of assumed uptake: 20 per cent and 40 per cent. These figures represent the net benefit of investing in taking additional measures to utilise EID to improve productivity—that is, the benefits of improved productivity less the additional investment costs after tagging.

Animal welfare

Animal welfare was raised as an issue in two ways. The first was in relation to the Exporter Supply Chain Assurance Scheme (ESCAS) and the second was in relation to the handling of animals in the domestic supply chain.

Animal welfare and ESCAS

Under the current ESCAS for exports of live sheep and goats, a mob-based accounting system is used to trace animals through the supply chain to final slaughter. Licensed exporters must:

- provide evidence of compliance with internationally agreed welfare standards
- demonstrate control through the supply chain
- demonstrate traceability through the supply chain
- meet reporting and accountability requirements
- include independent auditing (DAFF 2013a).

The purpose of independent auditing is to assess whether the supply chain meets the World Organisation for Animal Health code on animal welfare outcomes for sheep and goats and whether appropriate control and traceability of animals exists (DAFF 2013a). It is the combination of the mob-based accounting system and the additional verification and auditing requirements that enables traceability of these animals. As such it represents a higher cost system of traceability than the current NLIS for sheep and goats domestically. Improvements to the NLIS for sheep and goats, along the lines of the three options considered in this Decision RIS, may influence the operation of ESCAS, potentially affecting the likelihood and associated costs of non-compliance.

As sheep sold directly from properties for live export are exempt from tagging under Option 2, it is unlikely any significant additional animal welfare benefits would eventuate from adopting this option compared with the current system.

An independent review of live animal export trade (Farmer 2011) was undertaken to help the Australian Government establish new safeguards that provide verifiable and transparent supply chain assurance for every livestock consignment that leaves Australia for feeder/slaughter purposes. It noted the importance of traceability of animals for a number of purposes, including facilitating refinement of suitability for export. The review found that selection and certification of livestock suitable for live export remains an important operation in the export process and is sometimes poorly conducted.

The Farmer review recommended that the Commonwealth, state and territory governments and industry work together to implement individual identification of all sheep and goats as soon as practicable. While the review did acknowledge that accountability for sheep and goats could in principle be achieved without individual identification, it found that individual animal identification is likely to provide the greatest level of assurance that animals are kept within a defined supply chain. This implies that Option 3 in this RIS is the preferred option relevant to animal welfare. However, the extent of assurance from this option and the implications for animal welfare are not yet well understood.

The need for individual animal tracing was reiterated by animal welfare groups during the public consultation phase. It was suggested that individual identification of animals would increase capacity to identify leaks in the supply chain where only a few animals are lost. However, the need for destination countries to also have necessary infrastructure for scanning to realise the full benefits was noted. A common view from producers, stock agents and industry bodies was doubt that the NLIS would have any effect on ESCAS because the systems are separate. While NLIS regulations do not alter exporter obligations under ESCAS, tags present on sheep may be used to identify and trace them to demonstrate compliance with ESCAS.

If improvements to NLIS for sheep and goats deliver improved animal welfare, this benefit should be included in a cost–benefit analysis. For a number of reasons, however, this benefit is difficult to quantify. The most prominent is that animal welfare provides non-monetary benefits; it is not possible to assign a dollar value through the operation of markets. Methods involving extensive and costly surveys could be used to estimate the total cost people would be prepared to pay to ensure improvements in the treatment of animals destined for export markets to a desired level. Quantifying improvements to animal welfare as a result of improvements to the NLIS for sheep and goats is a potential area for further research.

Animal welfare domestically

It has also been argued that there might be animal welfare implications of improving traceability domestically. Animal welfare and veterinary organisations argued in their submissions that improved traceability using EID could improve animal welfare outcomes through better information around times in transit. Additionally, any mitigation of the impacts of an animal disease outbreak would also conceivably have animal welfare benefits. Other submissions argued that individual animal identification may allow for better monitoring of animal health on farm with minimal handling.

In contrast, a number of submissions have argued that there could potentially be negative animal welfare implications associated with improving the current NLIS. Any change to the system that requires additional handling of sheep or goats, or delays the movement of sheep or goats through saleyards and abattoirs, could have adverse outcomes for animals.

Given the difficulties associated with quantifying and valuing these impacts and the absence of conclusive evidence on animal welfare outcomes, estimates of the potential animal welfare implications are not included in this RIS.

Food safety

Improved animal traceability could enhance the efficiency and cost-effectiveness of tracing products through the supply chain, thus strengthening measures for achieving or maintaining food safety standards. Knowing where a food product can be found in the supply chain enables the source of a food safety problem to be quickly traced (Karippacheril et al. 2011).

A food safety incident, such as detection of contaminants beyond acceptable standards and presence of pathogens in meat products, can impose costs including restricted trade, reduced consumption, disruption to businesses and increased costs of standard enforcement.

Incidents of meat contamination could also increase cost of enforcement. In Australia when a sample is detected with a chemical residue above the Australian Standard, the National Residue Survey asks the relevant state or territory government to trace the sample back to its property of origin (DAFF 2011a). During 2011–12 a total of 5 540 samples were collected from sheep and analysed (DAFF 2012). The National Residue Survey requested 11 traceback investigations for sheep in 2011–12 and five in 2012–13. Most cases relate to metals, particularly cadmium and lead (DAFF 2011b).

Traceability of sheep and goats can reduce food safety related costs through:

- identification of products for rapid and effective recall
- investigation through the supply chain to prevent recurrence (FSANZ 2009)
- management of at-risk animals.

Recall of products

Rapid, targeted and effective recall is central to minimising trade disruption and any potential public health risks (FSANZ 2012). When a food safety problem is identified, food businesses must be able to quickly remove unsafe food from the marketplace.

The Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption requires processors to accept only animals that are identifiable and accompanied by vendor declarations to improve traceback if required. Traceability after slaughter, particularly for sheep and goats, depends on matching documentation with slaughter sequence and transferring tag information to the carcass.

While aligning documentation with animals' identification is improved through use of electronic tags and/or stomach bolus (FSANZ 2009), options 2 and 3 presented in this Decision RIS do not generate improvements in post-slaughter traceability, as EID tags are removed at slaughter. Accordingly there would be limited or negligible food safety benefits from an enhanced mob-based system or EID system in this respect.

Prevention of recurrence

Tracing sought by the National Residue Survey monitoring program aims to prevent further contraventions of Australian Standards. Action varies from simple advice in the case of a minor problem, through quarantining the property concerned, to prosecution where serious contamination has occurred (DAFF 2011b).

The type of residue determines the nature of traceability required in traceback investigations. For a residue from a drench or antibiotic injection with a short withholding period, it is necessary to trace the animal only to the location where the treatment was applied. For heavy metal residues, where the chemical accumulates, the full life history of the animal's movement is important as the contamination could have occurred at any time in its life (Paul Fry [National Residue Survey] pers. comm., April 2013).

Individual identification plays a role in the traceability of sheep and goats. Of the 16 cases the National Residue Survey nominated for tracing between 2011–12 and 2012–2013, one was not

traced to the likely contamination source. A liver sample, found to contain lead, came from a ewe consigned from a sheep feedlot, where no possible source of contamination was found. Without individual animal identification, it was not possible in this case to trace the animal back to the property of origin (DAFF 2011b).

While traceability issues for residues in sheep are most likely to occur in mixed saleyard lines and consignments from feedlots, traceback under the current mob-based system is still possible when records are sufficiently accurate. For example, a traceback investigation in 2011 successfully traced an animal back through a feedlot to its property of origin (Paul Fry [National Residue Survey] pers. comm., April 2013). The adequacy of the current mob-based system was supported in a number of submissions received during the consultation phase. It is assumed in this Decision RIS that none of the three proposed options would have material food safety benefits with regard to prevention. If there were benefits, however, they would likely be the same for all three options and, as such, not affect the preferred option.

Management of at-risk animals

The international Codex Alimentarius Code of Hygienic Practice for Meat states that provision of relevant information on animals intended for slaughter facilitates application of risk-based meat hygiene programs (FSANZ 2009).

EID tags provide options to manage residue risk in animals that move from property to property by assigning a risk status to the individual device so the animal's risk status is not lost as it moves around. On scanning the electronic devices into holding pens, a risk status would trigger a message at the abattoir prompting them to manage animals appropriately. Device-based risk status allows a degree of management of individual at-risk animals that is not possible under a mob-based system (Paul Fry [National Residue Survey] pers. comm., April 2013).

Traceback of sheep and goats for food safety enhancement is possible under the current mob-based system where complete paperwork is available, suggesting that improvements in the system would offer no additional benefits in terms of managing at risk animals. However, use of electronic tags would allow animals from particular populations with diseases or defects to be identified when not directly consigned to the abattoir. This could allow inspection procedures to be tailored to the spectrum and prevalence of hazards, enhancing risk-based meat hygiene programs and improving food safety (FSANZ 2009). This, again, would require additional measures to be taken that have not been assumed in this report.

Market access (European Union)

As well as the potential benefits from reducing biosecurity risks, conforming to the NLTPS has the benefit of assuring importers of Australian sheep and goat meat that Australia has the capacity to trace back any biosecurity or food safety threat to its source and take necessary remedial action as quickly as possible. The whole sheep and goat industry could benefit from such capacity as it supports continuity of access to export markets.

Of particular concern is access to the European Union market, which imposes stringent import requirements on animal products and has its own standards for livestock traceability. The European Union could impose restrictions on import of Australian sheep and goat meat based on Australia falling short of the European Union's own standard of animal identification or lack of confidence in the Australian system.

For example, in the late 1990s the European Union demanded a 'closed system' for hormonal growth promotant-free cattle destined for the European market and that the animals be whole-

of-life traceable (PWC 2006). To comply with this requirement and satisfy the market, EID tag technology was introduced in Australia (PWC 2006). Additionally, the importance of a rapid and accurate livestock tracing system was highlighted following discovery of bovine spongiform encephalopathy in Canada and the US in 2003. Canada was able to regain export market access for beef to most countries faster than the US as a result of a tracing system that successfully identified cohorts (PWC 2010).

In an audit conducted in 2008 the European Commission found the traceability levels for sheep and goats in Australia at that time were well below what the European Union required from countries exporting sheep meat. Furthermore, the European Union has already made electronic identification and individual recording of sheep movements compulsory. Animals sold direct to slaughter within 12 months are not required to have electronic tags but must have a visual tag identifying the property of birth (DEFRA 2012). European Union authorities and/or importers could require equivalence in tracing of sheep and goats, which would prevent Australia accessing this market under its current tracing system for sheep and goats.

However, feedback received during the consultation phase suggested that the likelihood and consequences of the EU imposing such restrictions are small. It was noted that, despite the current NLIS system not being compliant with EU export requirements, EU markets have remained open to Australian producers who voluntarily comply. Some stakeholders, such as Primary Industries and Regions South Australia, also noted that exports to the EU are not a significant driver of industry profits and, as such, any restrictions placed on exports to the EU would not have a significant effect on industry profitability (Table 6).

Table 6 Exports of sheep and goat products, by destination, 2011–12

Destination	Mutton ($m)	Lamb ($m)	Live exports ($m)
China	13.9	73.3	–
European Union	–	94.5	–
Hong Kong	–	21.1	–
Japan	23.9	63.1	–
Malaysia	19.6	–	–
Middle East	179.1	244.2	300.0
Papua New Guinea	–	39.8	–
Singapore	22.4	–	1.2
Taiwan	19.2	–	–
Turkey	–	–	37.0
United States	21.4	305.1	–
Other	62.4	219.7	6.8
Total	362.0	1 060.7	345.0

Source: ABARES 2012b

In light of the uncertainty around future market restrictions, and the small contribution of EU exports to industry profitability, the expected impacts of EU market restrictions are not estimated in this RIS.

7 Impacts

This chapter presents estimates of the impacts of the various options considered in this Decision RIS. In all cases, present values are calculated for costs and benefits incurred over a 25-year period using a discount rate of 7 per cent. The discount rate accounts for the time preference of money and was chosen on the advice of the Office of Best Practice Regulation (Australian Government 2013). Other discount rates were found to have no material effect on the estimated impacts or preferred option (Table G3 in Appendix G).

Estimated impacts under standard assumptions

Table 7 summarises and explains the assumed values for key parameters under the standard set of assumptions. Under the standard set of assumptions, variations in EID tag prices and the assumed effect of increased traceability on FMD impacts are considered. All other parameters are fixed.

Table 7 Standard assumptions

Key parameter	Assumed value(s)	Explanation
Initial level of traceability	90%	Agreed to by jurisdictions in a workshop prior to the release of the Consultation RIS.
Feasible level of traceability	98% for all options	Agreed to by jurisdictions in a workshop prior to the release of the Consultation RIS.
Labour costs for an enhanced mob-based system	Based on per sheep labour costs estimated by CIE (2010)	CIE (2010) provided the most detailed estimates comparable with ABARES' approach.
Labour costs for EID systems	Based on per sheep labour costs estimated by PWC (2010)	This is a high value relative to CIE (2010), which assumed that there would be no additional labour costs associated with EID, but is comparable with the range of estimates presented in the PIMC Working Group report (2012).
Infrastructure costs for EID systems	Based on low-end estimates considered in the PIMC Working Group report (2012)	The low-end infrastructure cost estimates reflect the outcomes of a survey conducted by the Livestock Saleyards Association of Victoria and are considered to be the best available estimates.
EID tag prices	\$0.80, \$0.90, \$1.30 and \$1.60	These four EID tag prices cover the range of values discussed at the workshop with jurisdictions prior to release of the consultation RIS, and received in submissions afterwards.
Impacts of an FMD outbreak on the Australian economy	\$52 billion (ABARES 2013)	The most recent estimate of the potential impacts of an FMD outbreak.
Reduction in FMD impacts from 1% increase in traceability	1, 2 and 3 percent	A range consistent with CIE (2010) and PWC (2010) is considered given the uncertainty around the relationship between traceability and disease impacts.
Potential on-farm productivity benefits from the use of EID technology	\$0	Use of EID for productivity purposes is limited in the cattle industry and uptake in the sheep and goat industry is highly uncertain.

Sources: ABARES, CIE (2010), PIMC Working Group (2012), PWC (2010), and stakeholders' feedback received through the public consultation process

Estimates of costs under standard assumptions

The estimated annual costs and present values of improving traceability for each option, under the standard cost assumptions, are presented in Table 8. The cost of improving the average level of traceability from 90 per cent to 98 per cent under the enhanced mob-based option is estimated to be $11.4 million per year. All costs are attributed to labour for additional verification and compliance measures as outlined by CIE (2010) and summarised in Appendix C. As Option 1 would not require any new infrastructure for it to be implemented, no additional capital costs would be incurred.

Table 8 Estimated annual implementation costs for each option, under the standard assumptions

Option	Present value of total cost ($m)	Annual equivalent[a] ($m/year)
Current (baseline)	**0**	**0**
Option 1	133	11.4
Option 2		
—tag price of $0.80	191.1	16.4
—tag price of $0.90	219.5	18.8
—tag price of $1.30	333.0	28.6
—tag price of $1.60	418.2	35.9
Option 3		
—tag price of $0.80	271.8	23.3
—tag price of $0.90	316.6	27.2
—tag price of $1.30	496.0	42.6
—tag price of $1.60	630.5	54.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
a The annual impact over a 25-year period with the same net present value.
Source: ABARES estimates

A comparison of the costs broken down by component for each option is summarised in Table 9, with additional detail documented in Appendix D. Option 2 is estimated to cost between $16.4 million and $35.9 million a year depending on the assumption made about the cost of electronic tags. Option 3 is estimated to cost between $23.3 million and $54.1 million a year, depending on the cost of electronic tags. The difference between Option 2 and Option 3 is based on the estimated number of animals that move through the non-exempt pathways of the supply chain. For options 2 and 3, tag costs contribute the largest share of costs, accounting for 68 to 89 per cent of estimated costs per year. Labour costs follow, accounting for 7 to 19 per cent of the total cost per year. Capital or infrastructure costs, the smallest component, account for 4 to 14 per cent on average per year.

Ongoing costs represent the largest cost component for all options. The enhanced mob-based system would have the largest increase in labour costs over the base case at approximately $11.4 million a year, to ensure full compliance through increased verification and enforcement. Option 2 and Option 3 are assumed to require a marginal increase in labour cost of $3.2 million and $3.7 million respectively to ensure animals are tagged with an electronic tag and the electronic system is properly scanning them.

Table 9 Breakdown of estimated annual implementation costs for each option, under the standard assumptions

	Tag cost ($m)	Labour cost ($m)	Capital/infrastructure cost ($m)	Total cost ($m)
Option 1	0	11.4	0.0	11.4
Option 2				
—tag price of $0.80	11.0	3.2	2.3	16.4
—tag price of $0.90	13.4	3.2	2.3	18.8
—tag price of $1.30	23.1	3.2	2.3	28.6
—tag price of $1.60	30.4	3.2	2.3	35.9
Option 3				
—tag price of $0.80	17.3	3.7	2.3	23.3
—tag price of $0.90	21.2	3.7	2.3	27.2
—tag price of $1.30	36.6	3.7	2.3	42.6
—tag price of $1.60	48.1	3.7	2.3	54.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
Source: ABARES estimates

The costs of implementation incurred at each point of the supply chain will differ amongst the three options (Table 10). The costs of compliance incurred by farmers, saleyards, abattoirs and exporters under Option 1 were estimated to total $4.0 million. The remaining costs of implementation are associated with auditing of saleyards and abattoirs for non-compliance. Auditing (and enforcement) costs will likely be incurred by state and territory government departments. In contrast, the entire costs of implementing options 2 and 3 are borne by businesses. For example, assuming a tag price of $0.80, Option 2 imposes a total cost on these businesses of $16.4 million and Option 3 imposes a cost of $23.3 million.

The final burden at each point in the supply chain will depend on the extent to which costs can be passed on to buyers or passed back to suppliers through higher prices received for output (or services) or lower prices paid for inputs. The estimates presented in Table 10 implicitly assume that no party is able to pass on or pass back these costs.

Table 10 Estimated annual implementation costs along the supply chain, under the standard assumptions

Cost	Farmers ($m)	Saleyards ($m)	Abattoirs ($m)	Exporters ($m)	Government ($m)	TOTAL ($m)
Option 1	1.1	2.1	0.8	0.0	7.4	11.4
Option 2						
—tag price of $0.80	11.7	2.6	1.9	0.2	0.0	16.4
—tag price of $0.90	14.2	2.6	1.9	0.2	0.0	18.8
—tag price of $1.30	23.9	2.6	1.9	0.2	0.0	28.6
—tag price of $1.60	31.2	2.6	1.9	0.2	0.0	35.9

Table 10 Estimated annual implementation costs along the supply chain, under the standard assumptions *continued*

Cost	Farmers ($m)	Saleyards ($m)	Abattoirs ($m)	Exporters ($m)	Government ($m)	TOTAL ($m)
Option 3						
—tag price of $0.80	18.1	2.6	2.5	0.2	0.0	23.3
—tag price of $0.90	21.9	2.6	2.5	0.2	0.0	27.2
—tag price of $1.30	37.3	2.6	2.5	0.2	0.0	42.6
—tag price of $1.60	48.9	2.6	2.5	0.2	0.0	54.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
Source: ABARES estimates

The current OBPR guidelines state that all proposals that impose a regulatory burden on individuals, businesses or community organisations through changes in Commonwealth legislation be accompanied by (a) proposed offset(s) (Australian Government 2014). However, changes to the NLIS system will come about through amendments to state and territory legislation (specifically the Stock Disease Acts). In the absence of any regulatory burden placed on individuals, businesses or community organisations as a direct result of changes in Commonwealth legislation, no offsets have been provided regarding changes to the NLIS.

Estimates of benefits under standard assumptions

All options are assumed to achieve a 98 per cent level of traceability for the rapidly moving disease standards (1.1 and 1.2). These benefits have been estimated under some assumptions about the likely impact of an FMD outbreak in Australia and the ability of improved traceability to reduce this impact. The benefits from reducing the impact of other biosecurity threats and other benefits described in Chapter 6 (food safety / product integrity, market access and animal welfare) as a result of increasing traceability to 98 per cent for the rapidly moving disease standards and to 95 per cent for the whole-of-life standards have not been assessed as part of the Decision RIS. The potential animal productivity benefits associated with an EID system are considered in the sensitivity analysis.

The estimated present values of the biosecurity benefits of improving traceability, using FMD as a case study, are presented in Table 11. The estimated benefits of improved short-term traceability are significant, ranging from $702.2 to $1 965.7 million. Expressed in annual terms over a 25-year period, these estimates equate to $60.3 million to $168.7 million a year.

These estimates are based on the assumption that the current NLIS for sheep and goats achieves an average 90 per cent level of traceability for the rapidly moving disease standards (1.1 and 1.2) and that the target level of traceability for these standards (98 per cent) is met by each option. As such, the estimated biosecurity benefits of improved traceability are equal for all three options.

Table 11 Biosecurity benefits from improved traceability, under the standard assumptions

Reduction in FMD impact from improved traceability[a] (%)	Present value of benefits ($m)	Annualised benefit ($m)
1	702.2	60.3
2	1 356.5	116.4
3	1 965.7	168.7

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent and impacts of an FMD outbreak are assumed to be equal to $52 billion over 10 years.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Measures of relative performance of alternative options under standard assumptions

The estimated net present values for the three options are presented in Table 12 under the standard assumptions. These estimates are equal to the difference in annual costs presented in Table 8 and the benefits presented in Table 11. The measures of performance are presented for varying assumptions around the effect of increased traceability on these impacts and EID tag prices. More detailed results are provided in Appendix F.

Table 12 Estimated annualised net present values of options ($m), under the standard assumptions

Option	Reduction in FMD impact from improved traceability[a] (%)		
	1	2	3
Option 1	49	105	157
Option 2			
—tag price of $0.80	44	100	152
—tag price of $0.90	41	98	150
—tag price of $1.30	32	88	140
—tag price of $1.60	24	81	133
Option 3			
—tag price of $0.80	37	93	145
—tag price of $0.90	33	89	142
—tag price of $1.30	18	74	126
—tag price of $1.60	6	62	115

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

The feasibility of options improves as the size of potential costs of disease outbreak and the percentage reduction in these costs—for a given increase in traceability—both increase. Given that all options are assumed to provide the same benefits, the relative economic feasibility between them is determined by the extent of differences in their implementation costs. That is, expensive options are less favourable than lower cost options.

As potential disease consequences increase, the potential benefit from improved traceability increases proportionately—that is, doubling the expected disease cost would double the potential benefits from an increase in traceability. Similarly, for a given disease impact, greater percentage reductions in the cost of disease would result in proportional increases in benefits.

As shown in Table 12, all options were estimated to have a positive NPV under the standard assumptions, regardless of the EID tag price or assumed reduction in FMD impacts for a given percentage increase in traceability. Using net present value as a guide, Option 1 is the preferred option under the standard assumptions.

Sensitivity analysis

Changing the standard assumptions

Alternative values for the key parameters considered in the sensitivity analysis are presented in Table 13. The rationale for these alternative values is discussed below and the full range of estimated costs, benefits and NPVs for each option presented.

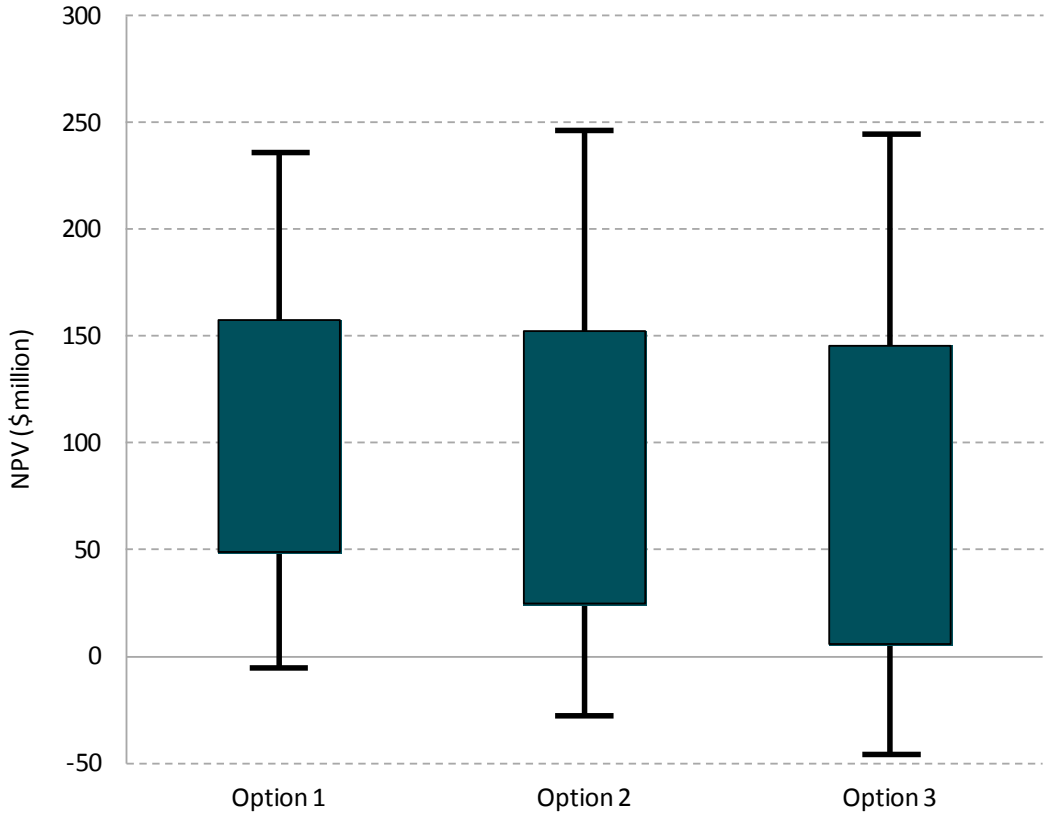
Table 13 Alternative values for key parameters considered in sensitivity analysis

Key parameter	Standard assumption	Sensitivity analysis
Initial level of traceability	90%	Values of 85% and 95% are considered in the sensitivity analysis to account for jurisdictional differences.
Feasible level of traceability	98% for all options	A lower level of 95 per cent under Option 1 is also considered because of uncertainty around the feasibility of achieving 98 per cent.
Labour costs for an enhanced mob-based system	Based on per sheep labour costs estimated by CIE (2010)	Higher labour costs (double the CIE estimates) are considered in the sensitivity analysis that encompasses high-end estimates considered by PWC (2010).
Labour costs for EID systems	Based on per sheep labour costs estimated by PWC (2010)	Higher labour costs (double the CIE estimates) are considered in the sensitivity analysis.
Infrastructure costs for EID systems	Based on low-end estimates considered in the PIMC Working Group report (2012)	Estimates presented by PWC (2010) and CIE (2010) were considered 'high' by the PIMC Working Group report but are assessed in the sensitivity analysis.
EID tag prices	$0.80, $0.90, $1.30 and $1.60	Same as standard assumptions
Impacts of an FMD outbreak on the Australian economy	$52 billion (ABARES 2013)	A lower value of $17 billion, estimated by Matthews (2011), is considered in the sensitivity analysis.
Reduction in FMD impacts from 1% increase in traceability	1, 2 and 3 percent	Same as standard assumptions
Potential on-farm productivity benefits from the use of EID technology	$0	Productivity benefits of up to $160 million (in net present value terms) are considered in the sensitivity analysis.

Sources: ABARES, CIE (2010), PIMC Working Group (2012), PWC (2010), and stakeholders' feedback received through the public consultation process

Figure 9 shows the full range of estimates of annualised NPV for the three options. The solid bars reflect the range of estimated NPVs under the standard assumptions, reported in Table 12. This range is associated with different EID tag prices and the assumed effect of increases in traceability on the impacts of an FMD outbreak.

Figure 9 Full range of estimated annualised net present values



Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The total industry infrastructure cost is spread over a five-year period. The solid bars reflect the range of estimates of annualised NPV under the standard traceability, cost, and benefit assumptions.
Source: ABARES estimates

There is considerable overlap in the estimates of NPV for the three options. However, the minimum estimates of annualised NPV for the three options differed significantly. For the enhanced mob-based system (Option 1) the minimum annualised NPV, based on a current level of traceability of 95 per cent, is estimated to be –$5.9 million. In contrast, the minimum annualised NPVs for options 2 and 3, based on the most conservative assumptions, is estimated to be –$28.5 million and –$46.7million respectively.

The minimum NPV for all three options are based occurs when the initial level of traceability is 95 per cent and, for options 2 and 3, EID tag prices are $1.60. The maximum estimate for all three options occurs when the initial level of traceability is 85 per cent. For options 2 and 3 EID tag prices are $0.80 and the maximum productivity benefits are achieved for all tagged sheep.

Preferred options under various assumptions

A summary of the preferred options under various assumptions is presented below (Table 14). Where changes in the assumed impact of an FMD outbreak ($17 billion or $52 billion) or assumed effect of improvements in traceability (1, 2 or 3 per cent) have no effect on the preferred option the table has been condensed, rather than displaying the full list of results.

Detailed results (estimates of net present value and preferred options for all plausible values for costs and benefits) are presented in Table G2 in Appendix G.

Table 14 Preferred options under various scenarios, labour costs and EID tag prices

Scenario description							Preferred option under various EID tag prices			
FMD impact ($b)	**Reduct-ion in FMD impact[a] (%)**	**EID non-tag costs**	**EID produc-tivity benefits ($m)**	**Initial tracea-bility level (%)**	**Option 1 labour costs**	**Option 1 feasible tracea-bility (%)**	**$0.80**	**$0.90**	**$1.30**	**$1.60**
17	1	Normal	0	90	Normal	98	1	1	1	1
17	1	***High***	0	90	Normal	98	1	1	1	1
17	1	Normal	***80***	90	Normal	98	1	1	1	1
17	1	Normal	***160***	90	Normal	98	2	2	1	1
17	1	Normal	***160***	***85***	Normal	98	2	2	1	1
17	1	Normal	0	***85***	Normal	98	2	1	1	1
17	1	Normal	0	***95***	Normal	98	1	1	1	1
17	1	Normal	0	**85**	***High***	98	2	2	2	None
17	1	Normal	0	90	***High***	98	2	2	None	None
17	1	Normal	0	90	Normal	***95***	1	1	1	1
17	2 or 3	Normal	0	90	Normal	98	1	1	1	1
17	2 or 3	***High***	0	90	Normal	98	1	1	1	1
17	2 or 3	Normal	***80***	90	Normal	98	1	1	1	1
17	2 or 3	Normal	***160***	90	Normal	98	2	2	1	1
17	2 or 3	Normal	***160***	***85***	Normal	98	2	2	1	1
17	2 or 3	Normal	0	***85***	Normal	98	2	1	1	1
17	2 or 3	Normal	0	***95***	Normal	98	1	1	1	1
17	2 or 3	Normal	0	**85**	***High***	98	2	2	2	2
17	2 or 3	Normal	0	90	***High***	98	2	2	1	1
17	2 or 3	Normal	0	90	Normal	***95***	2	2	1	1
52	1	Normal	0	90	Normal	98	1	1	1	1
52	1	***High***	0	90	Normal	98	1	1	1	1
52	1	Normal	***80***	90	Normal	98	1	1	1	1
52	1	Normal	***160***	90	Normal	98	2	2	1	1
52	1	Normal	***160***	***85***	Normal	98	2	2	1	1
52	1	Normal	0	***85***	Normal	98	2	1	1	1
52	1	Normal	0	***95***	Normal	98	1	1	1	1
52	1	Normal	0	**85**	***High***	98	2	2	2	2
52	1	Normal	0	90	***High***	98	2	2	1	1
52	1	Normal	0	90	Normal	***95***	2	2	2	1

Table 14 Preferred options under various scenarios, labour costs and EID tag prices *continued*

Scenario description							Preferred option under various EID tag prices			
FMD impact ($b)	**Reduction in FMD impact[a] (%)**	**EID non-tag costs**	**EID productivity benefits[b] ($m)**	**Initial traceability level (%)**	**Option 1 labour costs**	**Option 1 feasible traceability (%)**	**$0.80**	**$0.90**	**$1.30**	**$1.60**
52	2 or 3	Normal	0	90	Normal	98	1	1	1	1
52	2 or 3	Normal	0	90	Normal	98	1	1	1	1
52	2 or 3	***High***	0	90	Normal	98	1	1	1	1
52	2 or 3	Normal	***80***	90	Normal	98	1	1	1	1
52	2 or 3	Normal	***160***	90	Normal	98	2	2	1	1
52	2 or 3	Normal	***160***	***85***	Normal	98	2	2	1	1
52	2 or 3	Normal	0	***85***	Normal	98	2	1	1	1
52	2 or 3	Normal	0	***95***	Normal	98	1	1	1	1
52	2 or 3	Normal	0	**85**	***High***	98	2	2	2	2
52	2 or 3	Normal	0	90	***High***	98	2	2	1	1
52	2 or 3	Normal	0	90	Normal	***95***	2	2	2	2

Note: The lowest cost options are based on the estimates in Table G1 in Appendix G. 'None' indicates that none of the options were estimated to have a positive net present value.
a As a result of a one percentage point increase in traceability.
b Animal productivity benefits are the net benefits of utilising individual animal identification technology. This includes the additional costs that must be incurred and the benefits of improved management.
Source: ABARES estimates

The results presented in Table 15, and in Table G2 in Appendix G, provide a number of important insights.

Changes in the assumed biosecurity benefits of increased traceability have no effect on the preferred option under most of the scenarios considered in Table 15. The only instances where the biosecurity benefits of improved traceability have an effect are when the labour costs for Option 1 are doubled, EID tag prices are $1.30 or higher, and the assumed biosecurity benefits are at their lowest assumed value.

Similarly, animal productivity benefits for options 2 and 3 are estimated to have minimal effects on the preferred options. Potential animal productivity benefits of less than $160 million is estimated to have no effect on the preferred option under any of the scenarios considered in Table 15. Assuming net productivity benefits worth $160 million is sufficient to make Option 2 preferred over Option 1 at an EID tag prices of $0.90 or less. It is also worth noting that animal productivity benefits do not make Option 3 preferred to Option 2 for any scenario. That is, the additional productivity benefits under Option 3 (as a result of tagging of more animals) are outweighed by the additional tag costs. This is consistent with the observation that most producers do not use individual animal identification technology on a voluntary basis.

In contrast, the assumed levels of current traceability, feasible traceability under Option 1, and labour costs for Option 1 all have significant effects on the preferred options.

Under an EID tag price of $0.80, Option 2 is preferred over Option 1 when initial traceability is assumed to be only 85 per cent. It is important to note that this scenario is more reflective of individual jurisdictions that have lower than average compliance and traceability than Australia as a whole.

Lowering the feasible level of traceability of Option1, to 95 per cent, results in Option 2 being preferred over Option 1 for most EID tag prices and assumed biosecurity benefits.

If the labour costs associated with implementing Option 1 are double those considered under ABARES standard assumptions, then Option 2 may be the preferred option under a number of scenarios. For example, low tag prices ($0.80 or $0.90) result in Option 2 being favoured over Option 1.

Implementation costs by jurisdiction

The NLIS is a national scheme, with consistency across jurisdictions being paramount to its operation. As such, costs and benefits should be considered at a national level. However, there will likely be differences in the costs of implementing an enhanced mob-based system across states because of differences in the current level of compliance. For example, the costs of improving traceability will be lower in states such as New South Wales where compliance and traceability are higher.

The lowest cost option for each state will also depend on the number of sheep and goats moving through each point in the supply chain in that state, and the costs of implementing each option at that point. For example, the costs of the enhanced mob-based system are primarily associated with verification and auditing in saleyards. States with a larger share of saleyard transaction will incur higher costs under Option 1 than other states. Alternatively the most significant costs associated with an EID system will be those of tags. As such, states that process sheep from other states will likely incur lower costs under Option 2 than otherwise.

To illustrate the potential magnitude of these differences, the costs of implementing each option, broken down by component, is presented for each state in Table 15. Three potential levels of current traceability are considered for Option 1 in each state: 85, 90 and 95 per cent. The assumed current level of traceability does not affect the costs of implementing options 2 or 3.

New South Wales is estimated to incur the highest cost for any option and assumed level of current traceability. These costs are simply the result of a larger number of sheep passing through the supply chain.

Table 15 Estimated annual implementation costs by component and jurisdiction

Option/cost	NSW[a] ($m)	Vic. ($m)	Qld ($m)	WA ($m)	SA ($m)	Tas. ($m)	NT ($m)	Aust. ($m)
Option 1								
—85% initial traceability	7.6	5.2	0.6	2.5	2.5	0.2	0.006	18.6
—90% initial traceability	4.7	3.2	0.4	1.5	1.5	0.1	0.004	11.4
—95% initial traceability	1.8	1.2	0.1	0.6	0.6	0.0	0.001	4.3

Table 15 Estimated annual implementation costs by component and jurisdiction *continued*

Option/cost	NSW[a] ($m)	Vic. ($m)	Qld ($m)	WA ($m)	SA ($m)	Tas. ($m)	NT ($m)	Aust. ($m)
Option 2								
Tag cost								
—tag price of $0.80	4.7	2.4	0.7	1.0	1.8	0.4	0.004	11.0
—tag price of $0.90	5.7	3.0	0.8	1.2	2.2	0.4	0.005	13.4
—tag price of $1.30	9.9	5.1	1.4	2.1	3.9	0.8	0.009	23.1
—tag price of $1.60	13.0	6.8	1.9	2.8	5.1	1.0	0.012	30.4
Labour cost	1.3	1.0	0.1	0.3	0.5	0.0	0.001	3.2
Infrastructure cost	0.8	0.6	0.0	0.5	0.3	0.0	0.001	2.3
Option 3								
Tag cost								
—tag price of $0.80	6.4	3.6	0.8	3.6	2.4	0.5	0.005	17.3
—tag price of $0.90	7.9	4.4	1.0	4.3	2.9	0.6	0.006	21.2
—tag price of $1.30	13.6	7.5	1.8	7.5	5.0	1.1	0.010	36.6
—tag price of $1.60	17.9	9.9	2.3	9.9	6.6	1.4	0.013	48.1
Labour cost	1.4	1.2	0.1	0.5	0.5	0.0	0.001	3.7
Infrastructure cost	0.8	0.6	0.0	0.5	0.3	0.0	0.001	2.3

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. Lower traceability increases the costs of implementing Option 1 and increases the biosecurity benefits for all three options. The total industry infrastructure cost is $10.6 million spread over a five-year period.
a Includes the ACT.
Source: ABARES estimates

Table 16 shows the lowest cost option for each state based on the four EID tag prices and three levels of current traceability. Assuming a current level of traceability of 90 per cent or higher, Option 1 is the lowest cost option in all states for any EID tag price. If the current level of traceability is only 85 per cent, however, then Option 2 is the lowest cost option in some states when EID tag prices are $0.90 or less. For example, assuming an EID tag price of $0.90, Option 2 is the lowest cost option in Victoria and Western Australia.

For Queensland and Tasmania, Option 1 is estimated to be the lowest cost in all cases as there are relatively few sheep passing through saleyards in Queensland or Tasmania (as noted earlier, verification and auditing in saleyards make up the bulk of costs for Option 1). In contrast, for Victoria and Western Australia, the costs of implementing Option 2 are relatively low because there are more sheep moving through the supply chain that do not require tagging. This includes tagged sheep coming from interstate and sheep produced within the state that are sold directly to slaughter or export.

Table 16 Lowest cost option, by jurisdiction

Initial traceability	EID tag price	NSW[a]	Vic.	Qld	WA	SA	Tas.	NT	Aust.
85%	$0.80	2	2	1	2	1	1	1	2
	$0.90	1	2	1	2	1	1	1	1
	$1.30	1	1	1	1	1	1	1	1
	$1.60	1	1	1	1	1	1	1	1
90%+	$0.80	1	1	1	1	1	1	1	1
	$0.90	1	1	1	1	1	1	1	1
	$1.30	1	1	1	1	1	1	1	1
	$1.60	1	1	1	1	1	1	1	1

Note: The lowest cost options are based on the estimates in Table 15.
a Includes the ACT.
Source: ABARES estimates

Trends in technology and labour costs

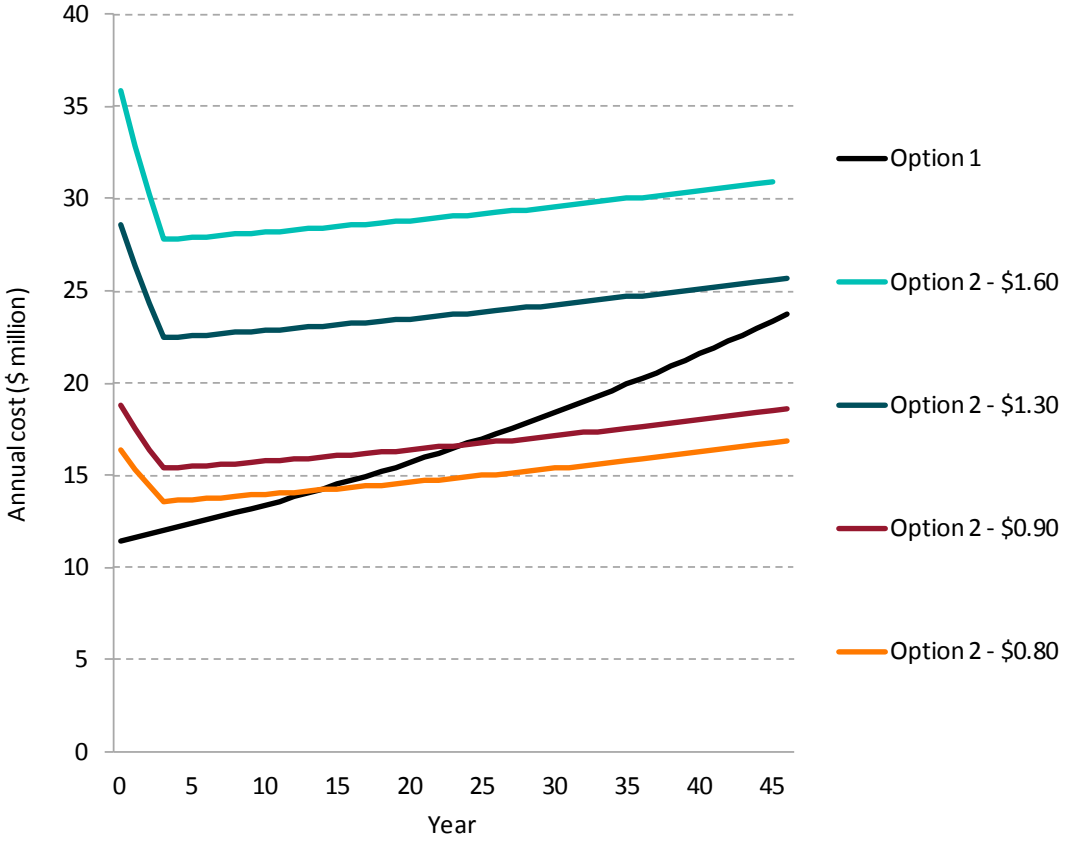
Past trends in technology and labour costs show the former to have been declining while the latter have been rising over time. With the EID system having a high technological component of its total implementation cost (in terms of capital investment in tagging and scanning equipment) and low labour component in comparison with the mob-based system, the implication is that the relative feasibility of the EID system can be expected to continue to improve over time.

In this section a stylised exercise is undertaken to demonstrate how trends in costs of labour and technology might affect investment decisions for NLIS for sheep and goats today and over time. Labour costs are assumed to rise by 1.6 per cent a year in line with the trend in real average weekly earnings over the past decade (ABS 2012b). Similar data on past and future price trends for the particular type of technology used in the full EID system are not available. Martin (2012) estimated the EID tag price to fall annually by 20 per cent in Victoria and 10 per cent in the rest of Australia between 2014 and 2017. The fall in prices is attributed mainly to expected cost savings from recycling transponders.

If labour costs rise and tag prices initially fall for a period, there could be a point in time when the annual costs of the two options equalise. Beyond this point the EID option would be increasingly preferred. The length of time that must elapse before the annual costs of the two options become equal depends on the rate of decline in tag prices and increase in labour prices.

Figure 10 shows the estimated annual costs of implementing each option if they were implemented today, under the assumption of increasing labour costs (1.6 per cent per year) and decreasing EID tag prices (10 per cent per year over the first three years of the scheme and 2 per cent thereafter). It is important to note that the decline in tag prices occurs as a result of recycling. As such, tag prices will not fall until the EID system begins to operate. For example, if an EID system were brought in at a later point, the initial tag prices are assumed to be as high as they would be if the scheme were implemented today. A 10 per cent per year decline in tag prices implies that after three years tag prices would be between $0.58 and $1.17.

Figure 10 Estimated annual implementation costs for options over time with increasing labour costs and decreasing tag prices



Note: Estimates are in 2012-13 dollars. Labour costs are assumed to increase by 1.6 per cent per year. EID tag prices are assumed to decrease by 10 per cent per year over the first three years of implementing an EID scheme.
Source: ABARES estimates

8 Stakeholder consultation process

Importance of stakeholder consultation

There is a need to consult with stakeholders where there may be a change in regulations, firstly as they would be affected by any changes, and also because they hold information which can make the analysis more accurate.

ABARES communicated with governments and agencies, industry bodies and the public in order to gain this valuable feedback.

Direct consultation with state and territory governments

During the preparation of the Consultation RIS, ABARES consulted representatives from state and territory governments. At a workshop on 17 May 2013, representatives from the Victorian, New South Wales, Queensland, Tasmanian, Western Australian, South Australian and Australian Capital Territory agriculture departments discussed proposed assumptions and other issues regarding the NLIS. The Northern Territory was unable to send a representative.

These jurisdictions agreed on the initial estimates of the current levels of traceability around the country, the targets of 98 per cent short-term and 95 per cent lifetime traceability, and tag prices. They also agreed that all of the options could achieve identical traceability levels.

Feedback from the public consultation

To ensure adequate consultation, ABARES:

- sought comments from PISC members prior to the release of the Consultation RIS
- released the Consultation RIS simultaneously on the websites of ABARES and Office of Best Practice Regulation
- allowed stakeholders eight weeks to submit their comments, from 11 October to 6 December 2013
- sent email invitations to over 35 stakeholders, inviting them to provide feedback on alternative proposals for improving the NLIS for sheep and goats as outlined in the Consultation RIS
- maintained a dedicated website, email address, telephone hotline and postal address for the NLIS consultation.

The submissions are available at daff.gov.au/abares/national-livestock-identification-scheme-stakeholder-consultation.

In total, ABARES received 108 submissions (Table 17). Of these, 37 were in a form letter from stock and land agents. The letter contains expressions of support of Option 1, support for voluntary use of RFID and concern about the cost of RFID to producers.

Individual producers, primarily from New South Wales, sent 27 submissions. Most of these express opposition to EID. The producers who oppose EID primarily do so because of the cost to

producers. A few producers who use EID in their businesses sent examples of how it has positively affected their business, but they did not necessarily advocate mandatory EID tagging.

Industry bodies sent 25 submissions, largely supporting the views of producers. Animal welfare and veterinary bodies support EID, though the view on whether there should be exemptions varied. Reasons for this support included increased individual traceability making animal welfare outcomes easier to assess, and the increased ability to contain disease outbreaks quickly.

Manufacturers or sellers of EID equipment, including tags and scanners, were in favour of EID.

Table 17 Number of submissions, by stakeholder type

Stakeholder type	Number
Stock agent form letter	37
Individual producer	27
Animal welfare and veterinary	4
Government body	7
Industry body	25
Tag and scanner manufacturer or distributor	5
Consultant	1
Research organisation	1
Duplicates	2

Source: Stakeholder submissions

Almost half of the submissions, 51 in total, came from New South Wales (Table 18). Victorians sent 19 submissions. South Australia and Western Australia sent seven submissions each. Tasmanians sent three submissions, Queenslanders sent two and there was one from the Northern Territory. The only jurisdiction not specifically represented is the Australian Capital Territory.

Table 18 Number of submissions, by jurisdiction

Jurisdiction	Number
Victoria	19
New South Wales	51
South Australia	7
Western Australia	7
Queensland	2
Tasmania	3
Northern Territory	1
Australian Capital Territory	0
Unknown	4
National	14

Source: Stakeholder submissions

Industry and government views

Table 19 presents the industry bodies and national organisations that made detailed submissions on the Consultation RIS. Many other submissions were also received; their views are included in the issue-by-issue analysis below. Most of the industry submissions supported Option 1 and opposed EID, primarily because of the increased cost to producers and the perception that a change to EID would increase the regulatory burden on the industry. Support for Option 2, EID with some exemptions, was usually given when the organisation saw the benefits of EID but did not think a non-exemptions system was feasible. Support for Option 3, EID with no exemptions, was generally because of potentially increased productivity and reduced labour costs and the enhanced biosecurity benefits.

Table 19 Stakeholders' preferred options

Stakeholder	Option 1	Option 2	Option 3
AgForce Sheep and Wool Queensland	Support		
Animals Australia			Support
Australian Live Exporters Council	Support		
Australian Livestock Markets Association	Support		
Australian Livestock and Property Agents Association		Recommends an alternative	
Australian Meat Industry Council	Support		
Australian Wool Innovation	Support		
Australian Veterinary Association		Support	
Cattle Council of Australia			No option endorsed
Department of Agriculture, Fisheries and Forestry (Queensland)		Support for options 2 and 3	
Department of Agriculture and Food Western Australia			No option endorsed
Department of Environment and Primary Industries (Victoria)		Support	Support
Department of Primary Industries (New South Wales)	Support		
Goat Industry Council of Australia	Support		
Livestock SA	Support		
Livestock and Rural Transport Association of Western Australia			No option endorsed
Livestock Saleyards Association of Victoria			Support
Mike Stephens and Associates			General support for EID
NSW Farmers Association	Support		
Miniature Goat Breeders Association of Australia		Supports, gives example exemptions	
Pastoralists and Graziers Association of Western Australia		Supports Western Australian system	
Pastoralists Association of West Darling	Support		
Primary Industries and Resources South Australia	Support		
RSPCA			Support
Sheep Cooperative Research Centre			General support for EID

Table 19 Stakeholders' preferred options *continued*

Stakeholder	Option 1	Option 2	Option 3
Sheepmeat Council of Australia	Support		
Stud Merino Breeders Association	Support		
Tasmanian Farmers and Graziers Association	Support		
United Stockowners of Australia			No option endorsed
Victorian Farmers Federation	Support		
Western Australian Farmers Federation	Support		
Wool Producers Australia	Support		

Source: Stakeholder submissions

Feedback on specific issues

ABARES asked for feedback on 12 issues in the Consultation RIS. These are outlined below with a summary of stakeholder feedback.

Issue 1: ABARES sought advice on the adequacy of the current National Livestock Identification System for sheep and goats in meeting the traceability requirements of the National Livestock Traceability Performance Standards and in reducing the biosecurity, food safety, market access and animal welfare risks.

SCoPI agreed that the current NLIS does not meet the traceability standards of the NLTPS.

A common view among prominent industry bodies was that the NLTPS goals are important and not currently being met, and that there is room for improvement in animal welfare and compliance. However, they emphasised that these issues are not necessarily specific to which NLIS system is used.

Victoria's Department of Environment and Primary Industries (DEPI) has the view that the current NLIS is not sufficient for traceability standards and advocates a change to EID. Queensland's Department of Agriculture, Fisheries and Forestry (Queensland DAFF) also has the view that the current system does not meet the NLTPS.

NSW DPI advises that, while the current system is not yet meeting NLTPS, it is capable of doing so with improvements.

The Department of Agriculture and Food Western Australia (DAFWA) submits that the current NLIS can achieve high short-term traceability if compliance is improved within the current system; however, it believes that the current system may not be able to deliver the lifetime traceability target of 95 per cent.

Primary Industries and Regions South Australia (PIRSA) recognises that the current system has limitations but says that it is meeting commercial expectations and that NSW DPI is correct that it can meet the NLTPS. PIRSA identifies inconsistent application of the current system between jurisdictions as a barrier to the current system meeting its full potential.

Many stock agents and producers submitted that the current NLIS is sufficient for the NLTPS. Many producers held that traceability could not be improved any more. Most of these producers were from NSW, where NSW DPI claims there is indeed high traceability.

The United Stockowners of Australia, a South Australian based organisation, was of the view that the NLTPS goals are unachievable with any system.

Animal welfare organisations consider the current NLIS to be inadequate for preventing risks to animal welfare, primarily because individual animals cannot be traced. A submission from the Miniature Goat Breeders Association put the view that the current NLIS is bad for the welfare of their animals because of the unsuitable ear tags used but that any system with large ear tags would be equally poor.

The Pastoralists and Graziers Association of Western Australia (PGA) submits that any flaws with traceability in the mob-based system are caused by low compliance rather than a technical problem which could be improved with a new system. As a new system would not necessarily increase compliance, the PGA submits that improvements to traceability would be achieved more efficiently through improving the current system.

The Sheepmeat Council of Australia (SCA) points out that, while the current NLIS is not meeting the NLTPS, the states and territories enforce it differently and in some cases not fully. This suggests to the SCA that improving the implementation of and compliance with current NLIS could deliver traceability benefits.

Issue 2: ABARES is seeking assistance to refine the documentation and the verification and compliance activities required to implement all options.

NSW DPI gives recommendations on compliance activities that could be used to improve the current NLIS to meet the NLTPS (Option 1). These recommendations are:

- that sheep saleyard audits or checking systems, similar to those currently occurring in NSW, should be implemented in all jurisdictions for a period of 12 months with a national compliance result obtained on the capacity of the mob-based system to meet the NLTPS
- that the scanning and uploading of NVD images from sheep saleyards into the NLIS database adds an extra level of data certainty
- that digital camera and optical character recognition (OCR) technology readability in abattoirs be used as the standard accreditation procedure for visual sheep ear tags by NLIS Ltd.
- that digital camera technology be installed at all major sheep-processing plants to improve the current NLIS system so that 99 per cent of sheep can be traced to the last property of residence
- that uploads of movements to the NLIS database of sheep and goats that have moved onto a new property be done within two days (not seven days) of the stock moving onto the property, or before the stock move again, whichever is the sooner.

Greater detail on these recommendations is provided in the submission, which may be found at daff.gov.au/abares/national-livestock-identification-scheme-stakeholder-consultation

PIRSA also gives a list of improvements to the current system:

- more accurate and complete movement documentation, particularly for non-vendor bred consignments.

- greater verification and compliance enforcement (including penalties) at key points along the supply chain, notably saleyards, abattoirs and live export depots. Procedures need to be systematic, documented and auditable.

- more complete reporting by producers of property-to-property (P2P) movements on the mob-based database (MBD). NLIS compliance should be a routine part of LPA audits, and all states should be monitoring P2P recording and following up non-compliance as is currently happening in South Australia and New South Wales.

- mandatory uploading of NVD images to the MBD by saleyards and abattoirs.

- consideration of outsourcing some compliance inspection activity to third-party sub-contractors, using a self-funding cost recovery model that would include performance incentives for individual inspectors. This initiative recognises declining commitment to verification and compliance enforcement by state jurisdictions. Only five expiation notices were issued by PIRSA during the 12 months to 31 September 2013. This is insufficient to send the market signals necessary to drive behavioural change amongst offending industry participants.

Queensland DAFF gave comments which could be applied to implementing any of the options. It suggests that transcription errors when using forms could be reduced by modifying the form design to allow machine reading. It is the view of Queensland DAFF that the use of electronic data systems, such as apps or the paperless systems used by couriers, could offer improved compliance in the longer term.

DAFWA suggested a change to the NVD/waybill under all options: the inclusion of the destination property identification code. It asserts that this, combined with its suggested expansion of the Western Australian transaction-tagging system, would make documentation simpler and less vulnerable to human error.

A common theme from industry bodies was the inconsistent application of the NLIS between jurisdictions. The NSW Farmers Association supports nationally consistent documentation requirements, which is not the current situation. The Victorian Farmers Federation and Western Australian Farmers Federation also highlight interstate inconsistencies as an issue and suggest that this could be linked to imperfect compliance.

A number of industry bodies as well as Queensland DAFF suggest that compliance with any option could be improved by adding electronic systems for forms. The Victorian Farmers Federation identifies compliance with NVDs and travel documents as an area for improvement. The Livestock Saleyards Association of Victoria supports the development of electronic documentation and verification systems, which it suggests will be less vulnerable to human error than manual or paper systems. The NSW Farmers Association agrees that the development of an electronic option for NVDs would be beneficial but cautions that paper alternatives may still be needed in areas with poor internet coverage.

Australian Wool Innovation and the Tasmanian Farmers and Graziers Association emphasise that, while compliance auditing may be needed to improve the performance of the current NLIS, they believe the cost of this should be fully met by government. Queensland DAFF suggests that NLIS should be considered a partnership between industry and government, and that compliance and verification checks should be a shared responsibility.

Issue 3: ABARES is seeking suggestions on any other viable option for improving the National Livestock Identification System for sheep and goats and information on how they might meet the National Livestock Traceability Performance Standards.

The Australian Livestock & Property Agents Association recommends a national expansion of the Western Australian system of transaction tags for non–vendor bred sheep and goats. PIRSA also advocates the use of transaction tags. DEPI asserts that transaction tags cannot feasibly meet NLTPS standards. Queensland DAFF also supports the view that transaction tagging will not meet the NLTPS. DAFWA does not assert a preferred option or advocate for the expansion of the Western Australian system.

Faye McPherson, a goat producer, explores the benefits of her own use of microchips but she acknowledges that the cost of microchips is considerably greater than that of EID ear tags. Maureen and Evan Dean, dairy goat producers, also support microchips for individual identification (among other options such as ear tags), citing their use in New Zealand as an example of their potential.

Issue 4: ABARES seeks comments on the proposed methodology for the benefit–cost analysis for the Decision RIS.

A small number of submissions expressed distrust of economic modelling techniques in general, primarily because they must to some extent rely on assumptions.

Where submissions agreed that all options could achieve the 98 per cent short-run traceability target, it agreed that examining the cost-effectiveness of each option was a suitable approach. Some submissions disputed whether some or all of the options could reach the 98 per cent target, and this was their main issue with the method.

Many submissions contained comments on the assumed costs of tags and labour. These comments have been taken into account in the revised economic analysis.

Queensland DAFF also commented that the ABARES RIS assumes a linear relationship between disease containment and traceability, while its own experience has been that this is not the case.

Issue 5: ABARES seeks advice on the measures and associated costs necessary to achieve that target [the NLTPS traceability targets of 98 per cent short-term and 95 per cent lifetime] for each option.

Most comments on costs concerned the assumptions of tag and labour costs. It was a common view from producers and industry bodies that the assumed EID tag prices used by ABARES were too low and were forecast to decrease too rapidly in the sensitivity analysis. Some cited the NLIS for cattle, which recently transitioned to EID but has not seen substantial decreases in tag costs or an increase in transponder recycling. Queensland DAFF gave the opposite view, suggesting that the price of visual tags would increase over time while the price of EID tags would decrease over time, particularly if tag recycling were introduced.

DAFWA commented on the assumed changes in labour and tag costs. In the Consultation RIS it is assumed that Option 2 would have lower labour costs than Option 3, but DAFWA believes from its experience with the cattle NLIS that a system with exemptions would in fact require more labour than one without. Queensland DAFF also suggested that exemptions would increase the labour requirements.

DAFWA suggests that overall the labour costs for both EID options are underestimated. PIRSA agrees that the assumed labour cost is too high for Option 1 and too low for options 2 and 3. DEPI emphasises the potentially high cost to jurisdictions that would result from changes to the current system and additional compliance measures being needed. Queensland DAFF also commented that implementing Option 1 would result in an increased ongoing cost to jurisdictions, as legislation would need to be implemented and compliance checks would need to be increased.

Queensland DAFF acknowledges that Option 3 in particular could result in increased infrastructure costs to saleyards, though if saleyards also process cattle, they may already have some EID-reading hardware in place. The Livestock Saleyards Association of Victoria, which supports Option 3, acknowledges this cost and suggests that governments provide funding to support saleyards.

Issue 6: ABARES seeks up-to-date information on the level of traceability, both for short run and lifetime tracing, that could be achieved under the three options, and any other proposed options.

Stakeholders put forward a variety of views on the levels of traceability achievable under the options presented. Where the targets were mentioned by government, industry or another stakeholder, most agreed that all three options had the potential to achieve the 98 per cent short-run traceability target. As mentioned in relation to Issue 1, some stakeholders gave the view that none of the options could achieve the NLTPS targets.

DAFWA is of the view that the current system, even with improvements, is unlikely to be able to achieve 95 per cent lifetime traceability. Victoria DEPI is of the view that only EID can meet the NLTPS targets. Queensland DAFF agrees that options 2 or 3, but not Option 1, could reach the 98 per cent target.

Issue 7: ABARES seeks opinions on how the alternative options to the current National Livestock System for sheep and goats may influence the operation of the Exporter Supply Chain Assurance System.

A common view from producers, stock agents and industry bodies was doubt that the NLIS would have any effect on ESCAS because the systems are separate. Other stakeholders expressed confusion about this issue, as ESCAS is a separate system to the NLIS. While NLIS regulations do not alter exporter obligations under ESCAS, tags present on sheep may be used to identify and trace them to demonstrate compliance with ESCAS.

Animal welfare organisations agreed that the individual identification abilities of EID could allow more detailed traceability under ESCAS, assuming that destination countries had the infrastructure present. It was suggested that individual identification of animals would increase capacity to identify leaks in the supply chain where only a few animals are lost.

Queensland DAFF cites the Farmer review of Australia's live export trade (2011), which proposes that individual identification of sheep and goats in the live export trade should be implemented as soon as possible.

The Victorian Farmers Federation says that, as ABARES assumes each option has identical potential for 98 per cent traceability, they should all be equal in terms of how they are used for ESCAS.

The Australian Live Exporters Council says that individual EID could only have an effect on ESCAS if foreign importers and processers adopt the scanning technology necessary to use it.

Issue 8: ABARES seeks opinions on the potential animal welfare benefits from improving the current National Livestock Identification System for sheep and goats.

There is disagreement among stakeholders on whether EID would increase handling and handling times (an adverse animal welfare outcome) or decrease it (a positive animal welfare outcome).

Some submissions argue that EID would increase the handling of animals as well as handling time, and thereby decrease welfare outcomes. Events where a tagged animal does not scan properly can cause significant delays in the loading or unloading of stock. Many producers were concerned about additional handling time caused by EID stressing animals.

Queensland DAFF asserts that EID would reduce the need to handle sheep and goats, as visual tags do not need to be checked. They suggest that this reduction in handling would reduce stress and the chance of bruising. They also suggest that EID would result in faster handling times, which could increase the speed of commerce, which can improve animal welfare.

Animal welfare and veterinary organisations submitted that the individual traceability achieved through EID would improve animal welfare outcomes. One aspect of this is the potential for data on time in transit (without food and water) to be more easily and possibly accurately recorded. Additionally the potential for increased traceability to allow diseases to be contained faster is considered a positive animal welfare outcome.

The Sheep CRC submitted that improved welfare could be achieved with EID because of its potential to make more precise management decisions about individual animals at sensitive times such as pregnancy. They also suggest the possibility of individual data such as weight and body score being recorded relatively easily, which could aid producers in monitoring the wellbeing of the mob, with minimal handling.

Issue 9: ABARES seeks information on the extent and frequency of food safety incidents and how reductions in this may differ between a mob-based and the Electronic Identification tracing system.

One submission asserted that food safety incidents with regard to sheep and goat meat are most commonly caused by post-slaughter microbial contamination. As none of the proposed options increase post-slaughter traceability, none have the potential to reduce the frequency of this type of food safety incident.

Other types of food safety incidents with sheep and goat meat involve chemical residues such as medicines used to treat the animals. The frequency of these events in Australia is very low, and submissions which mentioned residues were confident that changes to the NLIS would have a negligible effect on this.

PIRSA noted that the 10 residue investigations necessary in the last four years in South Australia were all traceable using the current NLIS.

Queensland DAFF says that food safety incidents involving sheep and goats are rare but that if a trading partner required lifetime traceability information on Australian sheep and goats for safety and market access reasons, the current NLIS would make this difficult.

Issue 10: ABARES seeks opinions on the likelihood and extent of trade restrictions that the European Union may impose on the basis of a lack of equivalence.

One submission suggested that if the EU were to begin requiring EID on imported Australian sheep and goats, the system may not be designed to match the Australian system. Queensland DAFF expects that the EU will seek to have other countries match its own electronic traceability system.

Some submissions also explained that EU markets are already open to Australian producers and exporters who choose to comply with EU requirements. Those who wish to trade with the EU are often able to do so through voluntary adoption of EU standards.

PIRSA and others comment that the value of sheep and goat trade to the EU is comparatively low and is unlikely to be a major driver of the industry profitability.

Issue 11: ABARES invites submissions about improvements in producer productivity from adopting an electronic identification system.

Where productivity was mentioned, the general view was that EID had potential to increase productivity in some businesses but that these gains rely on skilful use of the data available and innovative business practice.

A small number of producer submissions attributed their own experience of improved productivity to their use of EID. Garry Armstrong used EID to reduce the micron of his sheep wool and increase wool cut. Faye McPherson explored the benefits of EID in solving stock theft crimes. In other submissions, stakeholders gave hypothetical scenarios explaining the potential sources of productivity gains that EID might allow.

Queensland DAFF asserts that individual identification is the fastest way to increase productivity. It notes that this does require an identification process that is easy to use and that software is available to make data reviewing easier.

Some of the submissions mentioned that, while EID allows a great deal more data to be kept, no productivity benefits will be gained unless the producer takes and uses that data successfully.

Issue 12: ABARES invites comments and seeks relevant data and additional information in order to refine these cost estimates.

Many submissions gave general comments on the cost estimates used by ABARES. Producers and agents typically said that the estimated tag price was too low, and that the estimated labour cost under a visual tagging system was too high. Those general comments were consistent with the submissions which specified new data supplied by governments and industry bodies. Where EID tag prices were specifically given, they were typically higher than those used by ABARES.

More detail on the costing suggestions can be found in the revised analysis, which takes the public feedback into account.

9 Recommendations

This Decision RIS recommends that:

- the NLIS be improved through enhancing the current mob-based system
- further work be undertaken at the state level to clarify the appropriate values for initial traceability and implementation costs under all options
- traceability levels under an enhanced mob-based system, if implemented, be monitored and evaluated
- the costs and benefits of transitioning from a mob-based system to an EID system be reviewed within five years.

Recommended option and rationale

An enhanced mob-based system is the recommended option for improving the National Livestock Identification Scheme for sheep and goats. Improving the current mob-based system is expected to sufficiently address the short-term traceability standards (standards 1.1 and 1.2) set out in the NLTPS and has the potential to deliver long-term biosecurity benefits to not only industries dependent on sheep and goats but also other livestock industries that might be affected by an FMD outbreak.

The benefits and costs of enhancing the mob-based system are uncertain. The estimated net benefits of implementing such a system vary substantially with the assumed impacts of an FMD outbreak, the effect of improvements in traceability on those impacts, and the potential labour costs associated with implementing the scheme.

An enhanced mob-based system is recommended over an EID system for two main reasons:

- an enhanced mob-based system is estimated to have the highest net present value under the standard assumptions relating to the costs and benefits of implementing the three options
- an enhanced mob-based system is estimated to have a positive net present value for a greater range of assumed costs and benefits than options 2 and 3.

Impacts of an enhanced mob-based system

Table 20 summarises the costs of implementing an enhanced mob-based system at each point in the supply chain, assuming that the costs of compliance cannot be passed on to other points. Farmers, saleyards and abattoirs are expected to bear costs totalling $4.0 million a year. The majority of costs are associated with auditing and enforcement, which are most likely to be undertaken by state departments.

Table 21 summarises the total benefits and net benefits of implementing Option 1, on an annualised basis, under the standard benefit assumptions. The net benefits of implementing an enhanced mob-based system are positive in all cases and could be substantial if the impacts of an FMD outbreak are large or the effects of improved traceability are high.

Table 20 Implementation costs along the supply chain—Option 1

	Farmers	Saleyards	Abattoirs	Government	Total
Costs	1.1	2.1	0.8	7.4	11.4

Note: Costs are estimated in 2012–13 dollars at a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
Source: ABARES estimates

Table 21 Annualised benefits, net benefits and benefit-to-cost ratio for various degrees of impact and effect of improved traceability—Option 1

Reduction in FMD impact from improved traceability[a] (%)	Total benefits ($m)	Net benefit ($m)	Benefit-to-cost ratio
1	60	49	4.3
2	116	105	9.2
3	169	157	13.8

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Limitation of analysis

The estimated benefits and costs presented in this Decision RIS are sensitive to the various assumptions made around the biosecurity benefits of improved traceability and costs of implementation.

Traceability

The analysis and stakeholder feedback did not resolve two key uncertainties regarding traceability. These are:

- the overall level of current traceability against the complete set of standards stipulated in the NLTPS, especially those dealing with lifetime traceability
- the feasible level of traceability under each option.

Of the options examined in this analysis, it is assumed that when fully implemented all proposed options would provide a level of traceability of 98 per cent for standards 1.1 and 1.2 of the NLTPS, from an assumed current level of traceability of 90 per cent. To attain the higher traceability levels additional investment costs must be incurred. Moreover, there may be additional costs of achieving the target level of 95 per cent for lifetime traceability that would be needed to meet standards 3.1 and 3.2 of the NLTPS under an enhanced mob-based system.

The three options are not perfectly comparable in this Decision RIS as the additional costs and benefits of achieving a 95 per cent lifetime traceability level under an enhanced mob-based system are not included in the analysis. It is considered likely that there will be additional costs associated with achieving this target for Option 1. In contrast, the costs of options 2 and 3 in the Decision RIS are likely to implicitly capture the costs needed to achieve 95 per cent lifetime traceability, based on evidence from the cattle NLIS.

Furthermore, the debate around the technical feasibility of achieving a 98 per cent short-term traceability level, under an enhanced mob-based system, suggests that compliance and traceability should be reviewed at a future date.

Costs of implementation

There was also uncertainty around the potential costs of implementing each of the three options.

The reported price of EID tags varies considerably, ranging from as low as $0.90 in Victoria to as high as $1.65 elsewhere. Prices may come down over time through recycling of used tags, which would change the relative feasibilities of the options.

The costs of labour and infrastructure are also uncertain. Based on feedback received during the consultation period and prior work done by CIE (2010) and PWC (2010), the estimated costs for all three options could be higher or lower. In particular, doubling the costs associated with Option 1 was found to make Option 2 preferred over Option 1 under lower EID tag prices. However, while costs may be substantially higher in some jurisdictions with lower levels of traceability under the current system, overall it is unlikely that labour costs would be this high at the national level.

A number of submissions were received demonstrating the potential productivity gains that could be achieved using individual animal identification technology. However, even optimistic estimates of these benefits were insufficient to affect the preferred option at likely tag prices (greater than $0.80). In practice, the benefits of individual animal identification technology are not expected to be significant as uptake in the cattle sector has been limited.

Benefits of implementation

The major sources of uncertainty relating to the benefits of implementing the various options were the:

- ability of improved traceability to reduce the total effects stemming from various threats to biosecurity and food safety/product integrity
- actual or expected size of these impacts.

Given limited information, the benefits and costs of improving only the elements of traceability relevant to mitigating expected consequences of rapidly moving diseases (such as FMD) are estimated and compared for different options. The exclusion of animal welfare, food safety and market access benefits from the quantitative analysis is offset to some degree by the choice of high-end estimates of the impacts of an FMD outbreak used to derive the biosecurity benefits of improved traceability. It should also be noted, however, that the estimated impacts of an FMD outbreak are the product of a previous modelling exercise and subject to a range of assumptions around the costs of control, rate of spread and loss in market access (ABARES 2013).

Overview, implementation and review of an enhanced mob-based system

The enhanced mob-based system will improve upon the current system by making modifications to the business rules that improve traceability, and by enforcing compliance with the mob-based system.

Under an enhanced mob-based system, changes to the business rules will be brought into effect through synchronised changes to state-based legislation. The overall effect will be a nationally

consistent and improved approach to tracing movement of sheep and goats throughout Australia.

CIE (2010) recommended two improvements to the business rules: improvements in the accuracy and completion of movement documentation (such as NVD forms), and improvements in rules for verification and compliance with the NLIS system. Table C1 in Appendix C details the changes in business rules and types of verification and enforcement activities that would be required under the enhanced mob-based system at each point in the supply chain.

Since the preferred option builds on the current NLIS system for sheep and goats, implementation could begin sooner than other options for improving the NLIS. However, a period of time will be required for the relevant parties to understand their responsibilities under the new system.

As part of the implementation, it is recommended that further work be undertaken at the state level to clarify the appropriate values for initial traceability and implementation costs under all options.

Furthermore, it is recommended that the accuracy of the enhanced mob-based system should be assessed against the NLTPS in the near future. A repeat of Exercise Sheepcatcher (AHA 2007b), undertaken in 2007, would likely form the basis of such a review.

As highlighted in the analysis there may come a time when an EID system is more economically viable than an enhanced mob-based system for Australia as a whole. The point in time at which a transition from an enhanced mob-based system to an EID system is optimal will depend on the extent to which EID tag prices will fall with recycling, and the rate of increase in labour costs.

Furthermore, there were a number of uncertainties around the costs and benefits of implementing any of the three options. Importantly, if an enhanced mob-based system proves to be incapable, in practice, of achieving and sustaining a short term traceability level of 98 per cent, an EID system is likely to be superior, even under current costs assumptions. Accordingly, it is recommended that the possibility of transitioning to an EID system be re-examined within a five year period. A full assessment of the relative performance of the different options would be assisted if one or more jurisdictions were to adopt an EID system on a trial basis over this period.

Appendix A: National Livestock Traceability Performance Standards

Table A1 National Livestock Traceability Performance Standards

Applicable to all FMD susceptible livestock species[a]	
1.1	Within 24 hours of the relevant CVO[b] being notified[c], it must be possible to determine the location(s)[d] where a specified animal was resident during the previous 30 days.
1.2	Within 24 hours it must be also possible to determine the location(s)[d] where all susceptible animals that resided concurrently and/or subsequently on any of the properties on which a specified animal has resided in the last 30 days.
Applicable to cattle only[e]	
2.1	Within 48 hours of the relevant CVO **b** being notified **c**, it must be possible to establish the location(s)[d] where a specified animal has been resident during its life.
2.2	Within 48 hours of the relevant CVO[b] being notified[c], it must be possible to establish a listing of all cattle that have lived on the same property as the specified animal at any stage during those animals' lives.
2.3	Within 48 hours of the relevant CVO[b] being notified[c], it must also be possible to determine the current location[d] of all cattle that resided on the same property as the specified animal at any time during those animals' lives.
Applicable to all FMD susceptible livestock species except cattle (lifetime traceability excluding the preceding 30 days—addressed by 1.1 and 1.2 above)	
3.1	Within 14 days of the relevant CVO[b] being notified[c], it must be possible to determine all locations[d] where a specified animal has been resident during its life.
3.2	Within 21 days of the relevant CVO[b] being notified[c], it must also be possible to determine the location[d] of all susceptible animals that resided concurrently with a specified animal at any time during the specified animal's life.

Note:
a For the purposes of these Standards, 'FMD susceptible species' means cattle, sheep, goats, and domesticated buffalo, deer, pigs, camels and camelids.
b 'The relevant CVO' means the state or territory Chief Veterinary Officer, or their delegate, in the jurisdiction where the specified animal is located or has been traced to.
c For the purposes of these Standards, the term 'notified' means the relevant CVO is aware of an incident that required tracing.
d 'Location' means any definable parcel of land including (but not limited to): any parcel of land with a Property Identification Code, travelling stock routes, saleyards, abattoirs, feedlots, live export collection depots, showgrounds, Crown land and transport staging depots.
e Given the risks posed by bovine spongiform encephalopathy, it was considered appropriate to establish separate Standards for cattle.
Source: AHA 2012

Appendix B: Current operations

This appendix contains information on the current NLIS operations provided by each jurisdiction. ABARES has not assessed the information.

New South Wales

Mob-based NLIS is based on visual tags, movement documentation, and recording on the NLIS database.

All sheep must have an ear tag before they leave their property of birth or next property of consignment. All movements of mobs of sheep must be accompanied by a correctly completed NVD with all other tag PICs written on the NVD. Each movement must also be uploaded to the NLIS database, including property-to-property movements.

Compliance activities are undertaken at saleyards (about 50 per cent of sales) by Livestock Health and Pest Authority (LHPA) inspectors, who check that sheep are tagged for sale. Any untagged sheep are brought to the attention of the selling agents, who are then required to obtain an emergency tag to attach to any untagged sheep.

More intensive compliance inspections are carried out by LHPA inspectors at some sheep sales, where pens with non–vendor bred or mixed lines or untagged sheep are targeted. Any tagging non-compliance is instructed to be corrected and there are later re-inspections to check compliance. NVDs are examined to compare tag PICs on the sheep in the pen with 'other PICs' written by the vendor on the NVD. The saleyard operator is asked to enter any missing PICs into their software for that NVD for upload to the NLIS database. The more intensive compliance work has occurred more frequently at sheep sales since May 2013.

Occasional audits at saleyards are done in conjunction with DPI regulatory staff and rural crime Inspectors, such as in Operation Shepherd in 2011.

NSW DPI conducts quarterly desktop monitoring of NLIS compliance of every sheep saleyard and every sheep abattoir and sends each saleyard or abattoir a performance report. Areas such as compliance with required timeliness of uploads to the NLIS database, recording of NVD data, and whether to 'To' and 'From' PICs are traceable are measured and each saleyard's and abattoir's performance is ranked against other saleyards or abattoirs for that quarter. The reports on saleyard compliance are also sent to LHPA so that inspectors can follow up on poor performance.

New South Wales is the only jurisdiction reporting a high level of traceability (over 90 per cent) being achieved with the current mob-based NLIS.

Victoria

In audits of the operation of the NLIS (Sheep & Goats) in the supply chain, Victoria continues to find compliance issues—in particular those related to the accuracy of information in the NVDs. Victoria has proposed changes to the NLIS business rules to increase the traceability of the mob-based system.

Victoria does not require recording of property-to-property movements because, as other states have found, it is extremely difficult and resource intensive to monitor and enforce producer compliance.

Victoria is already progressing electronic identification of sheep and goats in its jurisdiction. It has attractively priced EID tags, scanning infrastructure in abattoirs, and a saleyard sector that is willing to implement an EID system for sheep and goats.

Queensland

The current operation of NLIS (Sheep & Goats) in Queensland still finds non–vendor bred lines of sheep and goats that have travel documents that are incomplete. These documents lack 'other PICs' information, which is vital for tracing. The percentage of non–vendor bred NVDs can be around 33 per cent at each sale but Queensland has been working on reducing this number over time. At the start, inspectors would sometimes find 80 per cent of non–vendor bred NVDs without other PICs filled in.

The property-to-property situation is impossible for Queensland inspectors to monitor other than through leads from saleyard consigned lots, and going back to properties to audit property-to-property movements recorded on the NLIS database. Inspectors do not have the ability to know when property-to-property movements are occurring, other than through roadside interception.

South Australia

NLIS (Sheep & Goats) commenced in South Australia in 2006 and operates entirely in accordance with the nationally agreed business rules. The only variation from the business rules is the timeframe for database notification—reduced from seven days to two days for movements associated with shows and other livestock events, and live export depots.

NLIS is managed in partnership with a state-based NLIS Industry Implementation Working Group on which all industry sectors are represented. It is supported by regulations under the *Livestock Act 1997*, which were updated in 2009–10 to accommodate various enhancements including the mob-based database. Two full-time equivalent staff currently allocated to the program are 90 per cent funded by the South Australian sheep industry.

Compliance monitoring and enforcement is actively undertaken by PIRSA at virtually all sheep sales. Such activity also extends to abattoirs, shows and other livestock events, seasonal ram and off-shears sales and, to a lesser extent, live export depots. Systematic audits conducted at three saleyards during 2012 consistently showed tagging compliance of 99 per cent, with movement documentation compliance at 97 per cent overall and around 85 per cent for non–vendor bred consignments.

The main ongoing issues limiting performance of the current system relate to the completeness of movement documentation accompanying non–vendor bred sheep in particular, and incorrectly identified adult (pre-2006) sheep. To date virtually no saleyards are routinely using emergency tags, and none have adequate checking and verification procedures. Consequently much non-compliance is escaping detection.

Monitoring of property-to-property movements for mob-based database compliance commenced in July 2013, recognising that compliance with this aspect of the system is very limited relative to the other key sectors.

While all industry sectors and participants have a shared responsibility for ensuring all stock are correctly identified and traceable at all points along the supply chain, in reality there is still a strong correlation between ongoing participant/system performance and compliance efforts by PIRSA.

Western Australia

Sheep being consigned from their property of birth are required to be fitted with a year colour tag embossed with the brand or PIC registered to the owner of the property, or optionally an RFID tag that is registered to the property of consignment on the NLIS database, before they leave that property. If RFID tags are used, the male button should be the year colour. Tags are required to be applied to the left ear of a male animal and the right ear of a female animal.

Sheep being consigned from a property that is not their property of birth are required to be fitted with a pink post-breeder tag embossed with the brand or PIC registered to the owner of the property they are being consigned from, or they can optionally be fitted with a pink post-breeder RFID tag that is registered to the property of consignment on the NLIS database. Post-breeder tags are required to be applied to the right ear of a male animal and the left ear of a female animal.

All movements of sheep are required to be recorded on the NLIS database as a mob-based movement unless RFIDs are fitted, in which case there is an option to transfer those devices on the database instead of a mob-based movement.

It is the responsibility of the receiver of animals to ensure that the database transfers are made; however, operators of saleyards, abattoirs and export depots are required to make the necessary transfers into and out of their premises. Agents, abattoir buyers and export buyers can use an agent's or buyer's PIC. It is their responsibility to ensure that animals transferred to their PICs are transferred off.

Untagged animals in saleyards, abattoirs and export depots are required to be tagged with pink post-breeder tags bearing a unique serial number before they leave. Movements of those animals to the premises are to be recorded on the database, including the serial number on the applied tag and the PIC of the property of consignment.

All movements of sheep are required to be accompanied by a valid waybill (or NVD/waybill). Because of the requirement for mandatory transaction tagging, only the PIC or brand of the property of consignment is required to be written on the waybill.

The allowance for use of PICs on producer tags and voluntary use of RFIDs has only recently (1 May 2013) been introduced as part of the implementation of new regulations. Previously only a brand on a visual tag could be used.

Tasmania

The *Animal (Brands and Movement) Act 1984* and the Animal (Brands and Movement) Regulations 2003 provide the basis for compulsory identification of animals, the regulation of movement of animals, a system of permanent identification of animals and other related matters. NLIS requirements for sheep and goats are embedded in these two pieces of legislation.

The Tasmanian sheep and goat industry is slightly different in nature compared to other states. The Tasmanian industry is characterised by the following attributes:

- movements of sheep and goats are less complex than movements within some mainland jurisdictions
- there is a high proportion of small- to micro-holdings (that is, hobby farms)
- there is a high proportion of movements direct to slaughter

- interstate movements are generally one way, to Victoria.

NLIS for sheep and goats in Tasmania is based on visual tags with paper mob-based movement documentation. The movement documentation can be in the form of national vendor declarations, generic vendor declarations or a movement record prescribed by legislation. Presently there is no requirement to upload sheep and goat information to the NLIS database, although some saleyards or processors may do so. This is a major point of difference compared to other states.

The adoption of a full mob-based system for sheep and goats in Tasmania has been delayed, primarily as a result of the uncertainty surrounding the final form of NLIS for sheep and goats.

Important aspects of the Tasmanian system are:

- Sheep and goats must not leave their property of residence unless tagged with an NLIS tag; to be authorised for NLIS tags the property must have a PIC. An exemption exists for dairy goats being consigned direct to slaughter or to another dairy property.
- Sheep born on a property must be identified with a breeder tag, which is colour coded by year of birth. The year-of-birth colour code system is based on eight colours, which are rotated through a cycle.
- Sheep not identified with an NLIS tag (perhaps the original tag was lost) and not on their property of birth must be identified with a pink post-breeder tag.
- Consignors dispatching sheep or goats that are already NLIS identified have two options for recording PIC information:
    - Option 1—recording all the PICs from NLIS tags attached to the animals in the consignment in addition to the PIC from which the consignment was dispatched
    - Option 2—each animal can be identified with a pink NLIS post-breeder tag and only the one PIC printed on the NLIS tag is recorded on the vendor declaration.
- From 1 January 2006 all sheep and goats must be identified with an NLIS breeder tag before being dispatched to a saleyards or to another property.
- Consignors must provide a vendor declaration (that is, NVD or a generic vendor declaration) when dispatching sheep or goats of any age to a saleyard, abattoir or another property with a different PIC; this must be retained for seven years:
    - NVDs are used for sheep consigned to a saleyards and abattoirs
    - NVDs or generic vendor declarations are used for property-to-property movements involving sales
    - movement records are used for property-to-property movements not involving sales.

Traceability of current system

The Tasmanian system at present is heavily underpinned by saleyard presence of three regional departmental officers. These officers attend saleyards for several purposes, including NLIS, animal welfare, biosecurity and general extension. Presently officers attend 85 to 90 per cent of

sales at saleyards. Monitoring and auditing from an NLIS system (database) perspective is presently negligible. Two staff are involved in other aspects of NLIS for sheep and goats.

Improvements to this system

A number of improvements are required to bring the present system in line with the basic NLIS mob-based system:

- Mandatory reporting to the NLIS database (including scanned vendor declarations and movement records)
- Ongoing extension and communications
- Improvement of compliance procedures, processes and guidelines
- Implementation of processes and agreements with industries, such as saleyards
- Increased jurisdictional monitoring and auditing of producer, saleyard and processing compliance with an emphasis on:
    - monitoring and auditing of producers, saleyards and processors through the NLIS database system
    - improving the system to detect and respond to property-to-property non-compliance.

Northern Territory

The Northern Territory currently uses a mob-based movement recording system for sheep and goats. All sheep and goats are required to be identified with an approved NLIS transaction tag identifying the property identification code (PIC) on the tag prior to movement off a property. A completed Northern Territory waybill must accompany livestock, and the original document handed to the receiving property owner on delivery. A duplicate (pink) copy is required to be sent to the department within 28 days of the stock arriving at the destination.

The movement information is recorded on the Northern Territory waybill database. All subsequent movements to properties require an additional transaction tag attached to the animal before movement; if sheep or goats are moving from a property to agistment, show or service then a further transaction tag is not required to be attached providing the ownership does not change and the animals are returning to the origin property. If sheep and goats are spelled overnight in a transit centre a further transaction tag is not required. However, a new waybill identifying the details of the second leg of the journey must be completed.

No previously attached transaction tags can be removed from an animal.

The Northern Territory has a small population of sheep and goats, and currently no abattoir or saleyard for these species. The department monitors compliance at annual shows.

Appendix C: Business rule changes and verification activities

Verification activities assumed in this report

Table C1 Verification activities under an enhanced mob-based system

Agent	Activity
On farm (sheep and goats)	Pre-sale verification—to ensure that all and only the PICs within mobs are on the NVDs. – Application of more tags to goats—rangeland goats would not be exempt. Requires investment in equipment to handle rangeland goats. – Ensure each sheep has a breeder tag and PICs correspond to NVDs. – Transaction tagging not acceptable except where tags are missing (compromises traceforward and slows the capture of PIC information to the database).
Saleyards (sheep only)	Sampling before sale—to ensure that all and only the PICs of mobs are on the NVDs. – Draft off required sample as sheep are unloaded, holding balance of mob until the sample is checked in case resample is required. – Physically manhandle sample sheep to enable read of the tag. – Record the PICs of the tags that are read—likely to involve a second person. – Reconcile the list of read tags with those listed on the NVD. – Replace missing tags where identified tags are missing. – Where the sample accords with the NVD, return the sample to the main mob. – Where they do not accord, draft another sample and repeat the process. Note: re-sampling may be more likely where original lots of non–vendor bred lines have been drafted prior to sale. Because of this issue there is the question of whether the appropriate sampling point is 'off the truck' or post drafting—noting that in the latter case re-sampling would be more frequent as the distribution of the secondary PICs may well be quite different post drafting into sale lots. Over time the extent and focus of sampling can be expected to change given a risk-based approach to the sampling. It would be anticipated that the extent of sampling would fall both as compliance increased and as industry adjusted to the costs of sampling. Sampling after sale prior to loading—to ensure that all and only the PICs of mobs are on the NVD following the sale. – Note that there is a degree of drafting of lots during the sale to meet buyer requirements, which would necessitate additional sampling. Auditing by department or third party—to ensure that the integrity of the sampling process: – Occasional/random third party verification through either verifying the process, or the sample draft. – Fines to apply to third-party and/or loss of employment—to ensure independence and integrity of sampling process. Inspection by department or third party—to ensure integrity of NVDs. – Cross-check saleyard summary against the NVD information on the database to ensure the consistency of records. – Enforcement of non-compliance, including advice, warnings, potential penalties for offenders.
Depots (goats only)	Verification—to ensure that all goats are correlated with NVDs.

Table C1 Verification activities under an enhanced mob-based system *continued*

Agent	Activity
Depots (goats only)	– Unmanaged goats moving through depots to the abattoir would not be exempt. – Depot operators to inspect goats to ensure presence of a tag and correlation with NVD. – Goats to be kept separate to ensure that they stay with the mob of property of origin. – Depots to upload mob-based movement information onto the database. – That is, same rules as sheep saleyards. – Random inspections in Qld, NSW, WA, Vic. and SA—one inspector per state. – Ensure that either process or outcome of verification is satisfactory. Auditing by department—to ensure verification completed at depots. – Random inspections in Qld, NSW, WA, Vic. and SA—one inspector per state. – Ensure that either process or outcome of verification is satisfactory.
Live export	– No additional verification or compliance required—satisfactory under current system. – AQIS is enforcing the Australian Standards for Export of Livestock.
Abattoirs	Verification—to ensure PICs are correlated with NVDs. – Verify tag against NVD for each animal—range of systems possible, but likely to require touchscreen or photographic system, and computer plus software to handle mixed PIC mobs. – Detection of incorrect NVD completion or missing tags to be followed up. Auditing by department of third party—to ensure the recording of all carcasses on NVDs and database. – Third party to audit the database and ensure consistency with kill sheets. Enforcement to ensure appropriate processes at abattoir. – Third party to inspect processes at abattoir to ensure that PICs from animals correspond to the NVDs. – Exposure of non-compliance beyond the level deemed acceptable; ongoing monitoring of processors 'at risk' of non-compliance. – Advice, warnings and fines or otherwise to deter non-compliance.
System level	System improvement—to reduce cost and risk of non-compliance or increase efficiency. – Database and system refining. – Research and development—development of technology options to assist with verification to reduce costs and increase accuracy of information. For instance, better sampling methods in saleyards or photographic capture of visual tag then uploaded to database. – Improve recording methods to facilitate easier reading and recording of PICs. Education and training. – Ongoing education on the requirements and penalties for non-compliance. – Training of auditors and inspectors to ensure system checks and balances are maintained.

Source: CIE (2010)

Business rule changes and verification procedures proposed by Victoria

The following business rule changes were proposed by Victoria to improve performance of the current NLIS (Sheep & Goats) system (Britt 2013a):

1) Use of transaction tags as a method for identifying non–vendor bred sheep and goats will no longer be permitted.

Explanation—The CIE (2010) report identified that while transaction tagging enhances traceback (establishing the sequence of the property identification codes [PICs] of residence in an animal's life), it compromises long term trace-forward (locating animals that have resided on a PIC concurrently with an animal of interest during that animal's life). The CIE (2010) report concluded that transaction tagging needed to be removed as an option for non–vendor bred sheep.

In the absence of transaction tagging, producers selling non–vendor bred sheep will need to record the PICs on the tags attached to introduced sheep, typically by the breeder, on the NVDs that they supply at the time of dispatch. This will improve the ability to 'trace-forward' because the 'additional PICs' recorded by consignors of non–vendor bred sheep will be available to record by receivers in mob based uploads to the NLIS database.

2) For sheep and goats traded—through saleyards, or sent directly to an abattoir for processing, or arriving at a depot in preparation for live export, or received by a producer directly from another producer—the person receiving the sheep and goats must within 2 days upload to the NLIS database a pdf of the verified, accompanying NVD.

Explanation—Storing pdfs of National Vendor Declarations (NVDs) on the NLIS database is currently voluntary. Storing NVD images on the NLIS database would help when NVDs need to be located during a disease emergency. It would also help with auditing of participant compliance with the system.

3) Mob-based movement recording for property-to-property movements needs to be mandatory with completion required within two days of arrival.

Explanation—To facilitate prompt traceback and trace-forward, mob-based movement recording needs to occur for property movements including for movements into live export depots. 'Additional PICs' recorded on NVDs or detected on post-arrival inspection need to form part of the mob-based movement upload. An appropriately resourced audit program, including on-farm checking of records, to support the legislation is needed to monitor compliance.

4) Verification procedures need to be mandated to ensure the traceability of incoming stock before they are permitted to move forward in the supply chain.

Explanation—Verification is crucial to ensuring sheep and goats are correctly identified with visually readable NLIS (Sheep & Goats) approved devices, and that accompanying NVDs are complete and accurate, before animals are permitted to move forward in the supply chain. Verification needs to occur in a systematic manner as part of documented standard operating procedures. Details of verification procedures for different sectors are shown in Table C2.

Verification procedures

Saleyards are critical points in the supply chain from a disease control perspective as animals arrive for sale from numerous consignors, have contact with one another, and are dispersed to a range of buyers.

Where the industry performs verification at each point along the supply chain, such procedures need to be subject to periodic third-party or government audit to confirm they are operating as expected. Sanctions through industry quality assurance arrangements or legal action should be available as a remedy if evidence that procedures are not being followed is detected. Where performed by government, such procedures would need to be subject to periodic independent audit to confirm they are operating as expected.

Table C2 Examples of verification procedures in saleyards for incoming stock

Issue	Procedure	Record keeping	Corrective action
Untagged sheep—one or more in a consignment	Inspect each incoming consignment for the presence of untagged sheep. Producers, live export depots and saleyards to maintain a supply of pink post-breeder tags printed with relevant PIC and a serial number.	When no untagged sheep are detected in a consignment, make record confirming checking has occurred. For each post-breeder tag used record in the tag register the serial number sequence against the PIC of dispatch (saleyards to include with copy of NVD and post-sale summary). Establish a post-breeder tag register. For processors and saleyards: – Where mobs have been returned to the vendor, record the movements as part of the mob-based movement upload.	Saleyards, producers and live export depots: – Tag untagged sheep in the consignment with a saleyard post-breeder tag – Mobs where no sheep has an NLIS tag may be returned to the vendor's property. Processors: – Where more than 2% of the consignment is untagged, alert the state department of primary industries/agriculture of the PIC of dispatch and date of arrival. Only process if the last PIC of residence is known. – Mobs where no sheep has an NLIS tag may be returned to the vendor's property; however, the state department of primary industries/agriculture must also be alerted.
Incomplete, inaccurate or absent NVD	Check there is an accompanying NVD for all incoming consignments. Check Q3 on NVD for declared vendor bred and non–vendor bred consignments. Follow checking procedure (below).	Make record confirming the NVD has been checked. Record remedial action, if required.	Saleyards and processors: – If an NVD is yet to arrive, hold sheep until a completed NVD arrives. Do not sell or process. – For incomplete and inaccurate NVDs, do not sell or process until NVD deficiencies have been remedied, as appropriate. Producers and live export depots: – Report incomplete or inaccurate NVDs to state department.
Vendor-bred checking procedure Confirm that sheep that are declared 'vendor bred' all have tags with a PIC identical to that on the accompanying NVD.	Check tags on a minimum of 5% of sheep in each consignment to confirm that the PICs on tags match the NVD PIC. Take particular note of variations in the brands of tags used.	Make record confirming that each consignment or line has been checked (saleyards to also record the PIC on the tags that were examined). Record remedial action if required.	– If 'rogue PICs' (that is, PICs not recorded on NVD) are present, before sheep are sold/processed/introduced check tags on each sheep in the consignment and establish a list of all PICs present on tags. Append a record of these to the NVD and in the mob-based movement upload.

Table C2 Examples of verification procedures in saleyards for incoming stock *continued*

Issue	Procedure	Record keeping	Corrective action
Non–vendor bred checking procedure Confirm that sheep that are declared 'non–vendor bred': – have all tag PICs recorded, or – are identified with a post-breeder tag with a PIC matching that on the NVD.	Check tags on a minimum of 10% of sheep in each consignment to confirm that the PICs on tags match the NVD PICs. If there is a suspicion that more additional PICs are recorded than actually present on tags in the mob, check tags on all sheep and record PICs present.	Make record confirming each consignment/line has been checked (saleyards record the PICs on the tags checked). Record remedial action if required.	If 'rogue PICs' are present, before sheep are sold or processed check tags on each sheep in the consignment and establish a list of all PICs present on tags. Append a record of these to the NVD and in the mob-based movement upload.
Transcription errors in NVD 'additional PICs', and WA brands (which are used in WA on tags instead of PICs).	Where established that a PIC has been recorded incorrectly, check all sheep in the consignment and record from the tags on sheep the correct PIC and attach to the NVD a record of the corrected PIC and record in the mob based movement. Saleyards and processors: – Ensure software can accommodate WA brands and has state algorithms to detect PICs that contain transcription errors. – Enter all 'additional PICs' into PIC checking software before sheep are sold.	Ensure all PICs recorded for non–vendor bred sheep are correct and are entered on mob-based movement files and PSSs.	The PICs actually present on tags (that is, with transcription corrected) must be included in mob-based movement uploads and post-sale summaries. – PICs that contain transcription errors must be corrected before sheep are released to buyers. – Corrected PICs must be included on mob-based movement files that are uploaded to the NLIS database.

Source: Britt (2013a)

Appendix D: Costs of implementing options—methods and assumptions

This appendix outlines the methods and assumptions used to calculate the cost of each proposed option. Costs estimated for each option are calculated as the additional costs over and above the base case. All costs are estimated over a 25-year period, using a discount rate of 7 per cent.

Data sources are listed at the end of the appendix.

Table D1 Summary of key assumptions under the standard scenarios

	Option 1	**Option 2**	**Option 3**
Timeframe and implementation			
Implementation timeframe	Full implementation from 2014	Phased in from 2014. By 2018 system is fully implemented.	Phased in from 2014. By 2018 system is fully implemented.
Implementation and infrastructure costs	None	Total infrastructure and implementation costs of $10.6 million.	Total infrastructure and implementation cost of $10.6 million.
Estimation of ongoing labour costs			
Number of animals costed (based on animals turned off)	For Option 1, approximately 35 million animals.	When Option 2 is fully implemented, approximately 23 million animals.	When Option 3 is fully implemented, approximately 35 million animals.
Labour costs	– Increase of $0.03 per sheep or goat off farm over base case. – Increase of $0.345 per sheep through saleyard over base case. – Increase of $0.075 per sheep through abattoir over base case.	– Increase of $0.11 per sheep through saleyard over base case. – Increase of $0.055 per sheep through abattoir over base case.	– Increase of $0.11 per sheep through saleyard over base case. – Increase of $0.055 per sheep through abattoir over base case.
Estimation of tag costs			
Number of animals costed (based on lambs marked and goats turned off)	Same as current system	When Option 2 is fully implemented, a total of approximately 23 million animals annually.	When Option 3 is fully implemented, a total of approximately 35 million animals annually.
Additional cost per tag	No additional costs	Difference between electronic and visual tag costs (visual tag = $0.35): —$0.45 with an EID tag price of $0.80 —$0.55 with an EID tag price of $0.90 —$0.95 with an EID tag price of $1.30 —$1.25 with an EID tag price of $1.60	Difference between electronic and visual tag costs (visual tag = $0.35): —$0.45 with an EID tag price of $0.80 —$0.55 with an EID tag price of $0.90 —$0.95 with an EID tag price of $1.30 —$1.25 with an EID tag price of $1.60

Source: ABARES assumptions

Option 1: Enhanced mob-based system

The enhanced mob-based system focuses on improvements to the current system; these aim to ensure full compliance through improved verification and auditing activities. The increase in cost over the base case is calculated as the additional labour costs incurred for full compliance. Estimates are based on assumptions of verification and enforcement costs from CIE (2010) and ABARES estimates of the number of sheep and goats moving through the supply chain. No infrastructure or equipment costs have been estimated as the additional cost is only the extra labour required to improve compliance in the current system. Rules for tagging in this option are identical to those in the baseline, and so there are no additional tag costs. Table D2 outlines the key assumptions used in estimating the costs of enhancing the mob-based system.

Table D2 Detailed cost assumptions for enhanced mob-based system (Option 1)

Cost	Point in supply chain	Previous estimates of costs (CIE 2010)	ABARES assumption[a]
Ongoing verification	Farmers	$0.5 million for verification of additional sheep $0.7 million for verification of goats These costs were estimated for 40.5 million sheep and 2 million goats sold off farms each year, implying a cost of 2.8 cents per head for sheep and goats combined.	3.0 cents per sheep or goat sold off farms
	Saleyards	$0.7 million for sampling mobs on entry $0.7 million for rectifying non-compliance. This includes replacing missing tags, correcting NVD forms, or returning non-compliant mobs to vendors. $0.6 million for sampling mobs on exit These costs were estimated for 24.2 million sheep and 1.71 million goats moving through saleyards and depots each year, implying a cost of 8.1 cents per head for sheep and goats combined.	9.0 cents per sheep or goat moving through saleyards or depots
	Abattoirs	$0.6 million for verification of additional sheep (31.7 million instead of 14 million) but at a reduced cost for all sheep (5 cents instead of 10 cents) $0.14 million for verification of 1.4 million goats at a cost of 5 cents per goat Total increase in verification costs of $0.74 million, implying a cost of 2.2 cents per head for sheep and goats combined.	2.5 cents per sheep or goat processed by abattoirs
Ongoing auditing	Saleyards	36 full-time inspectors at $0.13 million per inspector per year These costs were estimated for 24.2 million sheep and 1.71 million goats moving through saleyards and depots each year, implying a cost of 23.3 cents per head for sheep and goats combined.	25.5 cents per sheep or goat moving through saleyards or depots
	Abattoirs	6 full-time inspectors and 6 full-time auditors at $0.13 million per person per year (CIE 2010) These costs were estimated for 31.7 million sheep and 1.4 million goats processed in abattoirs each year, implying a cost of 4.5 cents per head for sheep and goats combined.	5.0 cents per sheep or goat processed by abattoirs

Note:
a Includes indexation to 2012–13 dollars and rounding.
Source: CIE (2010)

Option 2 and Option 3: Electronic tag-based systems

Option 2 and Option 3 are identification systems based on electronic tagging. Additional costs incurred for the system include an initial payment for infrastructure (capital costs), ongoing costs for tags and marginal increases in labour costs over the baseline.

The capital costs associated with installing the necessary equipment (including scanners and related hardware and software) to implement an electronic identification system were based on cost estimates provided by the PIMC Working Group (2012) and PWC (2010). Although some pathways are exempt from using EID tags, in Option 2 they would be required to have and use EID equipment because of movements of livestock from the saleyards (which are not exempt). As such, the capital costs for both options are assumed to be identical.

Most costs under this system are the ongoing costs, which are principally the cost to electronically tag all sheep and goats moving through the supply chain. CIE's (2010) estimate of the cost per tag is relatively similar to calculations of the PIMC Working Group (2012).

A small increase in labour resources for the electronic system over the baseline system is expected based on PWC (2010) estimates. This study accounts for the additional labour to ensure all sheep and goats have a certified EID tag and are properly scanned. ABARES acknowledges other cost estimates may suggest scanning and labour costs are lower than assumed in this report. However, given limited available information, the costs of scanning under EID options relative to the baseline have been estimated based on PWC (2010). The PWC report accounts for additional labour requirements under these options and reflects the findings of both the PWC (2010) and the PIMC Working Group (2012).

Table D3 outlines the key assumptions used in estimating the costs of options 2 and 3.

Table D3 Detailed cost assumptions for EID systems (options 2 and 3)

Cost	Point in supply chain	Previous estimates of costs (PWC 2010, PIMC Working Group report 2012)	ABARES assumption[a]
Ongoing labour	Saleyards	10 cents per sheep for rescanning and rectifying sheep or goats that are missed or have non-readable tags (PWC 2010)	11 cents per sheep or goat
	Abattoirs	5 cents per sheep for rescanning and rectifying sheep or goats that are missed or have non-readable tags (PWC 2010)	5.5 cents per sheep or goat
Ongoing tagging	Farmers	Electronic tag prices range from around $0.90 in Victoria to $1.60 elsewhere. Visual tag prices are $0.30 to $0.50 per tag (PIMC Working Group report 2012).	Four EID tag prices are considered: $0.80, $0.90, $1.30 and $1.60. Visual tags are assumed to cost $0.35.
Infrastructure	Farmers	$3 million for scanning equipment—based on one scanner each for 10 000 producers at $300 per scanner (PIMC Working Group report 2012) $0.5 million for tag applicators—based on one applicator each for 47 000 producers at $12 per applicator (PIMC Working Group report 2012)	$3.6 million every five years

Table D3 Detailed cost assumptions for EID systems (options 2 and 3) *continued*

Cost	Point in supply chain	Previous estimates of costs (PWC 2010, PIMC Working Group report 2012)	ABARES assumption[a]
Infrastructure	Saleyards	$1.4 million, based on an average installation cost of $30 000 for 46 large saleyards (PIMC Working Group report 2012) $0.29 million, based on an average installation cost of $5300 for 56 remaining saleyards (PIMC Working Group report 2012)	$1.8 million every five years
	Abattoirs	$4 337 000 based on capital installation costs of $2 667 000 and training costs of $1 671 000 (PIMC Working Group report 2012)	$4.5 million every five years
	Live exporters	$0.63 million, based on an average cost of $30 000 per site for 21 registered premises (PIMC Working Group report 2012) $0.1 million for 15 DAFF approved export premises (PIMC Working Group report 2012)	$0.8 million every five years

Note:
a Includes indexation to 2012–13 dollars and rounding.
Source: PWC (2010)

The number of animals moving through the supply chain was calculated as a percentage of the estimated total flock of sheep and goats turned off each year (based on a five-year turn-off rate from 2007–08 to 2011–12). The total flock of sheep and goats was estimated at approximately 77 million with around 35 million animals turned off annually. The proportion of sheep and goats moving through different parts of the supply chain was then estimated using data from the ABARES Australian Agricultural and Grazing Industry survey. All supply chain movements were estimated using statistics from ABARES, the ABS and Department of Agriculture transaction levy data.

Additional costs over the baseline for Option 1 are estimated as the increased ongoing labour costs for verification and enforcement activities. This cost applies to all 35 million animals passing through the supply chain in which extra labour is used to ensure full compliance. Additional labour costs for Option 2 and Option 3 differ to Option 1 as a result of the phasing in of the electronic system.

Using ABARES statistics it is estimated that 25 per cent of the Australian sheep herd are turned off each year. As such, it is assumed on average that 100 per cent of the herd in Year 0 would be turned off by Year 5. While some animals may be retained beyond Year 5, assumptions are based on the average observation, which is assessed in Year 5. Therefore, in Year 1 through Year 4 the additional labour costs would only apply to lambs. Once all adult sheep with visual tags have exited the system, which is assumed to occur in Year 5, all animals moving through the relevant supply chains would have an electronic tag and be included in the estimation of costs.

When fully implemented, ongoing labour costs for Option 2 are calculated based on the number of livestock passing through non-exempt pathways. Under Option 2, ongoing labour costs would only apply to about 23 million animals because 12 million animals would have been exempted each year. For Option 3 labour costs are based on the total number of animals passing through the supply chain each year, estimated at 35 million.

The required number of electronic tags is based on the number of lambs marked and the number of goats turned off each year. This would provide an estimate for the total annual tag costs for this option. The total number of animals tagged in Option 3 has been calculated as the number of lambs marked that would move through non-exempt routes of the supply chain. The cost of tags in Option 2 also includes the number of marked lambs that would not be turned off in Year 1, but sold later as adult sheep. The major cost saving in Option 2 would be the reduced number of animals tagged compared to Option 3.

Data sources

Table D4 summarises the sources of data used to derive sheep and goat movements and the assumptions to estimate costs.

Table D4 Data sources

Data source	Variables
ABARES (2012a) AAGIS survey data	Sheep turn-off rates Percentages of sheep sales by destination
ABARES (2012c) agricultural commodity data	Sheep flock Sheep and lambs slaughtered Live exports
ABS (2012a, b) data on agricultural commodities	Lambs marked
DAFF (2012) transaction levy data	Goats slaughtered Goats transacted
FAO (2012) agriculture statistics	Goat population estimates
Centre for International Economics (2010) report on NLIS	Labour costs for enhanced mob-based system
PricewaterhouseCoopers (2010) reports on NLIS	Labour costs for electronic tagging identification systems Electronic tagging equipment costs
PIMC Working Group (2012) report on NLIS	Capital cost estimates

Appendix E: Illustration of estimated reduction in disease cost

Table E1 Expected annual disease cost at different traceability percentages and disease scale, using a 5 per cent decline in disease cost for a one percentage point increase in traceability

Expected cost of an FMD outbreak	**$17b**	**$52b**
Traceability (%)	Expected annual cost ($m)	
90	255	780
91	242	741
92	230	704
93	219	669
94	208	635
95	197	604
96	187	573
97	178	545
98	169	517

Note: Estimates are in 2012-13 dollars. Annual expected costs assume a probability of incursion of 0.015 for all outbreak sizes. Disease costs are sourced from Matthews 2011 ($17b) and ABARES 2013 ($52b).
Source: ABARES estimates

Benefits from each option are calculated as the difference between disease cost at the baseline level of traceability (90 per cent) and its cost at the target traceability of 98 per cent.

Appendix F: Results under standard assumptions

For each given NLIS option, assumed reduction in disease outbreak costs and outbreak size Table F1 and Table F2 show:

- the present value of the cost of implementing the option (present value costs)
- the present value of gross benefits (present value gross benefits)
- the net present value, which is present value of benefits less present value of costs
- the benefit–cost ratio.

Present values are estimated using a 7 per cent discount rate, to allow comparison of benefits and costs over time.

Table F1 Performance measures over a range of percentage reductions in a potential FMD cost of $17 billion

Option	**Reduction in FMD impact from improved traceability[a] (%)**		
	1	2	3
Option 1			
Present value cost ($m)	133	133	133
Present value gross benefits ($m)	230	443	643
Net present value ($m)	96	310	509
Benefit–cost ratio	1.7	3.3	4.8
Electronic identification tag price = $0.80			
Option 2			
Present value cost ($m)	191	191	191
Present value gross benefits ($m)	230	443	643
Net present value ($m)	38	252	451
Benefit–cost ratio	1.2	2.3	3.4
Option 3			
Present value cost ($m)	272	272	272
Present value gross benefits ($m)	230	443	643
Net present value ($m)	-42	172	371
Benefit–cost ratio	0.8	1.6	2.4
Electronic identification tag price = $0.90			
Option 2			
Present value cost ($m)	220	220	220
Present value gross benefits ($m)	230	443	643
Net present value ($m)	10	224	423
Benefit–cost ratio	1.0	2.0	2.9

Table F1 Performance measures over a range of percentage reductions in a potential FMD cost of $17 billion *continued*

Option	Reduction in FMD impact from improved traceability[a] (%)		
	1	2	3
Option 3			
Present value cost ($m)	317	317	317
Present value gross benefits ($m)	230	443	643
Net present value ($m)	–87	127	326
Benefit–cost ratio	0.7	1.4	2.0
Electronic identification tag price = $1.30			
Option 2			
Present value cost ($m)	333	333	333
Present value gross benefits ($m)	230	443	643
Net present value ($m)	–103	110	310
Benefit–cost ratio	0.7	1.3	1.9
Option 3			
Present value cost ($m)	496	496	496
Present value gross benefits ($m)	230	443	643
Net present value ($m)	–266	–52	147
Benefit–cost ratio	0.5	0.9	1.3
Electronic identification tag price = $1.60			
Option 2			
Present value cost ($m)	418	418	418
Present value gross benefits ($m)	230	443	643
Net present value ($m)	–189	25	224
Benefit–cost ratio	0.5	1.1	1.5
Option 3			
Present value cost ($m)	630	630	630
Present value gross benefits ($m)	230	443	643
Net present value ($m)	–401	–187	12
Benefit–cost ratio	0.4	0.7	1.0

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.

a As a result of a one percentage point increase in traceability.

Source: ABARES estimates

Table F2 Performance measures over a range of percentage reductions in a potential FMD cost of $52 billion

Option	Reduction in FMD impact from improved traceability[a] (%)		
	1	2	3
Option 1			
Present value cost ($m)	133	133	133
Present value gross benefits ($m)	702	1357	1966
Net present value ($m)	569	1223	1833
Benefit–cost ratio	5.3	10.2	14.8
Electronic identification tag price = $0.80			
Option 2			
Present value cost ($m)	191	191	191
Present value gross benefits ($m)	702	1 357	1 966
Net present value ($m)	511	1 165	1 775
Benefit–cost ratio	3.7	7.1	10.3
Option 3			
Present value cost ($m)	272	272	272
Present value gross benefits ($m)	702	1 357	1 966
Net present value ($m)	431	1 085	1 694
Benefit–cost ratio	2.6	5.0	7.2
Electronic identification tag price = $0.90			
Option 2			
Present value cost ($m)	220	220	220
Present value gross benefits ($m)	702	1 357	1 966
Net present value ($m)	482	1 137	1 746
Benefit–cost ratio	3.2	6.2	8.9
Option 3			
Present value cost ($m)	316	316	316
Present value gross benefits ($m)	702	1 357	1 966
Net present value ($m)	386	1 040	1 649
Benefit–cost ratio	2.2	4.3	6.2
Electronic identification tag price = $1.30			
Option 2			
Present value cost ($m)	333	333	333
Present value gross benefits ($m)	702	1 357	1 966
Net present value ($m)	368	1 023	1 632
Benefit–cost ratio	2.1	4.1	5.9
Option 3			
Present value cost ($m)	496	496	496
Present value gross benefits ($m)	702	1 357	1 966

Table F2 Performance measures over a range of percentage reductions in a potential FMD cost of $52 billion *continued*

Option	Reduction in FMD impact from improved traceability[a] (%)		
	1	2	3
Net present value ($m)	206	861	1 470
Benefit–cost ratio	1.4	2.7	4.0
Electronic identification tag price = $1.60			
Option 2			
Present value cost ($m)	418	418	418
Present value gross benefits ($m)	702	1 357	1 966
Net present value ($m)	283	937	1 546
Benefit–cost ratio	1.7	3.2	4.7
Option 3			
Present value cost ($m)	630	630	630
Present value gross benefits ($m)	702	1357	1966
Net present value ($m)	72	726	1335
Benefit–cost ratio	1.1	2.2	3.1

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The initial level of short-term traceability is assumed to be 90 per cent. The total industry infrastructure cost is $10.6 million spread over a five-year period.

a As a result of a one percentage point increase in traceability.

Source: ABARES estimates

Appendix G: Results under full range of assumptions

This appendix presents detailed results for the full range of cost and benefit assumptions used in the analysis. Table G1 shows estimates of NPV for various assumptions regarding:

- the impacts of an FMD outbreak on the Australian economy
- the effects of increased traceability on the impacts of an FMD outbreak
- the initial level of traceability
- the potential on-farm productivity benefits from the use of EID technology
- EID tag prices
- labour and infrastructure costs.

Table G2 shows the preferred option under each scenario based on estimates of NPV reported in Table G1. 'None' indicates that no option is economically viable. Table G3 presents estimates of net present value for a high (0.10) and low (0.03) discount factor. Changes in the discount factor within this range did not have an effect on the preferred option under the standard cost and benefit assumptions.

Table G1 Estimates of net present values under various scenarios, labour costs and EID tag prices

Scenario description							NPV of options ($m)								
FMD impact ($b)	Reduction in FMD impact[a] (%)	EID non-tag costs	EID productivity benefits ($m)	Initial traceability level (%)	Option 1 labour costs	Option 1 feasible traceability (%)	Option 1	Option 2				Option 3			
								$0.80	$0.90	$1.30	$1.60	$0.80	$0.90	$1.30	$1.60
17	1	Normal	0	90	Normal	98	96	38	10	- 103	- 189	- 42	- 87	- 266	- 401
17	1	***High***	0	90	Normal	98	96	- 45	- 73	- 187	- 272	- 132	- 177	- 356	- 491
17	1	Normal	***80***	90	Normal	98	96	89	61	- 53	- 138	38	- 7	- 186	- 321
17	1	Normal	***160***	90	Normal	98	96	140	111	- 2	- 87	118	73	- 106	- 241
17	1	Normal	***160***	***85***	Normal	98	147	274	246	132	47	252	207	28	- 107
17	1	Normal	0	***85***	Normal	98	147	173	144	31	- 54	92	47	- 132	- 267
17	1	Normal	0	***95***	Normal	98	36	- 105	- 133	- 247	- 332	- 186	- 231	- 410	- 544
17	1	Normal	0	***85***	***High***	98	- 69	173	144	31	- 54	92	47	- 132	- 267
17	1	Normal	0	90	***High***	98	- 37	38	10	- 103	- 189	- 42	- 87	- 266	- 401
17	1	Normal	0	90	Normal	***95***	60	38	10	- 103	- 189	- 42	- 87	- 266	- 401
17	2	Normal	0	90	Normal	98	310	252	224	110	25	172	127	- 53	- 187
17	2	***High***	0	90	Normal	98	310	169	141	27	- 58	82	37	- 142	- 277
17	2	Normal	***80***	90	Normal	98	310	303	275	161	76	252	207	27	- 107
17	2	Normal	***160***	90	Normal	98	310	354	325	212	127	332	287	107	- 27
17	2	Normal	***160***	***85***	Normal	98	470	597	568	455	369	575	530	350	216
17	2	Normal	0	***85***	Normal	98	470	495	467	353	268	415	370	190	56
17	2	Normal	0	***95***	Normal	98	125	- 16	- 45	- 158	- 243	- 97	- 142	- 321	- 456
17	2	Normal	0	***85***	***High***	98	253	495	467	353	268	415	370	190	56
17	2	Normal	0	90	***High***	98	177	252	224	110	25	172	127	- 53	- 187
17	2	Normal	0	90	Normal	***95***	194	252	224	110	25	172	127	- 53	- 187
17	3	Normal	0	90	Normal	98	509	452	423	310	224	371	326	147	12

Table G1 Estimates of net present values under various scenarios, labour costs and EID tag prices *continued*

Scenario description							NPV of options ($m)								
FMD impact ($b)	**Reduction in FMD impact[a] (%)**	**EID non-tag costs**	**EID productivity benefits ($m)**	**Initial traceability level (%)**	**Option 1 labour costs**	**Option 1 feasible traceability (%)**	**Option 1**	**Option 2**				**Option 3**			
								$0.80	**$0.90**	**$1.30**	**$1.60**	**$0.80**	**$0.90**	**$1.30**	**$1.60**
17	3	***High***	0	90	Normal	98	509	368	340	227	141	281	236	57	- 77
17	3	Normal	***80***	90	Normal	98	509	502	474	360	275	451	406	227	92
17	3	Normal	***160***	90	Normal	98	509	553	524	411	326	531	486	307	172
17	3	Normal	***160***	***85***	Normal	98	755	882	853	740	655	860	815	636	501
17	3	Normal	0	***85***	Normal	98	755	781	752	639	553	700	655	476	341
17	3	Normal	0	***95***	Normal	98	210	68	40	- 74	- 159	- 12	- 57	- 236	- 371
17	3	Normal	0	***85***	***High***	98	539	781	752	639	553	700	655	476	341
17	3	Normal	0	90	***High***	98	376	452	423	310	224	371	326	147	12
17	3	Normal	0	90	Normal	***95***	318	452	423	310	224	371	326	147	12
52	1	Normal	0	90	Normal	98	569	511	483	369	284	430	386	206	72
52	1	***High***	0	90	Normal	98	569	428	400	286	201	341	296	117	- 18
52	1	Normal	***80***	90	Normal	98	569	562	533	420	335	510	466	286	152
52	1	Normal	***160***	90	Normal	98	569	612	584	470	385	590	546	366	232
52	1	Normal	***160***	***85***	Normal	98	897	1 023	995	882	796	1 002	957	777	643
52	1	Normal	0	***85***	Normal	98	897	922	894	780	695	842	797	617	483
52	1	Normal	0	***95***	Normal	98	220	79	50	- 63	- 148	- 2	- 47	- 226	- 361
52	1	Normal	0	***85***	***High***	98	680	922	894	780	695	842	797	617	483
52	1	Normal	0	90	***High***	98	436	511	483	369	284	430	386	206	72
52	1	Normal	0	90	Normal	***95***	356	511	483	369	284	430	386	206	72
52	2	Normal	0	90	Normal	98	1 223	1 165	1 137	1 023	938	1 085	1 040	861	726
52	2	High	0	90	Normal	98	1 223	1 082	1 054	940	855	995	950	771	636

Table G1 Estimates of net present values under various scenarios, labour costs and EID tag prices *continued*

Scenario description							NPV of options ($m)								
FMD impact ($b)	Reduction in FMD impact[a] (%)	EID non-tag costs	EID productivity benefits ($m)	Initial traceability level (%)	Option 1 labour costs	Option 1 feasible traceability (%)	Option 1	Option 2				Option 3			
								$0.80	$0.90	$1.30	$1.60	$0.80	$0.90	$1.30	$1.60
52	2	Normal	80	90	Normal	98	1 223	1 216	1 188	1 074	989	1 165	1 120	941	806
52	2	Normal	160	90	Normal	98	1 223	1 267	1 238	1 125	1 040	1 245	1 200	1 021	886
52	2	Normal	160	85	Normal	98	1 883	2 010	1 981	1 868	1 783	1 988	1 943	1 764	1 629
52	2	Normal	0	85	Normal	98	1 883	1 908	1 880	1 766	1 681	1 828	1 783	1 604	1 469
52	2	Normal	0	95	Normal	98	485	343	315	202	116	263	218	39	- 96
52	2	Normal	0	85	High	98	1 667	1 908	1 880	1 766	1 681	1 828	1 783	1 604	1 469
52	2	Normal	0	90	High	98	1 090	1 165	1 137	1 023	938	1 085	1 040	861	726
52	2	Normal	0	90	Normal	95	765	1 165	1 137	1 023	938	1 085	1 040	861	726
52	3	Normal	0	90	Normal	98	1 833	1 775	1 746	1 633	1 548	1 694	1 649	1 470	1 335
52	3	High	0	90	Normal	98	1 833	1 692	1 663	1 550	1 465	1 604	1 559	1 380	1 246
52	3	Normal	80	90	Normal	98	1 833	1 825	1 797	1 683	1 598	1 774	1 729	1 550	1 415
52	3	Normal	160	90	Normal	98	1 833	1 876	1 847	1 734	1 649	1 854	1 809	1 630	1 495
52	3	Normal	160	85	Normal	98	2 756	2 882	2 854	2 740	2 655	2 860	2 815	2 636	2 502
52	3	Normal	0	85	Normal	98	2 756	2 781	2 753	2 639	2 554	2 700	2 655	2 476	2 342
52	3	Normal	0	95	Normal	98	744	603	574	461	376	522	477	298	163
52	3	Normal	0	85	High	98	2 539	2 781	2 753	2 639	2 554	2 700	2 655	2 476	2 342
52	3	Normal	0	90	High	98	1 699	1 775	1 746	1 633	1 548	1 694	1 649	1 470	1 335
52	3	Normal	0	90	Normal	95	1 145	1 775	1 746	1 633	1 548	1 694	1 649	1 470	1 335

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years. The total industry infrastructure costs are spread over a five-year period.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Table G2 Preferred option under various scenarios, labour costs and EID tag prices

Scenario description							Preferred option			
FMD impact ($b)	**Reduction in FMD impact[a] (%)**	**EID non-tag costs**	**EID productivity benefits ($m)**	**Initial traceability level (%)**	**Option 1 labour costs**	**Option 1 feasible traceability (%)**	**$0.80**	**$0.90**	**$1.30**	**$1.60**
17	1	Normal	0	90	Normal	98	1	1	1	1
17	1	***High***	0	90	Normal	98	1	1	1	1
17	1	Normal	***80***	90	Normal	98	1	1	1	1
17	1	Normal	***160***	90	Normal	98	2	2	1	1
17	1	Normal	***160***	***85***	Normal	98	2	2	1	1
17	1	Normal	0	***85***	Normal	98	2	1	1	1
17	1	Normal	0	***95***	Normal	98	1	1	1	1
17	1	Normal	0	***85***	***High***	98	2	2	2	None
17	1	Normal	0	90	***High***	98	2	2	None	None
17	1	Normal	0	90	Normal	***95***	1	1	1	1
17	2	Normal	0	90	Normal	98	1	1	1	1
17	2	***High***	0	90	Normal	98	1	1	1	1
17	2	Normal	***80***	90	Normal	98	1	1	1	1
17	2	Normal	***160***	90	Normal	98	2	2	1	1
17	2	Normal	***160***	***85***	Normal	98	2	2	1	1
17	2	Normal	0	***85***	Normal	98	2	1	1	1
17	2	Normal	0	***95***	Normal	98	1	1	1	1
17	2	Normal	0	***85***	***High***	98	2	2	2	2
17	2	Normal	0	90	***High***	98	2	2	1	1
17	2	Normal	0	90	Normal	***95***	2	2	1	1
17	3	Normal	0	90	Normal	98	1	1	1	1

Table G2 Preferred option under various scenarios, labour costs and EID tag prices *continued*

Scenario description							Preferred option			
FMD impact ($b)	**Reduction in FMD impact[a] (%)**	**EID non-tag costs**	**EID productivity benefits ($m)**	**Initial traceability level (%)**	**Option 1 labour costs**	**Option 1 feasible traceability (%)**	**$0.80**	**$0.90**	**$1.30**	**$1.60**
17	3	***High***	0	90	Normal	98	1	1	1	1
17	3	Normal	***80***	90	Normal	98	1	1	1	1
17	3	Normal	***160***	90	Normal	98	2	2	1	1
17	3	Normal	***160***	***85***	Normal	98	2	2	1	1
17	3	Normal	0	***85***	Normal	98	2	1	1	1
17	3	Normal	0	***95***	Normal	98	1	1	1	1
17	3	Normal	0	***85***	***High***	98	2	2	2	2
17	3	Normal	0	90	***High***	98	2	2	1	1
17	3	Normal	0	90	Normal	***95***	2	2	1	1
52	1	Normal	0	90	Normal	98	1	1	1	1
52	1	***High***	0	90	Normal	98	1	1	1	1
52	1	Normal	***80***	90	Normal	98	1	1	1	1
52	1	Normal	***160***	90	Normal	98	2	2	1	1
52	1	Normal	***160***	***85***	Normal	98	2	2	1	1
52	1	Normal	0	***85***	Normal	98	2	1	1	1
52	1	Normal	0	***95***	Normal	98	1	1	1	1
52	1	Normal	0	***85***	***High***	98	2	2	2	2
52	1	Normal	0	90	***High***	98	2	2	1	1
52	1	Normal	0	90	Normal	***95***	2	2	2	1
52	2	Normal	0	90	Normal	98	1	1	1	1
52	2	***High***	0	90	Normal	98	1	1	1	1

Table G2 Preferred option under various scenarios, labour costs and EID tag prices *continued*

Scenario description							Preferred option			
FMD impact ($b)	**Reduction in FMD impact[a] (%)**	**EID non-tag costs**	**EID productivity benefits ($m)**	**Initial traceability level (%)**	**Option 1 labour costs**	**Option 1 feasible traceability (%)**	**$0.80**	**$0.90**	**$1.30**	**$1.60**
52	2	Normal	***80***	90	Normal	98	1	1	1	1
52	2	Normal	***160***	90	Normal	98	2	2	1	1
52	2	Normal	***160***	***85***	Normal	98	2	2	1	1
52	2	Normal	0	***85***	Normal	98	2	1	1	1
52	2	Normal	0	***95***	Normal	98	1	1	1	1
52	2	Normal	0	***85***	***High***	98	2	2	2	2
52	2	Normal	0	90	***High***	98	2	2	1	1
52	2	Normal	0	90	Normal	***95***	2	2	2	2
52	3	Normal	0	90	Normal	98	1	1	1	1
52	3	***High***	0	90	Normal	98	1	1	1	1
52	3	Normal	***80***	90	Normal	98	1	1	1	1
52	3	Normal	***160***	90	Normal	98	2	2	1	1
52	3	Normal	***160***	***85***	Normal	98	2	2	1	1
52	3	Normal	0	***85***	Normal	98	2	1	1	1
52	3	Normal	0	***95***	Normal	98	1	1	1	1
52	3	Normal	0	***85***	***High***	98	2	2	2	2
52	3	Normal	0	90	***High***	98	2	2	1	1
52	3	Normal	0	90	Normal	***95***	2	2	2	2

Note: The preferred options are based on the results from Table G1. 'None' indicates that no option was estimated to have a positive net present value.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Table G3 Estimates of net present values of options under various discount rates

Scenario description		NPV of options ($m)								
Reduction in FMD impact[a] (%)	Disc. rate	Option 1	Option 2				Option 3			
			$0.80	$0.90	$1.30	$1.60	$0.80	$0.90	$1.30	$1.60
1	0.03	858	772	731	568	446	656	592	334	140
1	0.07	569	511	483	369	284	430	386	206	72
1	0.10	440	395	372	281	212	330	295	151	43
2	0.03	1 835	1 750	1 709	1 546	1 423	1 634	1 569	1 311	1 118
2	0.07	1 223	1 165	1 137	1 023	938	1 085	1 040	861	726
2	0.10	950	904	882	790	722	840	804	661	553
3	0.03	2 746	2 660	2 619	2 456	2 334	2 544	2 480	2 222	2 028
3	0.07	1 833	1 775	1 746	1 633	1 548	1 694	1 649	1 470	1 335
3	0.10	1 424	1 379	1 356	1 265	1 196	1 315	1 279	1 135	1 027

Note: Estimates are in 2012–13 dollars and based on a discount rate of 7 per cent, over 25 years, and assuming 90 per cent current short-term traceability.
a As a result of a one percentage point increase in traceability.
Source: ABARES estimates

Glossary

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
Baseline	the current mob-based National Livestock Identification System for sheep and goats
CIE	Centre for International Economics
COAG	Council of Australian Governments
CVO	Chief Veterinary Officer
DAFF	Department of Agriculture, Fisheries and Forestry
EID	electronic identification
ESCAS	Exporter Supply Chain Assurance System
NLIS	National Livestock Identification System
NLTPS	National Livestock Traceability Performance Standards
non-excludable	it is impossible or very costly to exclude any individual or firm within the industry from consuming the good once it is supplied
non-rivalrous	consumption of this good by a firm or individual within the industry does not diminish the quantity available for consumption by others
NVD	national vendor declaration
PIC	property identification code
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
PWC	PricewaterhouseCoopers
RFID	radio-frequency identification
RIS	regulation impact statement
SCoPI	Standing Council on Primary Industries

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