Cost Benefit Analysis
of a GWRDC Hero Project

A report prepared for

Grape and Wine Research and Development Corporation

Prepared by

econsearch

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Abbreviations

ABS	Australian Bureau of Statistics
BCR	benefit cost ratio
CBA	cost benefit analysis
CRRDCC	Council of Rural Research and Development Corporation Chairs
GWRDC	Grape and Wine Research and Development Corporation
IRR	internal rate of return
NPV	net present value

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1. Introduction

EconSearch Pty Ltd was contracted by the Grape and Wine Research and Development Corporation (GWRDC) to undertake cost-benefit analysis of several, completed GWRDC investments in research and development. The results of this analysis will used by the Council of Rural Research and Development Corporation Chairs (CRRDCC) in their broader evaluation of the impact of research and development funded by Research and Development Corporations in Australia.

The purpose of this report is to present the results of a cost-benefit analysis (CBA) of a ‘hero project’ funded by the GWRDC. The hero project was based on GWRDC project number UA 03/02, entitled ‘*Better quality wine and lower production costs from new processing technologies for protein haze removal*’. The project was selected on the basis of demonstrable positive returns to the levy paying industry (i.e. winemakers) as well as the generation of spillover benefits to the broader community.

Further evaluation will subsequently be undertaken by EconSearch on a set of randomly selected GWRDC investments at the sub-program or cluster level. In addition to the provision of these services, the consultant has been contracted to liaise with GWRDC and ACIL Tasman on the appropriate application of the standardised CBA guidelines.

2. Method of Analysis

The CBA conducted for this project was undertaken according to the principles and method outlined in:

- the Council for Rural Research and Development Corporation Chairs *Guidelines for Evaluation* (ACIL Tasman 2007);
- the Commonwealth Government's *Introduction to Cost-Benefit Analysis and Alternative Evaluation Methodologies* (Department of Finance and Administration 2006a);
- the Commonwealth Government's *Handbook of Cost-Benefit Analysis* (Department of Finance and Administration 2006b); and
- Land and Water Australia's *Methodology for Evaluating Return on Investment from Natural Resource Management Research and Development* (Chudleigh et al. 2007).

The key characteristics of the CBA method employed in this analysis include the following.

- The CBA includes a base case or counterfactual scenario, that is, the benchmark against which the 'with GWRDC investment' scenario was compared. The base case was defined as what would have occurred without GWRDC investment in the technology.
- The CBA was conducted over a 30 year time period and results were expressed in terms of net benefits, that is, the incremental benefits and costs of the 'with GWRDC investment' scenarios relative to those generated by the base case scenario[1].
- Costs and benefits were specified in real terms (i.e. constant 2007 dollars). Past and future values were converted to present values by applying a discount rate of 5 per cent.
- In order to account for uncertainty, sensitivity analysis was undertaken using a range of values for key variables, including adoption profiles.
- The evaluation criteria employed in the analysis include net present value (NPV)[2], benefit-cost ratio (BCR)[3] and internal rate of return (IRR)[4].
- Reporting requirements for the analysis were based on a Microsoft Excel® spreadsheet template developed by ACIL Tasman for the broader Rural Research and Development Corporation evaluation project (Mark Barber, pers. comm.). These requirements include:
  - ➢ reporting NPV for 5, 10, 20 and 30 year time horizons;
  - ➢ reporting on the returns to total (public and private) investment and returns to GWRDC investment in the technology; and

1 Where incremental benefits = ('with GWRDC' benefits – 'without GWRDC' benefits) and incremental costs = ('with GWRDC' costs – 'without GWRDC' costs).

2 NPV was defined as discounted net benefits, where net benefits = (incremental benefits – incremental costs).

3 The BCR was defined as (discounted net benefits subsequent to the GWRDC investment phase) / (discounted net benefits during the GWRDC investment phase). This was consistent with the spreadsheet template developed by ACIL Tasman.

4 The discount rate at which the NPV of an investment scenario is equal to zero.

- allocation of NPVs to the Rural Research Priorities.

3. Costs and Benefits of the GWRDC Hero Project

3.1 Description of the GWRDC Hero Project

The hero project was based on GWRDC project number UA 03/02, entitled '*Better quality wine and lower production costs from new processing technologies for protein haze removal*'. The most significant outcome of this research was the development of technology for in-line dosing of white wine for bentonite fining with centrifugal clarification. This is a continuous processing technique with a range of improvements when compared with the traditional batch fining of bentonite. "In-line dosing followed by centrifugation provides a rapid processing method for protein haze reduction in wine or juice with a decreased volume of lees. It can reduce significant value losses presently arising in the wine industry from batch fining and the resulting quality downgrades that occur in wine recovered from bentonite lees by rotary drum vacuum filtration" (Muhlack et al. 2006).

The hero project was selected on the basis of demonstrable positive returns to the levy paying industry (i.e. winemakers) as well as the generation of spillover benefits to the broader community.

3.2 The Scope of Costs and Benefits

As outlined in Section 2 of the report, the costs and benefits the GWRDC hero project were measured using a 'with' and 'without' GWRDC investment framework, that is, quantification of the incremental changes associated with the 'with GWRDC investment' scenario compared to the base case ('without GWRDC investment') scenario. Tables 3.1 and 3.2 list, in qualitative terms, the costs and benefits associated with these scenarios.

Consideration was given to those benefits and costs that will accrue to the Australian community as a whole and are likely to occur over a 30-year time period. The costs and benefits listed in Tables 3.1 and 3.2 include those that can be readily identified and valued in monetary terms as well as those which cannot be easily valued in monetary terms because of the absence of market signals. The tables provide an indication of the likely distribution of the costs and benefits between stakeholder groups and the source of the information.

Table 3.1 The costs of the GWRDC hero project

Scenario	Cost	Bearer of the Cost	Valued in Monetary Terms	Source of Information
Base case (without GWRDC investment) scenario	Identical to the 'with GWRDC investment' scenario but with a time lag of 5 to 10 years	See below	See below	See below
With GWRDC investment scenario	Improved bentonite fining technology R&D costs	GWRDC and industry collaborators	Yes	GWRDC and industry collaborators
	Improved bentonite fining technology adoption costs	Wine industry	Yes	See text in section 3.3.1

Table 3.2 The benefits of the GWRDC hero project

Scenario	Benefit	Beneficiary	Valued in Monetary Terms	Source of Information
Base case (without GWRDC investment) scenario	Identical to the 'with GWRDC investment' scenario but with a time lag of 5 to 10 years	See below	See below	See below
With GWRDC investment scenario	Additional volume and value of recovered wine	Wine industry	Yes	See text in section 3.3.1
	Reduced waste disposal costs	Wine industry and the broader community	Yes	See text in section 3.3.1
	Capital cost savings	Wine industry	No	See text in section 3.3.1
	Decreased net operating costs	Wine industry	Yes	See text in section 3.3.1
	Increased processing capacity	Wine industry	No	See text in section 3.3.1

3.3 Data and Assumptions Used for Quantifying Costs and Benefits

This section of the report details the method, sources of information and assumptions used to estimate the costs and benefits listed in Tables 3.1 and 3.2. This information was based on consultation with:

- Chris Colby (Senior Lecturer, School of Chemical Engineering, University of Adelaide);
- Leon Deans (Innovations Manager, Pernod Ricard Pacific);
- Audrey Lim (Group Oenologist, Hardy Wine Company);
- Richard Muhlack (Process and Improvement Engineer, Hardy Wine Company); and

- Samantha Hellams (Business Manager, GWRDC).

Apart from the research and development costs, the information and assumptions described below have not been directly attributed to any of these individuals but rather reflect a synthesis of their opinions.

3.3.1 Costs of the GWRDC Hero project

Research and development costs

Estimates of annual investment in the hero project by GWRDC and industry collaborators (cash and in-kind) were provided by Samantha Hellams (GWRDC, pers. comm.) and are summarised in Table 3.3.

Table 3.3 Research and development costs of the GWRDC hero project (UA 03/02) [a]

	Cash and in-kind investment ($)		
	GWRDC	Industry collaborators	Total
2003/04	$52,800	$100,729	$153,529
2004/05	$162,580	$166,144	$328,724
2005/06	$114,029	$371,914	$485,943
Total	$329,409	$638,787	$968,196

[a] In nominal dollars. For the purpose of the CBA these values were expressed in current (2006/07) dollars using the Consumer Price Index for Adelaide (ABS 2007a).

Source: Samantha Hellams (GWRDC, pers. comm.).

Adoption costs

The cost of installing an in-line dosing/centrifugal clarification bentonite fining system would be minimised by the fact that much of the equipment necessary (particularly a centrifuge) would already be available at most large wineries. Based on a winery with a production capacity of 40 million litres of white wine per annum, it was assumed that capital and installation costs for the equipment would be approximately $400,000 or one cent per litre[5] and that the equipment would need to be replaced every 10 years.

Operating and maintenance costs

It was assumed that there would be a net decrease in operating and maintenance costs with the introduction of the improved bentonite fining technology, a proxy for which is the cost of operating and maintaining a rotary vacuum drum. As these costs are avoided they have been accounted for as a benefit of the new technology (see Section 3.3.2).

[5] The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable, using values of $0.001/l and $0.094/l. The former is indicative of a large winery with much of the equipment on-hand whilst the latter is indicative of a smaller operation which may require additional pipework (for bentonite contacting) and/or the purchase of a new or larger centrifuge.

3.3.2 Benefits of the GWRDC Hero project

Additional volume and value of recovered wine

Using traditional bentonite fining techniques for protein haze removal in white wine it is estimated that approximately 5 per cent of the volume of the wine is occluded in the bentonite lees[6]. The majority of large wineries in Australia use rotary vacuum drum (RVD) filtration to recover a proportion of this wine. Recovery rates are approximately 60 per cent of the volume but the quality of the recovered wine is diminished as a result of oxidation. The price penalty as a result of this quality downgrade is of the order of 50 per cent[7].

With the adoption of improved bentonite fining technology, namely the use of in-line dosing and centrifugal clarification, it is estimated that recovery rates of white wine from bentonite less (by volume) can be increased to 75 per cent[8] without any oxidation or associated quality (or value) penalty.

Estimates of Australian white wine production in 2006/07 (i.e. sales by volume and value) are provided in Table 3.4. For the purpose of this analysis it was assumed that bentonite fining with RVD filtration (i.e. current bentonite fining technology) is practised across all 'large' wineries in Australia. Wineries with a crush of 10,000 t/annum or more were responsible for 84 per cent of the crush in 2005/06 (ABS 2007c).

Table 3.4 Sales of Australian white wine in 2006/07

	Sales of Australian white wine		
	Value ($'000)	Volume ('000 l)	Unit value ($/l)
Domestic [a]	954,860	218,786	$4.36
Export [b]	845,557	276,602	$3.06
Total	1,800,417	495,388	$3.63

[a] Volume estimate was sourced from ABS (2007b). Unit value for 2006/07 was based on the 2005/06 estimate for domestic sales of Australian wine of all types (ABS 2007c), updated to 2006/07 using a CPI for wine from ABS (2007a). Value of domestic white wine sales in 2006/07 was imputed using the volume and unit value estimates.

[b] Value of exports is expressed in Australian dollars free on board (fob). Volume and value estimates were sourced from ABS (2007b).

[6] The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable, using values of 3 and 10 per cent.

[7] The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable, using values of 20 and 75 per cent.

[8] The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable, using values of 60 and 90 per cent.

The value of increased recovery rates - If all large wineries were to adopt the improved bentonite fining technology it was estimated that white wine production as a proportion of current production could be approximately 0.8 per cent higher[9] or approximately 4.1 million litres relative to 2006/07 production levels[10]. Assuming that the unit value of sales of Australian white wine in aggregate (i.e. $3.63/l in 2006/07) is a reasonable approximation of the value of the wine recovered by improved bentonite fining technology, the value of the increased recovery rate would be approximately $15.1 million per annum in current dollars, if it were adopted by all large wineries.

The value of the quality downgrade avoided - On the basis that all large wineries currently use RVD filtration and recovery rates are approximately 60 per cent, the proportion of current production recovered by this technology is approximately 2.5 per cent[11] of the total or 12.4 million litres relative to 2006/07 production levels. If this product is recovered through improved bentonite fining technology, without the quality downgrade associated with RVD filtration, the value of the quality downgrade avoided would be approximately $1.82/l[12] or $22.6 million per annum in current dollars, if it were adopted by all large wineries.

Reduction in waste disposal costs

It was estimated that the introduction of improved bentonite fining technology is able to reduce the volume of lees by 75 per cent. This results in a quantifiable reduction in winery waste disposal costs. Assuming that 80 per cent of the lees (with both RVD and improved bentonite fining) is further processed for tartrate recovery and the balance is disposed of directly to landfill, it was estimated, for a winery with a production capacity of 40 million litres of white wine per annum, that waste disposal costs could be reduced by 0.06 cents per litre of production per annum.

In addition to the quantifiable monetary benefit associated with a reduction in the volume of bentonite waste, there are range of spillover costs associated with the handling and disposal of bentonite lees that could also be avoided with the adoption of the improved bentonite fining technology. These costs include:

- occupational health and safety issues for winery staff; and
- contribution to waste streams including landfill and waste water.

Whilst there is a wide range of techniques available for attaching a monetary value to spillover costs of this type (e.g. benefit transfer), many of these techniques are beyond the scope of the analysis and/or suffer from significant shortcomings. For the purpose of this analysis, non-market benefits have been included in qualitative terms only.

9 That is, 5 per cent occlusion across 84 per cent of the crush by the difference in recovery rates (i.e. 80 per cent - 60 per cent).

10 The impact of wine inventories has been excluded from the analysis and it was assumed that sales are a proxy for production levels.

11 That is, 5 per cent occlusion across 84 per cent of the crush by a 60 per cent recovery rate.

12 On the basis that the price penalty as a result of the quality downgrade is 50 per cent and the unit value of sales of Australian wine in aggregate (i.e. $3.63/l in 2006/07) is a reasonable approximation of the value of the wine recovered by improved bentonite fining technology.

Capital cost savings

The switch from traditional to improved bentonite fining technology in large wineries would render RVD equipment obsolete. The market for this sort of equipment is likely to be very limited, although some small salvage value could be obtained from sale for scrap or recycling. This value has not been included in the analysis given its small magnitude.

Decreased net operating costs

There are a number of stages in the white wine filtration process that could be avoided with the introduction of improved bentonite fining technology. Whilst it is difficult to quantify the full extent of the reduced labour requirements and other operating costs, it has been possible to estimate the cost avoided by removing RVD from the filtration process.

For a winery with a production capacity of 40 million litres of white wine per annum, the total costs of operating an RVD (i.e. labour, water, energy, chemicals, energy, maintenance, etc.) are approximately 0.15 cents per litre of white wine production per annum[13]. These costs would be avoided with the introduction of in-line dosing of bentonite.

Other industry benefits

There are a range of other benefits that would accrue to the levy paying industry (i.e. winemakers) but are difficult to quantify in monetary terms. These are listed in below, in no particular order of significance.

- Given that processing time for clarification of white wine is significantly reduced by the in-line dosing/centrifugal clarification technique, there is the potential for a winery to increase the efficiency with which it utilises existing storage infrastructure (i.e. tanks and associated equipment) or reduces its requirements for this equipment (with an associated reduction in capital, operating and maintenance costs).
- Another important benefit of the research from the point of view of industry collaborators has been to highlight the potential of in-line dosing as a technique for improving the efficiency of operation of other stages in the wine production chain.

3.3.3 Adoption rate of the improved technology

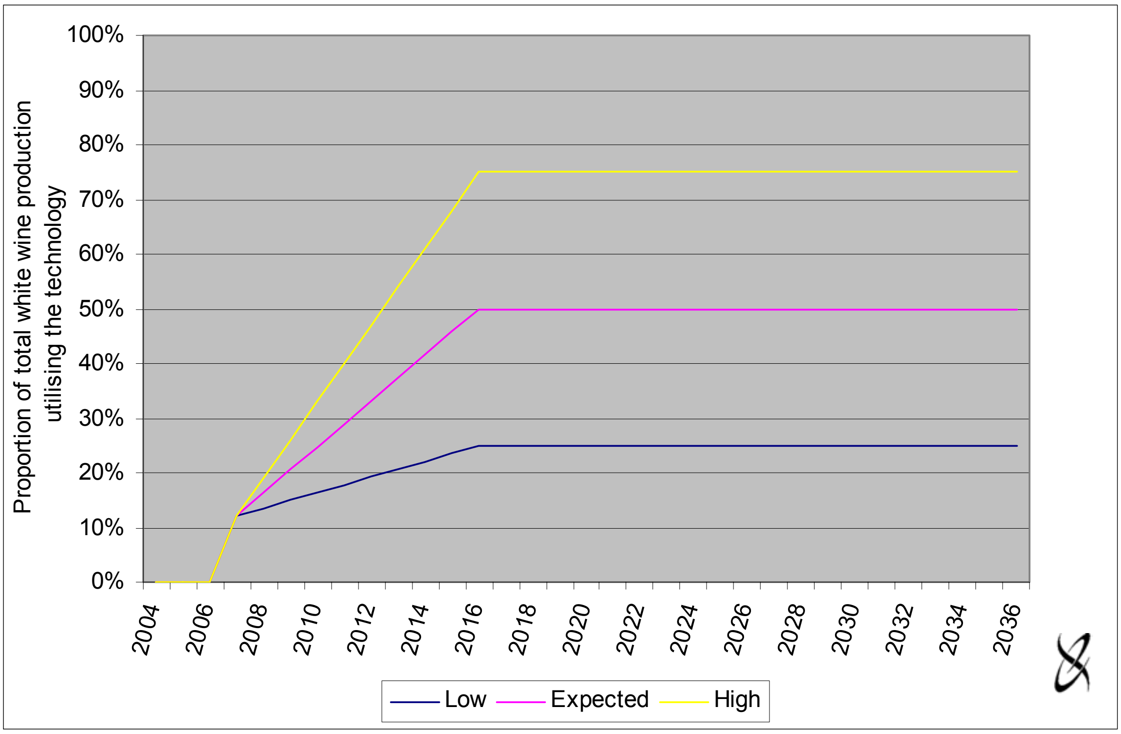
During the research and development phase of the project (i.e. 2003/04 to 2005/06), improved bentonite fining technology was installed in two commercial wineries for field testing purposes. The trial at Pernod Ricard Pacific still needs to be optimised by fully eliminating bentonite carryover from the centrifugation stage. This will require a modest investment by the company in research and testing (approximately $15,000 to $30,000). Once the process has been optimised it is expected to be rapidly implemented in all of the company's wineries (Leon Deans, pers. comm.).

[13] Based on a cost of 5c/l/annum of wine recovered by RVD. The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable, using values of 2.5 and 7 c/l/annum for wineries with a production capacity of 50 and 8 million litres, respectively.

For the 2007 vintage the Hardy Wine Company used a prototype version of the new technology to process approximately 50 million litres of white wine. This was equivalent to 12 per cent of the total national white wine vintage in that year. As above, the process still needs to be optimised by fully eliminating bentonite carryover from the centrifugation stage. Unless an alternative to bentonite fining becomes available in the interim, the process is likely to be adopted across all of the company's wineries in the near future (Audrey Lim, pers. comm.).

For the purpose of this analysis, it was estimated that approximately 50 per cent of the volume of white wine produced in Australia will utilise the improved bentonite fining technology by 2015/16[14].

Figure 3.1 Assumed adoption rates of the improved bentonite fining technology



Source: Based on consultation with industry and research providers.

3.3.4 The base case or counterfactual

It is highly likely that research into improved bentonite fining technology of the type developed with the assistance of GWRDC investment would eventually have been undertaken in the absence of this public investment. The likely impact of the GWRDC investment has been to bring forward the development of this technology by 5 to 10 years. Thus, for the base case scenario, it was assumed that the costs of developing and adopting the technology and the net benefits of its adoption are identical to the 'with GWRDC investment' scenario but with a lag of 5 to 10 years[15].

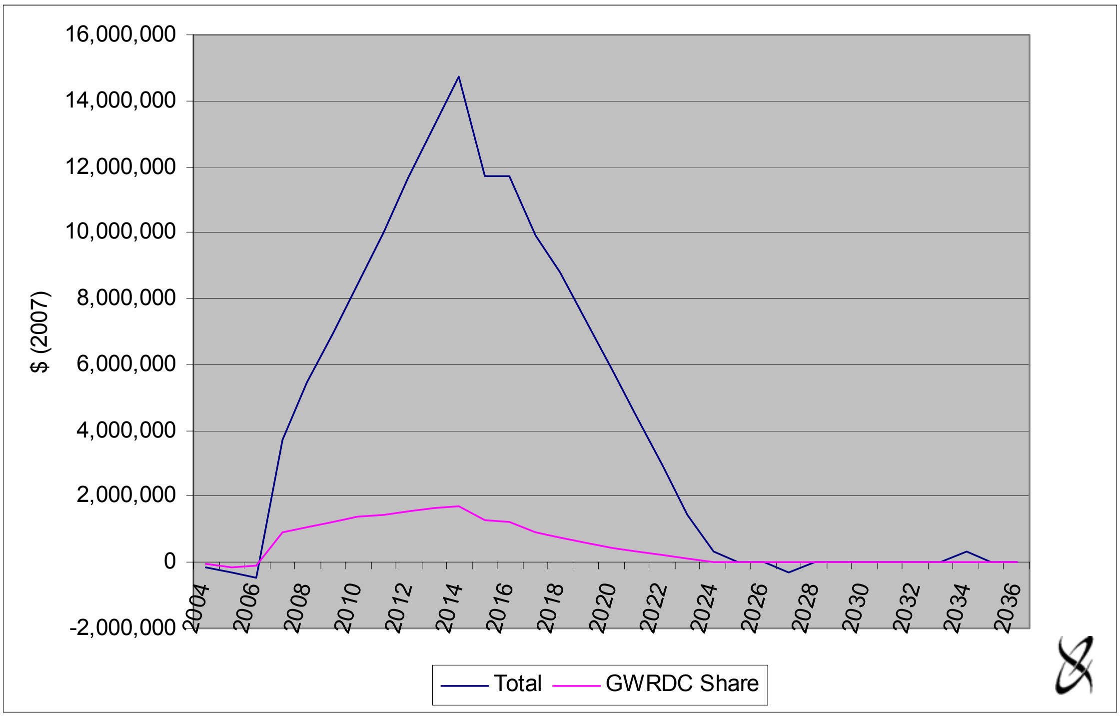
14 The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable, using values of 25 and 75 per cent.

15 The results of the analysis were subject to sensitivity analysis to reflect the uncertainty associated with this variable. The mid-point value of 8 years was used as the expected value.

3.3.5 Attribution of the net benefits of the technology to the GWRDC

Annual net benefits[16] of the improved bentonite fining technology were attributed to the GWRDC on the basis of its cumulative investment in the technology relative to cumulative costs incurred by all parties[17]. This is illustrated in Figure 3.2. The annual net benefits of the technology reach a maximum in the year 2014 and decline thereafter, reflecting the impact of the base case or counterfactual.

Figure 3.2 Net benefits of the improved bentonite fining technology [a]



[a] Estimates are in nominal 2007 dollars.

Source: EconSearch analysis.

[16] That is, incremental benefits less incremental costs.

[17] Including GWRDC investment, investment by industry collaborators and industry adoption costs.

4. Results of the Analysis

Reporting requirements for the analysis were based on a Microsoft Excel® spreadsheet template developed by ACIL Tasman for the broader Rural Research and Development Corporation evaluation project (Mark Barber, pers. comm.).

4.1 Key Indicators

The results of the CBA, in terms of returns to aggregate investment and GWRDC investment in the hero project, are provided in Tables 4.1 and 4.2, respectively.

Table 4.1 Returns to aggregate investment in the GWRDC hero project

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 30
NPV ($m) [a]	-1.0	29.7	74.7	95.3	97.5	97.5
IRR	-	-	-	-	-	186%
BCR	-	-	-	-	-	99

[a] In 2007 dollars.

Source: EconSearch analysis.

Table 4.2 Returns to GWRDC investment in the hero project [a]

	Year 0	Year 5	Year 10	Year 15	Year 20	Year 30
NPV ($m) [b]	-0.3	5.1	10.4	12.2	12.3	12.3

[a] Note that the IRR and BCR evaluation criteria for returns to GWRDC investment in the hero project are not reported as they are not directly comparable with those for aggregate investment in the project (Table 4.1).

[b] In 2007 dollars.

Source: EconSearch analysis.

Relative to the base case, it is apparent that the hero project would generate significant net benefits to the Australian community (i.e. NPV of $98m at Year 30, IRR of 186% and BCR of 99 in Table 4.1). Assuming that annual net benefits of the technology are attributable to the GWRDC on the basis of its cumulative investment in the technology relative to cumulative costs incurred by all parties, returns to GWRDC investment in the technology would also be strongly positive (i.e. NPV of $12m at Year 30 in Table 4.2).

Based on the assumptions outlined in Section 3 of the report, it is apparent that all of the identified monetary benefits of the new technology are attributable to the levy paying industry. As discussed above, the monetary value of net environmental and social benefits (i.e. spillovers) that may occur as a result of the introduction of the new technology have not been included in the CBA calculations.

Attribution of the results of the analysis to the Rural Research Priorities is outlined in Table 4.3, based on the assumption that 80 per cent of the GWRDC investment in the project was allocated to the 'productivity and adding value' priority and the balance to the 'natural resource management' priority.

Table 4.3 Attribution of net present values to Rural Research Priorities

Rural Research Priority	NPV at Year 30 ($m) [a]	
	Total	GWRDC share
Productivity and adding value	78.0	9.8
Supply chain and markets	0.0	0.0
Natural resource management	19.5	2.5
Climate variability and climate change	0.0	0.0
Biosecurity	0.0	0.0

[a] In 2007 dollars.

Source: EconSearch analysis.

4.2 Sensitivity Analysis

The results of the analysis were re-estimated using values for key variables that reflect the uncertainty of those variables. Sensitivity analyses were undertaken for different values of the:

- proportion of white wine volume occluded in bentonite lees with existing technology (3, 5 and 10 per cent);
- proportion of wine volume recovered with new technology (60, 75 and 90 per cent);
- price penalty for wine recovered by RVD (i.e. existing technology) (-20, -50 and -75 per cent);
- Cost avoided of running RVD (i.e. with new technology) (2.5, 5.0 and 7.0 c/l of recovered wine);
- Adoption costs associated with the new technology ($0.001, $0.010 and $0.094/l of wine production);
- time lag to development and adoption of technology without GWRDC investment (i.e. the base case) (5, 8 and 10 years); and
- adoption profile of the new technology (maximum adoption rate by Year 10 of 25, 50 and 75 per cent of white wine production).

The results of the sensitivity analyses are provided in Tables 4.4 and 4.5 below.

Table 4.4 Sensitivity of net present values to adoption rates

Adoption rate	NPV ($m) [a]					
	Year 0	Year 5	Year 10	Year 15	Year 20	Year 30
Low (25%)	-1.0	21.3	43.2	50.1	51.0	51.0
Expected (50%)	-1.0	29.7	74.7	95.3	97.5	97.5
High (75%)	-1.0	38.0	106.1	140.4	144.0	144.0

[a] NPVs are in 2007 dollars and relate to total investment in the hero project.

Source: EconSearch analysis.

Table 4.5 Sensitivity of net present values to a range of other uncertain variables [a]

	Low	Expected	High
Proportion of white wine volume occluded in bentonite lees with existing technology			
Assumed value for variable	*3%*	*5%*	*10%*
NPV ($m) at Year 30	*57.9*	*97.5*	*196.5*
Proportion of wine volume recovered with new technology			
Assumed value for variable	*60%*	*75%*	*90%*
NPV ($m) at Year 30	*65.3*	*97.5*	*129.7*
Price penalty for wine recovered by RVD (i.e. existing technology)			
Assumed value for variable	*-20%*	*-50%*	*-75%*
NPV ($m) at Year 30	*58.8*	*97.5*	*129.7*
Cost avoided of running RVD (i.e. with new technology)			
Assumed value for variable (c/l of recovered wine)	*2.5*	*5.0*	*7.0*
NPV ($m) at Year 30	*96.6*	*97.5*	*98.2*
Adoption costs associated with the new technology			
Assumed value for variable ($/l of wine production)	*$0.001*	*$0.010*	*$0.094*
NPV ($m) at Year 30	*98.6*	*97.5*	*87.0*
Time lag to development and adoption of technology without GWRDC (base case)			
Assumed value for variable (years)	*5*	*8*	*10*
NPV ($m) at Year 30	*65.3*	*97.5*	*116.4*

[a] NPVs are in 2007 dollars and relate to total investment in the hero project. For each sensitivity analysis, values have been calculated by holding all other variables constant at their expected levels.

Source: EconSearch analysis.

Whilst the results of the analysis are sensitive to a number of the variables and assumptions used in the analysis, it is apparent that the incremental net benefits of aggregate investment in the technology would be strongly positive across the likely range of values for these variables.

5. Conclusions

Based on the data and assumptions utilised in this analysis it is apparent that there are strong positive returns to GWRDC and industry investment in the development of technology for in-line dosing of bentonite for protein haze removal in white wine. Whilst it was assumed that this technology would eventually have been developed without GWRDC investment (i.e. the base case is based on a time lag of 8 years), by bringing forward its development the GWRDC and industry investment will generate significant net benefits to the Australian community (i.e. estimated NPV of $98m over 30 years).

The results of the analysis were tested for sensitivity to a number of the variables and assumptions used in the analysis. The incremental net benefits of aggregate investment in the technology would be strongly positive across the likely range of values for these variables. Furthermore, based on consultation with industry representatives, the adoption profiles used in the analysis would appear to be conservative both in terms of the likely maximum adoption rate and the time taken to reach this level of adoption.

It is also important to note that there are a range of spillover benefits of the technology which are difficult to quantify in monetary terms and have been excluded from the CBA calculations. For example, there are costs associated with the handling and disposal of bentonite lees, such as occupational health and safety issues for winery staff and contribution to waste streams, which could be avoided with the adoption of the improved bentonite fining technology. There is also a range of other potential benefits that would accrue to the levy paying industry from the development of the technology, such as alternative uses for the in-line dosing technique, that were difficult to quantify in monetary terms.

References

Australian Bureau of Statistics (ABS) 2007a, *Consumer Price Index, Australia,* ABS Cat. No. 6401.0, Canberra.

Australian Bureau of Statistics 2007b, *Sales of Australian Wine and Brandy by Winemakers, July 2007*, ABS Cat. No. 8504.0, Canberra.

Australian Bureau of Statistics 2007c, *Australian Wine and Grape Industry, 2006,* ABS Cat. No. 1329.0, Canberra.

ACIL Tasman 2007, *Guidelines for Evaluation,* a report prepared for the Council of Rural Research and Development Corporation Chairs, May.

Chudleigh, P., Simpson, S. and Schofield, N. 2007, *A Methodology for Evaluating Return on Investment from Natural Resource Management Research and Development,* a report prepared for Land and Water Australia, March.

Department of Finance and Administration 2006a, *Introduction to Cost-Benefit Analysis and Alternative Evaluation Methodologies,* Financial Management Reference Material No. 5, January.

Department of Finance and Administration 2006b, *Handbook of Cost-Benefit Analysis,* Financial Management Reference Material No. 6, January.

Muhlack, R., Nordestgaard, S., Waters, E., O'Neill, B.K. and Colby, C.B. 2006, *In-line dosing for bentonite fining of wine or juice: contact time, clarification, product recovery and sensory effects*, Australian Journal of Grape and Wine Research.

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