Final Report

Project title:

Horticulture Impact Assessment Program:

Appendix 5: Maximise the biosecurity of the Australia Citrus Industry Budwood Facility (CT17003 Impact Assessment)

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AgEconPlus and Agtrans Research

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What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in Project CT17003: Maximise the biosecurity of the Australia Citrus Industry Budwood Facility. The project was funded by Hort Innovation over the years ending June 2018 to June 2020.

Methodology

The investment was first analysed qualitatively within a logical framework that included activities and outputs, outcomes and impacts. Actual and/or potential impacts then were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation in monetary terms (quantitative assessment). Past and future cash flows were expressed in 2019/20 dollar terms and were discounted to the year 2019/20 using a discount rate of 5% to estimate the investment criteria and a 5% reinvestment rate to estimate the modified internal rate of return (MIRR).

Results/key findings

The investment in Project CT17003 has delivered a higher level of preparedness of the Australian citrus industry for any future incursion of HLB and ACP. The new budwood preparation facility will reduce the future risk of Australian citrus production being damaged by HLB. Also, the availability of HLB-free budwood will reduce the spread of any future incursion of HLB, as well as play a major role in re-establishing orchards that may have been affected by any future HLB incursion. In addition to the facility itself, the project has improved biosecurity practices in nurseries producing citrus trees, as well as an increased understanding and appreciation of industry input supply management businesses to reduce risks and impacts of HLB.

Investment Criteria

Total funding from all sources for the project was $0.86 million (present value terms). Given the assumptions made, the investment produced estimated total expected benefits of $2.1 million (present value terms). This gave a net present value of $1.26 million, an estimated benefit-cost ratio of 2.48 to 1, an internal rate of return of 11.3% and a modified rate of return of 9.0%.

As one of the identified impacts was not valued explicitly, the investment criteria estimated by the evaluation may have slightly underestimated the actual performance of the investment.

Conclusions

The investment in CT17003 has contributed most likely to the continuing productivity and profitability of Australian future citrus production via reducing the risk of the industry being affected by an outbreak of HLB and being able to recover more quickly than otherwise would be the case in the event of an incursion occurring.

Keywords

Impact assessment, cost-benefit analysis, citrus, budwood, Huanglongbing, HLB

Introduction

Horticulture Innovation Australia Limited (Hort Innovation) required a series of impact assessments to be carried out annually on a number of investments in the Hort Innovation research, development and extension (RD&E) portfolio. The assessments were required to meet the following Hort Innovation evaluation reporting requirements:

- Reporting against the Hort Innovation's current Strategic Plan and the Evaluation Framework associated with Hort Innovation's Statutory Funding Agreement with the Commonwealth Government.
- Annual Reporting to Hort Innovation stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

Under the impact assessment program (Project MT18011) three series of impact assessments were conducted in calendar 2019, 2020 and 2021. Each included 15 randomly selected Hort Innovation RD&E investments (projects). The third series of impact assessments (current series) was selected from an overall population of 56 Hort Innovation investments worth an estimated $38.9 million (nominal Hort Innovation investment) where a final deliverable had been submitted in the 2019/20 financial year.

The 15 investments were selected through a stratified, random sampling process such that investments chosen represented at least 10% of the total Hort Innovation RD&E investment in the overall population (in nominal terms) and was representative of the Hort Innovation investment across six, pre-defined project size classes.

Project CT17003: Maximise the biosecurity of the Australia Citrus Industry Budwood Facility was randomly selected as one of the 15 investments under MT18011 and was analysed in this report.

General Method

The impact assessment follows general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and actual and/or potential impacts. The principal economic, environmental and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. Where impact valuation was exercised, the impact assessment used cost-benefit analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

Background & Rationale

Background

The Australian citrus industry is one of Australia's 'traditional' horticultural industries. A range of citrus types are produced in Australia. Oranges are the predominant citrus type grown by tonnage followed by mandarin, lemon/lime and grapefruit, in that order. Table 1 below illustrates some recent descriptive statistics for the overall Australian citrus industry.

Table 1: Australian Citrus Production and Value for Years Ended June 2018 to June 2020

Year ended June	Total Australian Production (tonnes)	Total Production Value ($m)	Production Value ($/tonne)
2018	764,318	836.8	1,094.8
2019	762,483	875.1	1,147.7
2020	767,766	942.4	1,227.1
Average	764,856	884.8	1,156.8

Source: Hort Innovation (2020)

The research and development (R&D) activities of the citrus industry are guided by the industry's Strategic Investment Plan (SIP). The activities are funded by levies payable on citrus produced in Australia.

The process of preparing the latest SIP was managed by Hort Innovation in consultation with the Industry Representative Body (Citrus Australia) and the Strategic Investment Advisory Panel. The current citrus SIP has been driven by levy payers and addresses the Australian citrus industry's R&D needs (and marketing specifically for the orange industry) from 2017 to 2021.

General Biosecurity

Biosecurity is a high priority for the Australian citrus industry. In particular, the spread of disease by the use of infected plant material (e.g. via grafting) has been at the forefront of this priority. The priority is addressed by detecting diseases on entry to Australia and checking for such diseases in planting material before material is planted. Improved diagnostic tools have strengthened these detection activities and/or evidence of absence of disease (e.g. Hort Innovation project CT14009 Protecting Australian Citrus Germplasm through Improved Diagnostic Tools).

Huanglongbing

Huanglongbing (HLB) is a devastating bacterial disease of citrus trees found worldwide. The disease spreads through the tree causing decline and death. The disease cannot be treated and trees have to be destroyed (PIRSA , 2019). The disease is spread via infected plant movement, plant propagative material and by insects, the Asiatic citrus psyllid (ACP) and the African citrus psyllid, both of which are not present in Australia.

HLB and ACP are both present in countries to Australia's north and pose a threat of being introduced to Australia via various means including cyclones. An earlier biosecurity project funded by Hort Innovation that addressed HLB had focused on identification of the most likely entry pathways for HLB and its vectors, as well as the development of an incursion management plan for the citrus, nursery and garden industries.

Rationale

Origin and Purpose of Project CT17003

In Australia, foundation trees of the major commercial citrus varieties are currently maintained in insect proof structures within the National Citrus Repository at Dareton in the far west of NSW. There is insurance provided by one tree of each variety being held at the Elizabeth Macarthur Agricultural Institute at Camden NSW. This is a world renowned, premier biosecurity facility that enhances food and fibre production and helps protect the environment. A second tree of each variety is held at Auscitrus, Dareton NSW. These trees provide the high health, true to type bud source for the establishment of budwood multiplication trees. The Dareton foundation screenhouse was partially funded under an earlier Horticulture Australia project CT04022 in 2004-06.

The management of HLB in countries with the disease and its vector includes the use of an insect proof climate controlled horticultural structure for budwood production. An earlier Horticulture Australia/Auscitrus project (CT13705) had recommended following this strategy by considering various screening options and moving all Australian citrus budwood production into an insect screened facility as soon as financially and physically possible. This resulted in Project CT17003 being funded.

Project Details

Summary

Project Code: CT17003

Title: *Maximising the Biosecurity of the Australian Citrus Industry Budwood Facility*

Research Organisation: Australian Citrus Propagation Association Incorporated (Auscitrus)

Project Leader: Tim Herrmann, Manager, Auscitrus

Period of Funding: January 2018 to December 2019

Objectives

The objective of Project CT17003 was to increase the preparedness of the Australian Citrus Industry for any future incursion of the ACP and the associated disease HLB by building a structure to house citrus budwood multiplication plants under insect proof conditions, thereby providing a source of insect-free budwood to Australian citrus nurseries.

Logical Framework

Table 2 provides a description of CT17003 in a logical framework.

Table 2: Logical Framework for Project CT17003

Activities	**Planning and Management** • A plan was developed for changes to the existing budwood facility and design of a new facility to be integrated into the existing Auscitrus nursery complex at Dareton, NSW. • A monitoring and evaluation plan was developed. • A project risk register and management plan was prepared. • A stakeholder engagement/communication plan was prepared. **Building and Commissioning** • A number of commercial companies were engaged to build the facility; these included specialist companies for earthworks, structures and coverings, cooling systems, electrical works; flooring, drainage and irrigation systems were the responsibility of Auscitrus staff. • Completion of a physical structure providing a safe growing environment for citrus budwood; the facility was opened in the second half of 2019. **Stakeholder Engagement and Communications** • Written communication messages were prepared and disseminated to citrus growers stressing the need to use budwood tested for HLB and other pathogens. • Field days involving growers and nurseries were held to demonstrate the new structure and the critical aspects regarding climate control and insect exclusion. • Presentation of an overview at completion via various communication channels providing the reasons for its development. • Mainstream target audiences for communication were nurseries supplying the retail sector and nurseries supplying commercial orchardists.
Outputs	**Key outputs**

	• The central output was the completion of a physical structure designed and operated to exclude ACP as well as to produce citrus budwood tested as free of HSB and other graft-transmissible diseases.
	• The new structure will allow a significant proportion of Australian budwood production to be carried out under insect-proof climate controlled conditions.
	• A maintenance and monitoring plan/protocol for the new facility was developed.
	• Plans were developed to rapidly expand the insect screened production area as required, in case of a future incursion of HLB.
	
	Communication
	• Various communication outputs were produced by the project for citrus growers and citrus nurseries; these included:
	  o field days
	  o fact sheets
	  o newsletters

Outcomes	• Improved level of preparedness of the Australian citrus industry for any future incursion of HLB and ACP. • A new functioning facility that reduces the risk of Australian citrus production being affected by HLB and, potentially, by other exotic pests and diseases. • The availability of HLB-free budwood will reduce the spread of any future incursion of HLB, as well as play a major role in re-establishing orchards that may have been affected by any future HLB incursion. • Improved biosecurity practices in nurseries producing citrus trees. • Increased understanding and appreciation of industry input supply management to reduce risks and impacts of HLB. • The pricing intention is to continue operating on a self-funding basis for day to day operations; that is, the sales of seed and budwood will fund their production on a commercial, albeit not for profit, basis (Tim, Herrmann, pers. comm., 2021). • There is currently no intention to increase budwood prices solely to cover any additional production costs. In fact, increased demand for budwood from the facility allows for improvements in economies of scale, such that production costs per bud are reduced overall. In the event of an incursion, the increased demand for tested budwood should continue to enable stable prices (Tim Hermann, pers. comm., 2021). • Also. from an operational viewpoint, the technology integrated into the new facility has allowed higher production (primarily through climate control) and lower labour input when compared to the former non-screened shadehouse production area. • Citrus budwood is currently being sold for $0.60 per bud including GST. Average tree prices are around $17-$18 each, so the cost of tested budwood is only around 3.5% of the total cost. Any small increase in bud price in the future is therefore a very small fraction of the total tree cost, and should not result in cost increases to growers. For example, a 5c increase in bud price might be possible, but this won't have a material impact on the cost per hectare of an orchard (Tim Hermann, pers. comm., 2021).

Impacts	• The new facility will reduce the risk and extent of an outbreak of HLB/ACP in Australia leading to a reduction in the associated potential industry costs of tree removal, new tree replacement purchase and planting, and the intervening citrus annual production losses. • Reduced negative regional spillover impacts on families and businesses in citrus producing areas from the reduced risk of an HLB/ACP outbreak.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project CT17003 by Hort Innovation. There was no in-kind financial contribution from Auscitrus or other funding agencies.

Table 3: Annual Investment in Project CT17003 (nominal $)

Year ended 30 June	Hort Innovation ($) (a)	Auscitrus ($) (b)	TOTAL ($)
2018	490,052	24,000	514,052
2019	0	37,000	37,000
2020	169,819	48,000	217,819
Totals	659,871	109,0000	768,871

Source: (a) Hort Innovation funding, Research Agreement: Project Plan and Payment Schedule (Oct. 2017)

(b) Estimated based on input from Tim Herrmann including his time of 0.3FTE over 18 months, Auscitrus labour by permanent staff for installing flooring and irrigation, and Auscitrus cash reserves, for example, to install concrete paths instead of gravel, a larger higher specification backup generator, polycarbonate cladding in place of poly film in some places, and upgraded cooling in the existing propagation house.

Program Management Costs

For the Hort Innovation investment the cost of managing and administration of funding was added to the Hort Innovation contribution for the project via a management cost multiplier (1.162). This multiplier was estimated based on the share of 'payments to suppliers and employees' in total Hort Innovation expenditure (3-year average) reported in the Hort Innovation's Statement of Cash Flows (Hort Innovation Annual Report, various years). This multiplier was then applied to the nominal investment by Hort Innovation shown in Table 3.

For the investment by Auscitrus it was assumed that the management and administration costs were already included in the nominal values reported in Table 3.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2019/20 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2020). No additional costs of extension were included as the project itself heavily involved the industry and was totally industry oriented.

Impacts

Table 4 provides a summary of the principal types of impacts delivered by the project, based on the logical framework. Impacts have been categorised into economic, environmental and social impacts.

Table 4: Triple Bottom Line Categories of Principal Impacts from Project CT17003

Economic	• Reduced risk and associated costs of an outbreak of Huanglongbing in the Australian citrus industry.
Environmental	• Nil
Social	• Some regional social impacts may have been derived from increased spillovers to families and businesses in citrus growing regions from reduced negative impacts on citrus grower incomes. • Increased capability and capacity of citrus growers and nurseries to understand the risks and impacts of HLB and associated vectors being introduced to Australia.

Public versus Private Impacts

The impacts identified from the investment are predominantly private impacts accruing to citrus growers and their supply chains in Australia. However, some minor public benefits may have been produced in the form of spillovers to regional communities from enhanced grower and supply chain incomes associated with the citrus industry.

Distribution of Private Impacts

The private impacts will have been distributed along the relevant citrus supply chains. The share of impact realised by supply chain participants will depend on both short-and long-term supply and demand elasticities that are experienced along the various linkages in the supply chains.

Impacts on Other Australian Industries

It is likely that most impacts will be confined to the Australian citrus industry, including consumers. However, there be a reduction in the potential marginal increase in some other horticultural industries that may substitute for citrus growing due to the reduced risk of losses of production in the citrus industry.

Impacts Overseas

It is unlikely that there will be any significant impacts to overseas industries from the lowered risk to Australian citrus production and exports.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project outcomes and related impacts will contribute primarily to Rural RD&E Priority 2, and to Science and Research Priority 1.

Table 5: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	**Science and Research Priorities (est. 2015)**
1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D	1. Food 2. Soil and Water 3. Transport 4. Cybersecurity 5. Energy and Resources 6. Manufacturing 7. Environmental Change 8. Health

Sources: DAWR (2015) and OCS (2016)

Alignment with the Citrus Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the citrus industry are outlined in the Citrus Industry's Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project CT17003 is particularly relevant to the Outcome 2 (Growers and the industry reduce biosecurity, phytosanitary and agrichemical related risks). This outcome was directly addressed through Strategy 2.1 (Safeguard the Australian citrus industry from future biosecurity and phytosanitary risks throughout the value chain).

The project addresses also Outcome 4 via Strategies 4.1 and 4.2 to build the skills, capacity and knowledge of growers and other members of the citrus value chain.

[1] For further information, see: https://www.horticulture.com.au/hort-innovation/funding-consultation-and-investing/investment-documents/strategic-investment-plans/

Valuation of Impacts

Impacts Valued

The impact that was valued was the reduced risk to the Australian citrus industry of a future outbreak of HLB. This reduced risk was valued by the likely cost to the industry of a future outbreak HLB with and without the funding of Project CT0003. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved in the risk and cost assumptions involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. The impact of a reduction in negative social spillovers from the expected reduction in HLB impacts on the industry was not valued largely due to the difficulty in developing credible assumptions. Further, the increased capability and capacity of citrus growers and nurseries to understand the risks and impacts of HLB and associated vectors being introduced to Australia was not specifically valued; however, this impact could be viewed as being a component of delivering the risk reduction of HLB.

Summary of Assumptions

The impact that was valued (the expected reduction in costs of a future HLB outbreak) was valued via a reduction in costs of tree removal, new tree planting and the associated production losses, all due to a future outbreak of HBL.

The specific assumptions that have been developed to value the risk reduction are provided in Table 6.

Table 6: Summary of Assumptions for Impact Valued

Variable	Assumption	Source/Comment
Risk of an outbreak of HLB without the project		
Year in which outbreak occurs	2025	Analyst assumption
Probability of an outbreak occurring	25%	
Proportion of industry affected by the outbreak in 2025	2.5%	
Risk of an outbreak of HLB with the project		
Year in which outbreak occurs	2025	Analyst assumption
Probability of an outbreak occurring	10%	
Proportion of industry affected by the outbreak in 2025	2.5%	
Impact of the outbreak with and without the project		
Area of citrus in Australia	28,000 ha	Citrus Australia (2021)
Trees per ha	500	Based on Citrus Farm Management Handbook (2018)
Number of citrus trees in Australia	14 million	28,000 ha x 500
Expected area affected by assumed outbreak without	175 ha	28,000 x 25% x 2.5%

project		
Expected area affected by the assumed outbreak with the project	70 ha	28,000 x 10% x 2.5%
Cost assumptions		
Cost of tree removal	$5,000 per ha	Analyst assumption
Cost of tree replacement	$10,000 per ha, based on 500 trees per ha) @$20 per tree planted	Based on Citrus Farm Management Handbook (2018)
Full Gross Margin foregone in years of lost production	$4,460 per ha (based on gross margins for oranges in the Riverina and Sunraysia, averaged across export and domestic markets	Citrus Farm Management Handbook (2018)
Period of lost gross margins	0 yield for first 3 years and then linear increase to year 10, when full gross margin is achieved.	Analyst assumption, based on Development budgets in Citrus Farm Management Handbook (2018)
Risk and attribution factors		
Probability of output (facility constructed)	100%	Estimate by Analyst
Probability of outcome (facility operating successfully, and increased awareness/detection of HLB by growers and nursery operators) given a successful output	90%	
Probability of impact (lowered risk of an outbreak of HLB and associated cost reduction)	75%	

Results

All costs and benefits were discounted to 2019/20 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the modified internal rate of return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the project investment period plus 30 years from the last year of investment (2018/19) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

Tables 7 and 8 show the investment criteria estimated for different periods of benefits for the total investment and the Hort Innovation investment alone.

Table 7: Investment Criteria for Total Investment in Project CT17003

Investment Criteria	**Years after Last Year of Investment**						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.41	2.66	3.03	3.03	3.03	3.03
Present Value of Costs ($m)	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Net Present Value ($m)	-0.97	-0.56	1.69	2.06	2.06	2.06	2.06
Benefit-Cost Ratio	0.00	0.42	2.74	3.12	3.12	3.12	3.12
Internal Rate of Return (%)	negative	negative	18.7	19.8	19.8	19.8	19.8
MIRR (%)	n.s.	n.s.	15.	12.8	10.9	9.8	9.0

n.s. no solution

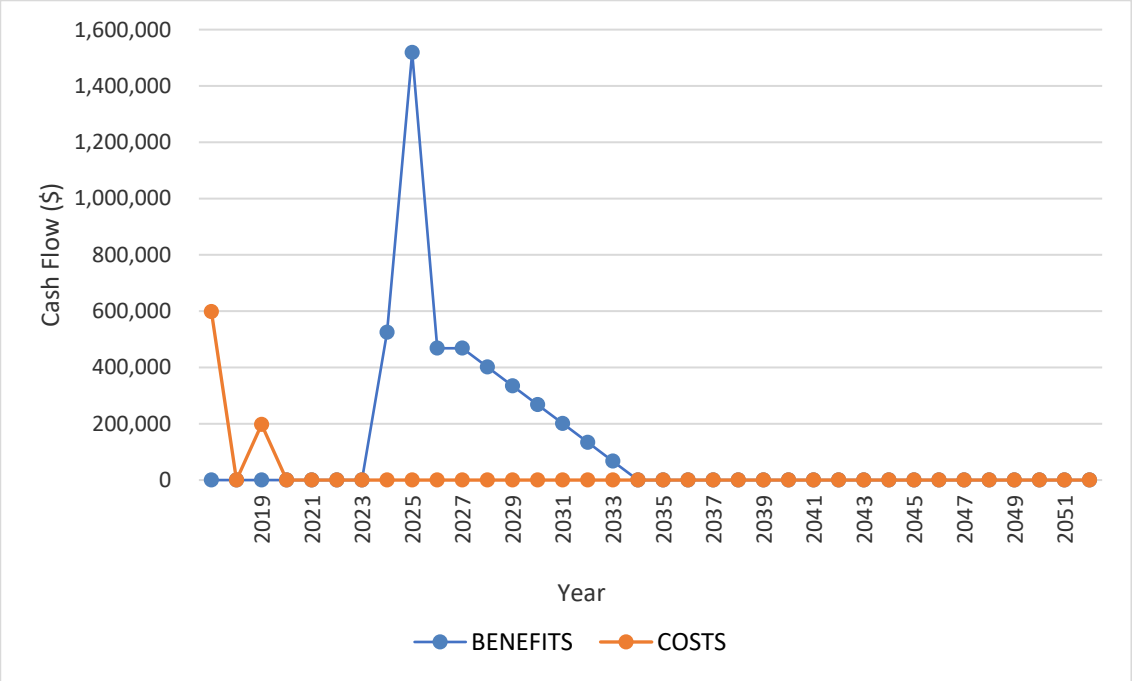
Table 8: Investment Criteria for Hort Innovation Investment in Project CT17003

Investment Criteria	**Years after Last Year of Investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present Value of Benefits ($m)	0.00	0.36	2.33	2.66	2.66	2.66	2.66
Present Value of Costs ($m)	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Net Present Value ($m)	-0.86	-0.50	1.48	1.80	1.80	1.80	1.80
Benefit-Cost Ratio	0.00	0.42	2.72	3.11	3.11	3.11	3.11
Internal Rate of Return (%)	negative	negative	18.5	19.5	19.5	19.5	19.5
MIRR (%)	n.s.	n.s.	16.1	13.2	11.1	9.9	9.0

n.s. no solution

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the CT17003 investment plus 30 years from the last year of investment are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 9 presents the results that show a moderate sensitivity to the discount rate.

Table 9: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	**Discount rate**		
	0%	**5%**	**10%**
Present Value of Benefits ($m)	4.38	3.03	2.16
Present Value of Costs ($m)	0.91	0.97	1.04
Net Present Value ($m)	3.48	2.06	1.11
Benefit-cost ratio	4.84	3.12	2.07

A sensitivity analysis was then undertaken for the probability of an outbreak of HLB of 2.5% of the total citrus area, with and without the project CT17003. Results are provided in Table 10. Given a 25% probability of an outbreak occurring in 2025 without CT17003, the break-even probability for the Project investment impact would need to be a fall from 25% to just over 20% (20.2%).

Table 10: Sensitivity to Assumption of Probability of an Outbreak of HLB with and without Project CT17003
(Discount rate 5%, Total investment, 30 years)

Investment Criteria	**Probability without Project CT17003**	**Probability with Project CT17003**	**Net present value (NPV) ($M)**	**Benefit-cost ratio**
Probability of an outbreak	25%	20%	0.04	1.04
	25%	15%	1.05	2.08
	25%	10%	2.06	3.12

A sensitivity analysis was then undertaken for the assumed year in which the outbreak might occur. Instead of 2025, it was assumed that the outbreak occurred in 2030. Results are provided in Table 11 and show that the further into the future the hypothetical outbreak is assumed to occur, the lower the Net Present Value and the Benefit-cost ratio delivered by the investment.

Table 11: Sensitivity to Year of Outbreak of HLB (Total investment, 30 years)

Investment Criteria	2025 (base)	2030
Present Value of Benefits ($m)	3.03	2.38
Present Value of Costs ($m)	0.97	0.97
Net Present Value ($m)	2.06	1.40
Benefit-cost ratio	3.12	2.44

Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 12). The rating categories used are High, Medium and Low, where:

- High: denotes a good coverage of benefits or reasonable confidence in the assumptions made
- Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made
- Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 12: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
High	Low-Medium

Coverage of benefits was assessed as High. The most important impact from the investment was valued (the reduction in risk of damage by HLB). The impacts relating to increased regional community spill-overs was not valued. Consequently, the investment criteria as provided by the valued benefits are likely to be only marginally underestimated.

Confidence in assumptions for valuation was rated as Low-Medium as many of the assumptions made were dependent on future uncertain events and their likelihood of occurrence.

Conclusions

The investment in CT17003 is likely to contribute to a reduced risk of damage to the citrus industry if HLB enters Australia in future.

Total funding from all sources for the project was $0.97 million (present value terms). Given the assumptions made, the investment produced estimated total expected benefits of $3.03 million (present value terms). This gave a net present value of $2.06 million, an estimated benefit-cost ratio of 3.12 to 1, an internal rate of return of 19.8% and a modified internal rate of return of 9.0%.

Glossary of Economic Terms

Cost-benefit analysis:	A conceptual framework for the economic evaluation of projects and programs in the public sector. It differs from a financial appraisal or evaluation in that it considers all gains (benefits) and losses (costs), regardless of to whom they accrue.
Benefit-cost ratio:	The ratio of the present value of investment benefits to the present value of investment costs.
Discounting:	The process of relating the costs and benefits of an investment to a base year using a stated discount rate.
Internal rate of return:	The discount rate at which an investment has a net present value of zero, i.e. where present value of benefits = present value of costs.
Investment criteria:	Measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return.
Modified internal rate of return:	The internal rate of return of an investment that is modified so that the cash inflows from an investment are re-invested at the rate of the cost of capital (the re-investment rate).
Net present value:	The discounted value of the benefits of an investment less the discounted value of the costs, i.e. present value of benefits - present value of costs.
Present value of benefits:	The discounted value of benefits.
Present value of costs:	The discounted value of investment costs.

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Abbreviations

ACP	Asiatic citrus psyllid
CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
HLB	Huanglongbing
MIRR	Modified Internal Rate of Return
OCS	Office of Chief Scientist, Canberra
R&D	Research and Development
RD&E	Research, Development and Extension
SIP	Strategic Investment Plan