Hort Innovation

Final Report

Industry-specific impact assessment program: Nursery

Impact assessment report for project *Budget tool to calculate the cost to successfully establish trees in the urban landscape* (NY18003)

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Executive Summary

What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in Budget tool to calculate the cost to successfully establish trees in the urban landscape (NY18003). The project was completed over the period January 2019 to December 2019.

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 2020/21 dollar terms and were discounted to the year 2020/21 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 the Tree Cost Tool to enhance tree planting decision making has provided those involved in urban area tree planting with greaser confidence in decision making, particularly on future costs that may be involved over time. A more accurate estimate of future costs associated with new tree planting may influence the type and number of additional trees that may be planted in line with supporting the 202020 vision for greening urban landscapes. While new tree plantings will benefit the Nursery and Garden Industry, additional costs of trees, planting and maintenance will be incurred by some Local Government Areas (LGAs). Over time, these additional costs will be offset by the increased health and wellbeing gained by residents of urban landscapes in the Local Government Areas.

One of the key assumptions in the analysis was the timing of when health and wellbeing impacts will commence to be valued by urban residents and further information on this aspect would be worthwhile of further investigation.

Investment Criteria

Total funding from all sources for the project was $0.18 million (present value terms). The investment produced an estimated total expected benefit of $4.86 million (present value terms). This gave a net present value of $4.68 million, an estimated benefit-cost ratio of 26.5 to 1, an internal rate of return of 8.6% and a MIRR of 6.8%.

Conclusions

The investment in NY18003 that deliver the Tree Cost Tool will likely contribute to improved decision making within some Local Government Areas regarding the type and number of new trees planted in urban areas in the future. The use of the Tree Cost Tool by some LGAs has increased confidence in the lifetime costs of new tree planting. This increased confidence is likely to result in additional tree plantings in some LGAs that would not have occurred in the absence of the tool. The current analysis has indicated that, while the LGAs undertaking additional plantings will incur significant additional costs, in time these are likely to be offset by the health and wellbeing benefits accruing to the LGA residents.

Keywords

Impact assessment, cost-benefit analysis, trees, establishment, urban landscape, health and wellbeing

Introduction

All research, development, and extension (RD&E) and marketing levy investments undertaken by Horticulture Innovation Australia Limited (Hort Innovation) are guided and aligned to specific investment outcomes, defined through a Strategic Investment Plan (SIP). The SIP guides investment of the levy to achieve each industry's vision. The relevant industry SIPs apply for the financial years 2016/17 – 2020/21.

In accordance with the Organisational Evaluation Framework, Hort innovation has the obligation to evaluate the performance of its investment undertaken on behalf of industry.

The impact assessment program addresses this requirement through conducting a series of industry-specific ex-post independent impact assessments of the berry (RB + BS), mango (MG), turf (TU) and nursery (NY) RD&E investment funds.

Fourteen RD&E investments (projects) were selected through a stratified, random sampling process. The industry samples were as follows:

- Four RB + BS projects were chosen worth $1.44 million (nominal Hort Innovation investment) from an overall population of 16 projects worth an estimated $8.59 million,
- Three MG projects worth $1.77 million (nominal Hort Innovation investment) from an overall population of 16 projects worth approximately $7.90 million,
- Four TU projects worth $0.66 million (nominal Hort Innovation investment) from a total population of 15 projects worth $4.81 million, and
- Three NY projects worth $0.96 million (nominal Hort Innovation investment) from an overall population of 19 projects worth $7.32 million.

The project population for each industry included projects where a final deliverable had been submitted in the five-year period from 1 July 2015 to 30 June 2020.

The projects for each industry sample were chosen such that the investments represented (1) at least 10% of the total Hort Innovation RD&E investment expenditure for each industry, and (2) the SIP outcomes (proportionally) for each industry where possible given the small sample sizes. Also, for the NY sample only, there were three projects that had been evaluated previously in 2019 (two projects) and 2020 (one project). Hort Innovation requested that the three additional NY projects be assessed against the current sample criteria. All three projects that had previously been evaluated met the current sample criteria. As a result, and to increase the sample size for the NY industry evaluations, the benefit and cost cash flows from the 2019 and 2020 evaluations were updated and the three projects were incorporated into the current NY sample.

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 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 uses 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 nursery and garden (N&G) industry is a diverse industry that is present in all Australian States and Territories. The N&G industry produces live plants for various uses such as production of fruit, vegetables, forestry, as well as plants for landscaping for households and community areas.

The N&G industry is a very large horticultural industry with value of production of $2.56 billion for the year ending June 2020; wholesale value was higher at $2.69 billion in the same year (Australian Horticulture Statistics Handbook 2019/20). The value of both nursery exports and imports is relatively minor compared to the Australian value of production.

Table 1 following shows the recent production, supply and value of the Australian N&G industry.

Table 1: Australian N&G Industry Production and Value for Years Ending June 2018 to 2020

Year ended June	Total Australian Production (million units)	Production ($m)	Imports ($m)	Supply Wholesale Value ($m)
2018	1,900	2,400.0	37.7	2,571.2
2019	2,030	2,440.0	41.9	2,563.0
2020	2,100	2,563.0	37.8	2,685.7
Average	2,010	2,467.7	39.1	2,606.6

Source: Australian Horticultural Statistics Handbook, 2019/20

The marketing and research and development activities of the industry are guided by the industry's strategic investment (SIP) developed by Hort Innovation in consultation with the N&G industry and levy payers (Hort Innovation, 2017). The current SIP addresses the Australian N&G industry's research and development (R&D) needs from 2017 to 2021. The activities are funded by levies payable on nursery plants produced in Australia; the R&D levy funds are managed by Hort Innovation.

Rationale

Project NY18003 was developed in the context of the 202020 Vision, a national collaborative campaign to increase urban green space in Australia by 20% by the year 2020. The campaign commenced in 2013. The simple rationale for the campaign was that plants and trees cool down cities, reduce pollution, get people out and about and make them healthier, happier and more productive. The nursery industry was in a unique position to assist the achievement of the vision by supplying plants and trees for planting by both the private and public sectors.

However, there was a lack of awareness of the true lifecycle cost of planting and establishing trees in the landscapes of differing urban areas. It was postulated that the development of a budget tool to more accurately estimate the lifecycle cost would allow more confident plans to be developed and decisions to be made by those entities considering planting more trees. Better understanding of the economics of the lifecycle of trees in different urban areas, as well as stakeholder engagement to use any tool developed, were viewed as key factors that would assist delivery of the 202020 vision.

Project Details

Summary

Project Code: NY18003

Title: *Budget Tool to calculate the cost to successfully establish trees in the urban landscape*

Research Organisations: Alluvium Consulting Australia Pty Ltd, in conjunction with Mosaic Insights and Natural Capital Economics

Project Leader: Dominic Blackham, Mosaic Insights

Period of Funding: January 2019 to December 2019

Objectives

The broad aim of the project was to develop a Budget Tool to establish the cost over the life cycle of a successful urban tree from production to maintenance.

The specific objectives of the project were intimately aligned with the first desired outcome and associated strategies contained in the Nursery Industry SIP, namely:

Outcome 1: Increased demand and sales of green-life products by four per cent per annum plus CPI (Consumer Price Index). Associated strategies for Outcome 1 were:

- Continue to support the 202020 vision
- Enhance the 2002020 Vision brand beyond 2020

The specific objectives of Project NY18003 included:

- Conduct a global review with industry leaders around the world and in Australia to:
  - Determine what is critical to achieving the successful establishment of an urban tree throughout its lifecycle from supply to maintenance
  - Establish the best practice tools currently available for determining the economics of an urban tree, and determine what relevant stakeholders like and not like in current tools and what capabilities would they like to see in a new tool.
- Create, adopt, or retrofit a budget tool to calculate the economics of an urban tree in Australia through its lifecycle; this tool, would need capabilities to assess all types, sizes and numbers of trees.
- Succeed in having the new tool adopted by relevant stakeholders in Australia such as Local Government Areas and state and federal authorities.

Logical Framework

Table 2 following provides a detailed description of the project in a logical framework.

Table 2: Logical Framework for Project NY18003

Activities	Major project activities undertaken throughout the project included: <u>Scoping and inception meeting</u> • The project team consisted of personnel from three organisations (Alluvium Consulting Australia, Mosaic Insights and Natural Capital Economics); an inception meeting was held to update the planned proposal activities and assess any changes in roles. • This meeting also was used to develop a Services Delivery Plan with program logic, as well as a Monitoring and Evaluation (M&E) Plan and a risk register. • A Stakeholder Engagement Plan was developed that covered initial information collection from the prospective users of the budget tool, and

	included user involvement during tool development and promotion of the tool once developed.
	
	<u>Stakeholder engagement</u>
	• A total of 30 stakeholders were engaged via surveys, workshops and interviews.
	• Stakeholders included were predominantly from Local Government, with others from State Government, research bodies, and some Industry leaders (two from overseas countries).
	• Most stakeholders engaged were from east coast capital cities.
	• A range of topics were addressed in the engagement process including:
	  ○ future climate and tree species,
	  ○ scale of planting,
	  ○ reasons for planting more trees,
	  ○ constraints to planting,
	  ○ use of contractors,
	  ○ current tree planting mortality rates,
	  ○ length of maintenance periods,
	  ○ how costing is currently carried out,
	  ○ physical and institutional challenges in implementing urban tree planting,
	  ○ the importance of different functions for a tree budget tool.
	• The information from the stakeholder engagement process was analysed (see Outputs section below for results).
	• The lifecycle costs for establishing trees were provided by six stakeholders (councils and contractors in Adelaide, Melbourne, Sydney and Brisbane); such information was used in the development of the Tree Costing Tool.
	
	<u>Development of the Tree Costing Tool</u>
	• The decision framework and information assembled from stakeholders were used to develop the first version of the Tree Costing Tool .
	• The initial tool was tested in stakeholder workshops in Adelaide, Melbourne, Sydney and Brisbane and in one online webinar; feedback on functionality and ease of use was obtained.
	• The tool was then updated taking into account the feedback, and then the Tool was finalised.

Outputs	<u>Scoping and inception meeting</u> • The inception meeting resulted in an update of the proposed project plan and activities, as well as a Services Delivery Plan, a M&E Plan and a risk register. <u>Stakeholder engagement</u> • Information from prospective users of the tool that shaped the tool development process was categorised into three categories: tree establishment, tree survival, and tree acceptance in the community. • A large number of variables involved in tree establishment were selected by stakeholders according to the fit and context of the environment of the local aera. • With regard to tree survival, tree size, soil quality, watering regimes, and powerlines were identified as major factors in tree survival; it was reported that various maintenance regimes to address these issues can be practiced and these will affect the life cycle costs of urban trees.

	• Community tree acceptance (e.g. damage to roads, street sweeping costs) was considered important by stakeholders although many of these issues are related to engineering rather than horticultural issues.
	
	<u>Development of the Tree Costing Tool</u>
	• A preliminary version of the Tree Costing Tool was produced.
	• Testing of the preliminary version of the Tool was carried out by various stakeholders.
	• A final version of the tool was produced that accommodated the feedback from stakeholders.
	• The tool is available at https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/tree-costing-tool-and-instruction-manual/
	
	<u>Recommendations for follow up projects</u>
	• Four follow-up projects were identified in the final report of the project; they were:
	  ○ Development of an on-line version of the tool.
	  ○ An assessment of tree benefits for the Australian urban climate and urban developments.
	  ○ Research and development of better understanding of causal relationships between tree choice and establishment and the likelihood of tree mortality.
	  ○ Integration between the Tree Costing Tool and the Interactive Plant Features tool which was being developed within another project (the Which Plant Where? Project).

Outcomes	• The use of the new Tree Costing Tool has provided more reliable information for some decision makers regarding urban tree planting costs. • For example, the tool was used by Macquarie University to estimate the economic cost of an extreme climate event in western Sydney. Results from that study are available in a published journal paper (https://www.sciencedirect.com/science/article/abs/pii/S1618866721002466) (Dominic Blackham, pers. comm., 2021), • Potentially for users, use of the tool will lead to increased confidence in decision making regarding new tree planting in Australian Local Government Areas (LGAs). • Users have easy access to rigorous lifecycle economic modelling that can be combined with their own input data (or industry standards) to produce accurate, rigorous costing data that can be directly used in business case development • Further, there may be some change to tree types planted in urban areas, as the tool allows users to accurately calculate the cost of different procurement and planting strategies. • Also, use of the tool may result in an increase in tree planting in urban areas due to increased confidence in predicting costs incurred in future. • The tool will contribute to efficient and effective urban tree planting strategies. • While none of the four follow-up projects identified have been funded to date, there are current funding discussions between industry stakeholders to fund a project on estimating tree benefits in urban Australia (Dominic Blackham, pers. comm., 2021). • After the project was completed, the project team was approached by a research group at Macquarie University for guidance in using the tool to

	estimate the economic cost of a recent extreme heat event in Western Sydney. The project team collaborated with Macquarie University and this led to a journal paper publication (https://www.sciencedirect.com/science/article/abs/pii/S1618866721002466) • The team collaborated with the "Which Plant where" team at Macquarie University. However, there is still a need for integration of the two tools (i.e. the Tree Costing Tool and the Which Plant Where? Tools) (Dominic Blackham, pers. comm., 2021). • Since the tool was made available there have been several contacts from local government and other stakeholders about the tool and the data used in the tool (e.g. Sutherland Shire Council, Specialty Trees, Transport NSW, etc) (Dominic Blackham, pers. comm., 2021).
Impacts	• The likely increase in tree planting will deliver an increase in the total health and wellbeing status of the population across some LGAs. • Potential reduced costs associated with high tree mortality rates due to poor maintenance. • A potential increase in nursery industry sales due to some increase in tree planting. • A potential increase in the value of biodiversity in some LGAs. • A positive contribution to the realisation of the 202020 Vision brand beyond 2020.

Project Investment

Nominal Investment

Table 3 shows the annual investment made in Project NY18003 by Hort Innovation. All funding was provided by Hort Innovation.

Table 3: Annual Investment in Project NY18003 (nominal $)

Year ended 30 June	HORT INNOVATION ($)	TOTAL ($)
2019	60,785	60,785
2020	83,137	83,137
Total	143,922	143,922

Program Management Costs

For the Hort Innovation investment the cost of managing the Hort Innovation 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.

Real Investment and Extension Costs

For purposes of the investment analysis, the investment costs of all parties were expressed in 2020/21 dollar terms using the Implicit Price Deflator for Gross Domestic Product (ABS, 2021). No additional costs of extension were included as the project was directly concerned with communication and communicated findings to stakeholders within the project activities.

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 NY18003

Economic	• A potential increase in N&G industry sales.
Environmental	• A potential increase in the value of biodiversity in some LGAs.
Social	• An increase in the total health and wellbeing status of the population across some LGAs compared to what otherwise would have been delivered without the project investment. • A positive contribution to the realisation of the 202020 vision.

Public versus Private Impacts

The major impact identified from the investment is predominantly a public impact accruing predominantly via improved decision making associated with tree planting in urban landscapes. The increased confidence provided by the use of the Tool regarding current and future costs associated with planting and maintenance of trees into the future should increase the planting of greenlife in urban areas.

The ensuing principal benefits from any increase in the area of greenlife in urban areas will be an increase in the total health and wellbeing status of the population across some LGAs. Some private impacts also will be delivered, potentially to contractors and N&G businesses.

Distribution of Private Impacts

The private impact captured by N&G businesses and contractors due to the additional sales of nursery plants will be shared with businesses operating across the input and output supply chains of N&G industry and contractors.

Impacts on Other Australian Industries

It is likely that most industry impacts will be confined to the N&G industry and industries serving local government organisations.

Impacts Overseas

There are assumed to be no impacts to overseas interests.

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 3. In addition, the project is likely to contribute to Science and Research Priorities 2, 7 and 8.

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: DAWE (2015) and OCS (2015)

Alignment with the Nursery Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the Australian nursery industry are outlined in the Nursery Strategic Investment Plan 2017-2021[1] (Hort Innovation, 2017). Project NY18003 addressed primarily Outcome 1 of the Plan.

Outcome 1: Increased demand and sales of green life products by four percent per annum plus CPI. This outcome was addressed by the project in line with the following two strategies:

- Continue to support the 202020 Vision program
- Enhance the 202020 Vision brand beyond 2020

[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

Two impacts listed in Table 4 were valued in this assessment. The impacts valued were:

- An increase in the total health and wellbeing status of the population across some urban LGAs due to an increase in tree plantings.
- A potential increase in N&G industry sales to urban locations due to use of the Tree Costing Tool.

A degree of conservatism was used when finalising assumptions for the impact valuations as some significant uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the resulting investment criteria.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. The impacts not valued were:

- A potential increase in the value of biodiversity in some LGAs.
- A positive contribution to the realisation of the 202020 vision.

These impacts were not valued due to:

- The lack of data related to the extent of any improvement in biodiversity in LGAs from an increased area of greenlife.
- The contribution to the realisation of the 202020 vision was not valued specifically; however, a contribution to the 2020202 vision was already valued via the total health and wellbeing improvement that was valued in this assessment.

Summary of Assumptions

The first impact that was valued was the increase in profits of nursery businesses due to an increase in sales of young trees to some urban areas; this increase in sales was driven by an assumed increase in confidence associated with future tree costs gained by some LGAs due to use of the tool.

The second impact that was valued was an increase in the future health and wellbeing of some urban residents provided by the increase in the planting of trees in urban areas.

A summary of all assumptions made for valuation of the two impacts due to the project is provided in Table 6.

Table 6: Summary of Assumptions for Impacts Valued

Variable	Assumption	Source/Comment
Benefit 1: Increased sales of N&G industry		
Gross farm gate value of Australian nursery industry	$2.44 billion	Greenlife Industry Australia (2019)
Total increase in sales of N&G industry due to increased confidence in the lifetime costs of trees	0.01%	Analyst assumption
Value of increased sales; it should be noted that this value also represents a cost to LGAs in Benefit 2 following	$244,000	$2.44 billion x 0.01%
Profit as a percentage of turnover	9.8% (average of 15%	Previous benchmarking studies

	and 4.6%)	have previously estimated profit as a percentage of turnover of nurseries at between 4.6% and 15% (e.g. IBISWORLD)
Potential total increase in total net profits	$23,912	$244,000 x 9.8%
Year of first impact of sales and profits	2020/21	Analyst estimate of year in which increased sales and profitability commence and end due to the project
Year of final impact of sales and profits	2025/26	
Proportion of total net profits for each year over the six years ending June 2021 to 2026	10%, 20%, 25% 20% 15%, 10%	Analyst assumption
Risk and attribution factors for Benefit 1		
Probability of project output	100%	Analyst assumptions
Probability of outcome (use of the project outputs)	90%	
Probability of impact given usage	90%	
Attribution to project	100%	
Benefit 2: Increased health and wellbeing in LGAs due to additional tree plantings		
Value of a Statistical Life (VSL)	$5.1 million	Australian Government (2021)
Value of a Statistical Life Year (VSLY)	$222,000	
Increase in QALY due to additional tree plantings	0.01	Analyst assumption
Year in which QALY first increases	5 years after trees are planted	Analyst assumption
Value of increase per person	$2,200 p.a.	0.01 x 222,000
City LGAs assumed targeted	Sydney, Melbourne, Brisbane and Adelaide	Based on stakeholders (councils and contractors in Adelaide, Melbourne, Sydney and Brisbane); where information was sourced in the development of the Tree Costing Tool
Population of Sydney	4,627,345	https://worldpopulationreview.com/countries/australia-population
Population of Melbourne	4,246,375	
Population of Brisbane	2,189,878	
Population of Adelaide	1,225,235	
Total population of target cities	12,288,833	
Percentage of population of target cities assumed to benefit	0.025%	Analyst assumption
Estimated total number of people in cities that may benefit from additional trees planted due to the Tree Costing Tool	3,072	0.025% x 12,288,833
Year of first health and wellbeing (H&WB) benefit from new tree planting	2026 (five year lag)	Analyst assumptions
Year of maximum H&WB benefit	2031	
Additional tree purchase costs to deliver new H&WB benefit	$244,000 p.a.	$2.44 billion x 0.01%; based on the increased sales by nurseries

Planting period for new trees	6 years; 2021-2026	Analyst assumption
Proportion of total planting costs (100%) each year from 2021-2026	10%, 20%, 25% 20% 15% 10%	Based on annual proportion of total nursery tree sales over period 2021-2026
Tree purchase costs as % total establishment costs	28%	Tree cost model (NY18003)
Establishment costs as % total life costs	21%	
Total additional tree establishment costs over the period 2021 to 2026 to deliver benefits	$871,529	$244,000*100/28
Additional maintenance costs of trees per annum once all trees are planted	$4,149,660	$871,529 *100/21
Risk and attribution factors for Benefit 2		
Probability of project output	100%	Analyst assumptions
Probability of outcome (use of the project outputs)	75%	
Probability of impact given usage	75%	
Attribution	100%	
Counterfactual		
Without the NY 18003 project funding, it is assumed that the impacts assumed in Table 4 would not have occurred.		

Results

All costs and benefits were discounted to 2020/21 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 (2019/20) 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. As Hort Innovation was the only financial contributor, the investment criteria in Tables 7 and 8 are the same.

Table 7: Investment Criteria for Total Investment in Project NY18003

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	-5.69	-7.21	-3.01	0.27	2.84	4.86
Present Value of Costs ($m)	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Net Present Value ($m)	-0.18	-5.87	-7.39	-3.20	0.09	2.66	4.68
Benefit-Cost Ratio	0.00	-31.03	-39.31	-16.44	1.47	15.51	26.51
Internal Rate of Return (%)	n.s.	n.s.	n.s.	negative	5.11	7.47	8.56
MIRR (%)	n.s.	n.s.	n.s.	0.36	5.07	6.40	6.82

n.s. no solution

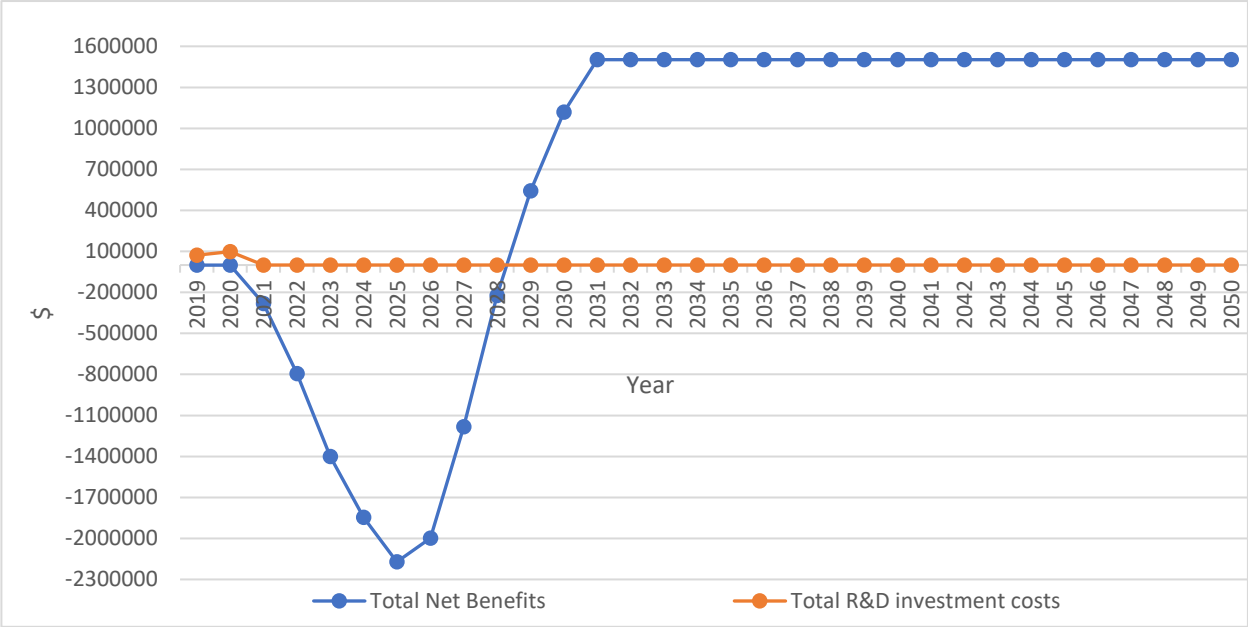
Table 8: Investment Criteria for Hort Innovation Investment in Project NY18003

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	-5.69	-7.21	-3.01	0.27	2.84	4.86
Present Value of Costs ($m)	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Net Present Value ($m)	-0.18	-5.87	-7.39	-3.20	0.09	2.66	4.68
Benefit-Cost Ratio	0.00	-31.03	-39.31	-16.44	1.47	15.51	26.51
Internal Rate of Return (%)	n.s.	n.s.	n.s.	negative	5.11	7.47	8.56
MIRR (%)	n.s.	n.s.	n.s.	0.36	5.07	6.40	6.82

n.s. no solution

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the NY18003 investment are shown in Figure 1. The period of negative benefits is due to the period when the additional tree establishment and maintenance costs are higher than the gradually increasing but lagged H&WB as the new trees grow.

Figure 1: Annual Total Net Benefits and Investment Cost Flows



Source of benefits

Table 9 shows the contribution to total benefits from that each of the two benefits valued. The health and wellbeing benefit was the principal contributor.

Table 9: Source of Total Benefits
(Total investment, 30 years)

Relative Sources of Benefits	Contribution to PVB ($)	Share of benefits (%)
Impact 1 (nursery profits)	17,272	0.4%
Impact 2 (health and wellbeing)	4,843,479	99.6%
Total	4,860,751	100.0%

Sensitivity Analysis

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 10 presents the results. The results show an extremely high sensitivity to the discount rate, largely due to the significant period between costs incurred in establishment and tree maintenance in relation to the later incidence of the health and wellbeing impacts. For example, given the assumptions made the annual health and wellbeing benefits only commence to outweigh the annual maintenance costs of the new trees in the year 2029.

Table 10: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5% (base)	10%
Present Value of Benefits ($m)	21.81	4.86	-0.90
Present Value of Costs ($m)	0.17	0.18	0.20
Net Present Value ($m)	21.64	4.68	-1.10
Benefit-cost ratio	127.57	26.51	-4.60

A sensitivity analysis was then undertaken for the assumption of the timing of the commencement of the H&WB impact due to the additional tree plantings. Results provided in Table 11 show that the investment criteria are highly sensitive to this assumption. This suggests that a willingness-to pay study of beneficiaries of tree planting in urban areas could be valuable for use in any future valuation of the benefits from urban tree planting. Such a study could address the type of impacts valued by beneficiaries (e.g. shade, scenic amenity) and when beneficiaries would commence to value such impacts after tree planting.

Table 11: Sensitivity to Assumption on the Commencement of the H&WB impact
(Total investment, 30 years)

Investment criteria	Number of years after planting		
	7	5 (base)	3
Present Value of Benefits ($m)	-0.37	4.86	10.63
Present Value of Costs ($m)	0.18	0.18	0.18
Net Present Value ($m)	-0.56	4.68	10.45
Benefit-cost ratio	-2.03	26.51	57.98

Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are especially 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 an 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
Medium	Medium-Low

Coverage of benefits was assessed as Medium. The most important impact (the health and wellbeing improvement from additional tree plantings) was valued. Secondary impacts not valued included the increased value of biodiversity in some LGA and the contribution to the 202020 vision.. To some degree, Some components of both of these impacts could be viewed as being included in the health and wellbeing impact already valued.

Confidence in assumptions for valuation of impacts was rated as Medium-Low as some of the assumptions made (for example. the increase in the Quality of Life index) were not supported strongly by surveys or other forms of evidence of change.

Conclusion

The investment in NY18003 and the resulting Tree Cost Tool is likely to contribute to increased plantings of trees in some LGAs due to the increased confidence in the future costs of planting trees via use of the tool. The increased tree planting will benefit the suppliers of trees (the N&G industry). Although the cost to the LGAs associated with the plantings of additional trees will be substantial, the additional tress will provide health and wellbeing benefits to residents.

The investment criteria estimated are very sensitive to the assumption of when, in the life cycle of a tree, H&WB benefits may commence accruing to urban residents. Further information on this observation may be valuable to address in any future studies regarding the value of urban tree planting.

Total funding from all sources for the project was $0.18 million (present value terms). The investment produced estimated total expected benefits of $4.86 million (present value terms). This gave a net present value of $4.68 million, an estimated benefit-cost ratio of 26.5 to 1, an internal rate of return of 8.6% and a modified internal rate of return of 6.8%.

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

ABS	Australian Bureau of Statistics
BS	Strawberry
CRRDC	Council of Research and Development Corporations
DAWE	Department of Agriculture, Water and the Environment
GDP	Gross Domestic Product
H&WB	Health and Wellbeing
IRR	Internal Rate of Return
LGA	Local Government Area
MG	Mango
MIRR	Modified Internal Rate of Return
M&E	Monitoring and Evaluation
n.s.	no solution
N&G	Nursery and Garden
NGIA	Nursery and Garden Industry Association
NY	Nursery
PVB	Present Value of Benefits
RB	Rubus
R&D	Research and Development
RD&E	Research, Development and Extension
QALF	Quality Adjusted Life Year
SIP	Strategic Investment Plan
VSL	Value of a Statistical Life
VSLY	Value of a Statistical Life Year
TU	Turf