

**Final Report**

**Industry specific impact assessment  
program: Turf**

**Impact assessment report for project *Developing a  
national standard for turf as an erosion control  
measure* (TU13034)**

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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 *TU13034: Developing a National Standard for Turf as an Erosion Control Measure*. The project was funded by Hort Innovation over the period June 2014 to July 2017.

### 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

Investment in TU13034 has delivered an Australian Standard for the use of turf in erosion control which will provide confidence that turf can be used to minimise any environmental damage caused during construction and operation of relevant engineered works. When outcomes from TU13034 are combined with previous work aimed at demonstrating and training in the use of turf for erosion control, it is likely that the turf industry will secure additional sales of turf in the erosion control market.

### Investment Criteria

Total funding from all sources for the project was \$0.16 million (present value terms). The investment produced estimated total expected benefits of \$0.57 million (present value terms). This gave a net present value of \$0.42 million, an estimated benefit-cost ratio of 3.62 to 1, an internal rate of return of 14.5% and a modified internal rate of return of 8.8%.

### Conclusions

The Hort Innovation investment in Project TU13034 has delivered an Australian Standard for the use of turf in erosion control. As three environmental and social impacts identified were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

## Keywords

Impact assessment, cost-benefit analysis, turf, erosion control, construction, mining, agriculture, Australian Standard, Standards Australia.

## 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.

This 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 \$7.9 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.

## 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 turf industry has a five-year average production volume of 38.9 million square metres and a gross value of production of \$250.2 million – Table 1. In 2019/20, turf had an estimated farmgate value of \$280.2 million (Turf Australia/Hort Innovation 2021).

Table 1: Turf Industry Performance 2016-2020

| Year Ended 30 June | Area (ha) | Production (million m <sup>2</sup> ) | Gross Value of Production (\$m) | Wholesale Value (\$m) |
|--------------------|-----------|--------------------------------------|---------------------------------|-----------------------|
| 2016               | 3,736     | 42.8                                 | 257.5                           | 257.5                 |
| 2017               | 3,880     | 38.5                                 | 228.6                           | 270.6                 |
| 2018               | 3,863     | 38.4                                 | 240.6                           | 240.6                 |
| 2019               | 3,880     | 36.4                                 | 243.9                           | 243.9                 |
| 2020               | 3,880     | 38.5                                 | 280.2                           | 280.2                 |
| Average            | 3,848     | 38.9                                 | 250.2                           | 258.6                 |

Source: Australian Horticulture Statistics Handbook 2017/18, 2018/19 and 2019/20.

Turf covers live grass products grown for parks, gardens, residential and commercial properties, sporting venues and for land rehabilitation and landscape improvement purposes. Production occurs in all states and territories of Australia. The majority of production occurs in New South Wales (NSW) and Queensland (QLD). Production is year-round, with a number of different varieties being grown, although there is a peak of production during the spring and summer months. (Australian Horticulture Statistics Handbook 2019/20).

Turf research and development (R&D) activity is guided by the Turf industry's Strategic Investment Plan (SIP). The activities are funded by levies payable on turf produced in Australia; and the R&D levy funds are managed by Hort Innovation.

The recently completed SIP has been driven by levy payers and addressed the Australian turf industry's needs from 2017 to 2021. The SIP focussed on five outcome areas:

- Turf revenue has increased by five per cent plus consumer price index (CPI) from targeted marketing programs.
- Improved strategic decision making by turf growers from increased knowledge of industry data and consumer insights.
- Improved farm practices and profitability from increased awareness and adoption of turf R&D.
- Turf industry leadership program graduates are adopting innovation and using their leadership skills in business and industry decision making.
- Improved industry sustainability from identifying and managing risks.

Turf Australia is the representative body of the turf industry comprising of levy-paying turf producers and individual members Australia wide. Turf Australia plays a vital role in the dissemination of information on both levy-funded R&D and marketing outputs as well as industry intelligence.

### Rationale

Turf Australia wishes to expand the market for turf in Australia and to this end has worked with Hort Innovation to invest levy funds in an erosion control and demonstration facility at Redlands Research Station, Cleveland QLD. Hort Innovation project TU10025 funded development of the facility and TU12022 delivered an extensive demonstration and training program targeting both policy makers and potential users of turf for erosion control.

Through research, development, and extension (RD&E) activity at the Redlands Research Station, Turf Australia has demonstrated that turf can be used during construction and on completed works to control erosion. Turf Australia expects that relevant applications for these research findings will include buildings, roads, waterways, mining, agriculture, and any other similar engineered works.

The next step in having turf recognised as an effective erosion control agent was to secure an appropriate Australian Standard from Standards Australia and this has been achieved. Standards are documents that set out specifications, procedures and guidelines that aim to ensure products, services, and systems are safe, consistent, and reliable. Standards Australia is the nation’s peak non-government, not-for-profit standards organisation.

## Project Details

### Summary

|  |
|--|
| Project Code: TU13034  |
| Title: Developing a national standard for turf as an erosion control measure |
| Research Organisation: GED Advisory  |
| Project Leader: Graeme Drake   |
| Period of Funding: June 2014 to July 2017                                    |

### Objectives

The objective of this project was to deliver an Australian Standard for the use of turf as an erosion control measure in construction management and completed work. The project was to be delivered in two parts:

- Preparation and submission of a project proposal to Standards Australia.
- Subsequent development and publication of the standard if the proposal is approved.

### Logical Framework

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

*Table 2: Logical Framework for Project TU13034*

|            |  |
|------------|--|
| Activities | <ul style="list-style-type: none"> <li>• Consultation to inform the proposal submitted to Standards Australia. Consultation completed with Turf Australia, Hort Innovation, turf growers and suppliers, Standards Australia, researchers, Master Builders Association, Housing Industry Association, Australian Industry Group, Engineers Australia, Institute of Public Works Engineering Australasia, relevant government departments, AusRoads, local government associations, Australian Construction Association, Australasian Construction and Procurement Council, environmental and soil erosion interests, Insurance Council of Australia and CSIRO.</li> <li>• Proposal submitted to Standards Australia who accepted it in principle and without change. However, Standards Australia considered it of insufficient priority to fund in 2014 and held it over to the following year. The proposal was subsequently developed by a Standards Australia management committee consisting of the Australian Institute of Landscape Architects, Engineers Australia, Hort Innovation, the International Erosion Control Association, Soil Science Australia, the Sports Turf Association, Sports Turf Research Institute, Turf Australia, and the University of Queensland.</li> <li>• Standard AS:5181:2017 for “Use and Installation of Turf as an Erosion, Nutrient, and Sediment Control Measure” was issue by Standards Australia, 30 June 2017.</li> </ul> |
| Outputs    | <ul style="list-style-type: none"> <li>• A proposal for an Australian Standard for using turf as an erosion control measure.</li> </ul>  |

|          |  |
|----------|--|
|          | <ul style="list-style-type: none"> <li>• A completed and published Australian Standard for using turf as an erosion control measure.</li> </ul>  |
| Outcomes | <ul style="list-style-type: none"> <li>• An Australian Standard for the use of turf in erosion control which will provide industry with confidence that turf can be used to minimise environmental damage during construction and operation of relevant engineered works.</li> <li>• Growth in the market for Australian turf with expanded use of the product during construction and operation of relevant engineered works.</li> <li>• Additional profitable sales opportunities for Australian turf growers.</li> </ul>    |
| Impacts  | <ul style="list-style-type: none"> <li>• Additional profitable turf sales into the erosion management market.</li> <li>• Reduced environmental damage during construction and operation of engineered works.</li> <li>• Additional policy maker, landscape architect, engineer and researcher skills and knowledge in turf use and erosion control.</li> <li>• Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of a more profitable turf industry.</li> </ul> |

## Project Investment

### Nominal Investment

Table 3 shows the annual investment made in Project TU13034 by Hort Innovation and others. There were no other investors in the project.

*Table 3: Annual Investment in Project TU13034 (nominal \$)*

| Year ended 30 June | HORT INNOVATION (\$) | OTHERS (\$) | TOTAL (\$)    |
|--------------------|----------------------|-------------|---------------|
| 2014               | 40,000               | 0           | 40,000        |
| 2015               | 9,500                | 0           | 9,500         |
| 2016               | 0                    | 0           | 0             |
| 2017               | 28,116               | 0           | 28,116        |
| 2018               | 19,404               | 0           | 19,404        |
| <b>Total</b>       | <b>97,020</b>        | <b>0</b>    | <b>97,020</b> |

Source: Hort Innovation fully executed letter of variation, 2016.

### 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 the 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). Attainment of the Australian Standard for use of turf in erosion control was communicated to the landscaping and engineering sectors by Turf Australia.

## 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 TU13034

|               |   |
|---------------|---|
| Economic      | <ul style="list-style-type: none"> <li>Additional profitable turf sales into the erosion management market.</li> </ul>  |
| Environmental | <ul style="list-style-type: none"> <li>Reduced environmental damage during construction and operation of engineered works.</li> </ul>   |
| Social        | <ul style="list-style-type: none"> <li>Additional policy maker, landscape architect, engineer and researcher skills and knowledge in turf use and erosion control.</li> <li>Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of a more profitable turf industry.</li> </ul> |

### Public versus Private Impacts

The impacts identified from the investment are both private and public in nature. Private impacts accrue to turf producers (additional profitable sales into the erosion management market). Public impacts include reduced environmental damage during construction and operation of engineered works; additional stakeholder skills and knowledge; as well as spill-overs to regional communities from enhanced turf producer profit.

### Distribution of Private Impacts

Private impacts will mostly be retained by turf growers who control the supply chain and have a direct relationship with final purchasers.

### Impacts on Other Australian Industries

Impacts on other Australian industries are unlikely – the project generated an Australian Standard for turf.

### Impacts Overseas

Australian Standards are also used by our near neighbours. Application of AS:5181:2017 in the Pacific may also deliver the impacts described in Table 4 for countries like New Zealand.

### 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 to Rural RD&E Priority 3, and to Science and Research Priority 2.

Table 5: Australian Government Research Priorities

| Australian Government   |   |
|---|---|
| Rural RD&E Priorities (est. 2015)   | Science and Research Priorities (est. 2015)   |
| <ol style="list-style-type: none"> <li>Advanced technology</li> <li>Biosecurity</li> <li>Soil, water and managing natural resources</li> <li>Adoption of R&amp;D</li> </ol> | <ol style="list-style-type: none"> <li>Food</li> <li>Soil and Water</li> <li>Transport</li> <li>Cybersecurity</li> <li>Energy and Resources</li> <li>Manufacturing</li> <li>Environmental Change</li> <li>Health</li> </ol> |

Sources: (DAWR, 2015) and (OCS, 2015)

### Alignment with the Turf Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the turf industry are outlined in the Turf Industry's Strategic Investment Plan 2017-2021<sup>1</sup> (Hort Innovation, 2017). Project TU13034 addressed outcome one ('Turf revenue has increased by five per cent per annum plus CPI from targeted marketing programs').

## Valuation of Impacts

### Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some 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 investment criteria.

A single impact was valued – additional profitable turf sales into the erosion management market due to the development and publishing of an Australian Standard.

### Impacts Not Valued

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

- Reduced environmental damage during construction and operation of engineered works.
- Additional policy maker, landscape architect, engineer and researcher skills and knowledge in turf use and erosion control.
- Contribution to improved regional community wellbeing from spill-over income and employment benefits as a result of a more profitable turf industry.

These impacts were not valued due to lack of data to support credible assumptions.

### Summary of Assumptions

A summary of the key assumptions made for valuation of additional sales that may be realised as a result of securing an Australian Standard for erosion control using turf is provided in Table 6.

Table 6: Summary of Assumptions for Impact Valuation

| Variable   | Assumption                              | Source/Comment  |
|--|---|---|
| Total turf production.   | 38,900,000 m <sup>2</sup> /year.        | See Table 1.  |
| Increase in turf sales due to the industry's investment in its erosion control research program including TU10025, TU12022, TU12026 and TU13034. | 6%<br>(2,334,000 m <sup>2</sup> /year). | Estimate made after considering the analysis of current turf sales channels provided in the Australian Turf Industry Snapshot, 2019/20. |
| Share of total sales increase due to securing an Australian Standard via TU13034.  | 10%.                                    | 90% of increased sales due to demonstration facility development and training programs at Redlands Research Station.                    |
| Average profit on additional turf sales.   | \$0.65/m <sup>2</sup> .                 | Average farm gate price \$6.50/m <sup>2</sup> (sourced from the Australian Turf   |

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

|   |          |  |
|---|----------|--|
|   |          | Industry Snapshot, 2019/20) and an assumed profit margin of 10%.   |
| Year of first impact.                                 | 2018/19. | Assumes 2 years required after publishing the Australian Standard for uptake by industry. Industry uptake commences at 10% of total relevant turf production before doubling each year for 4 years before reaching 100% of relevant production in 2023/24. |
| Attribution of impacts to this project.               | 80%      | AgEconPlus assumption that allows for cost of communicating the Australian Standard to the landscape and engineering sectors.  |
| Probability of the project generating useful outputs. | 100%     | Outputs have been delivered – the Australian Standard has been published.  |
| Probability of valuable outcomes.                     | 80%      | Adoption of turf for erosion control will dependent on multiple factors including its competitiveness against alternatives.  |
| Probability of impact (assuming successful outcome)   | 80%      | Increased total sales will depend on conditions in other market segments.  |
| Counterfactual.                                       | 50%      | In the absence of TU13034 research, it is 50% likely that results would have been generated by another project.  |

## 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 (2017/18) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

### Investment Criteria

Table 7 shows the investment criteria estimated for different periods of benefits for the total investment. Hort Innovation was the only investor in the project.

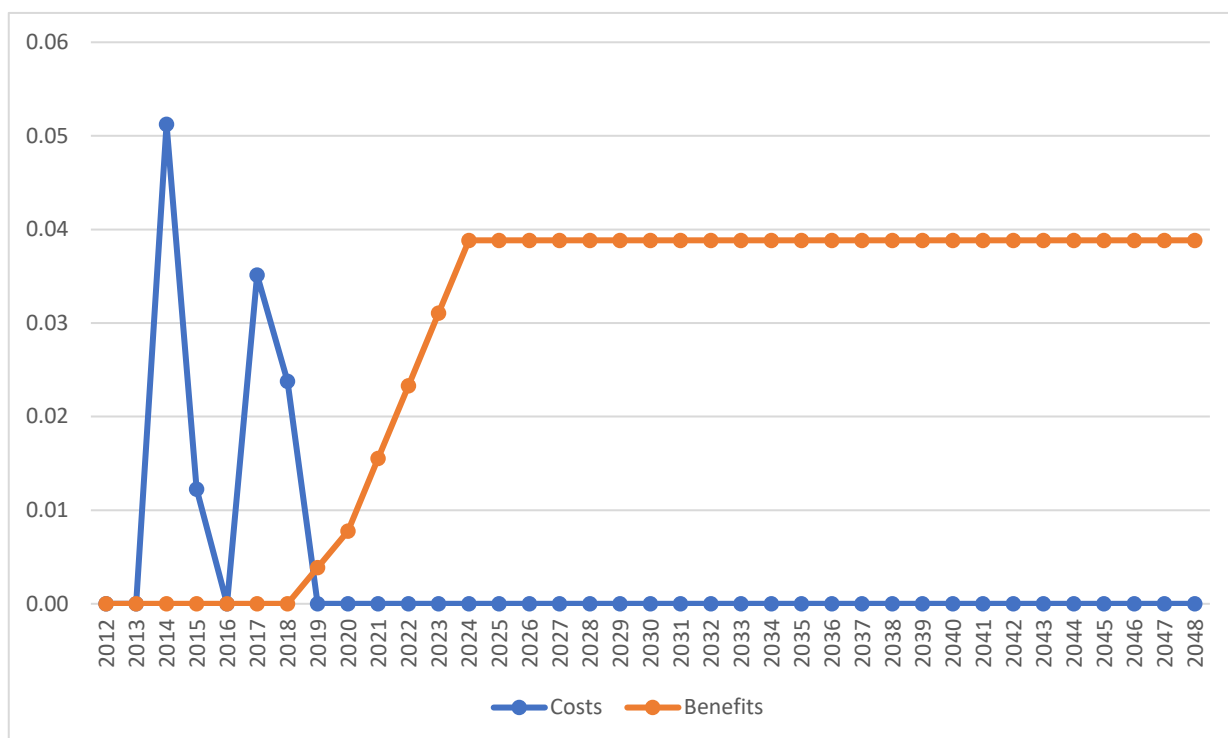
*Table 7: Investment Criteria for Total Investment in Project TU13034*

| Investment Criteria             | Years after Last Year of Investment |          |      |      |      |      |      |
|---------------------------------|-------------------------------------|----------|------|------|------|------|------|
|                                 | 0                                   | 5        | 10   | 15   | 20   | 25   | 30   |
| Present Value of Benefits (\$m) | 0.00                                | 0.08     | 0.23 | 0.35 | 0.44 | 0.52 | 0.57 |
| Present Value of Costs (\$m)    | 0.16                                | 0.16     | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| Net Present Value (\$m)         | -0.16                               | -0.08    | 0.07 | 0.19 | 0.29 | 0.36 | 0.42 |
| Benefit-Cost Ratio              | 0.00                                | 0.49     | 1.45 | 2.21 | 2.80 | 3.26 | 3.62 |
| Internal Rate of Return (%)     | negative                            | negative | 8.1  | 12.2 | 13.7 | 14.3 | 14.5 |
| MIRR (%)                        | negative                            | negative | 7.0  | 9.1  | 9.3  | 9.1  | 8.8  |

The annual undiscounted benefit and cost cash flows for the total investment for the duration of the

TU13034 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<sup>2</sup>



### 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 8 presents the results. The results are moderately sensitive to the discount rate.

Table 8: Sensitivity to Discount Rate (Total investment, 30 years)

| Investment Criteria             | Discount rate |           |      |
|---------------------------------|---------------|-----------|------|
|                                 | 0%            | 5% (base) | 10%  |
| Present Value of Benefits (\$m) | 1.05          | 0.57      | 0.37 |
| Present Value of Costs (\$m)    | 0.12          | 0.16      | 0.20 |
| Net Present Value (\$m)         | 0.93          | 0.42      | 0.16 |
| Benefit-cost ratio              | 8.60          | 3.62      | 1.79 |

A sensitivity analysis was then undertaken on the increase in turf sales as a result of industry investment in the erosion control demonstration facility, training, and securing an Australian Standard. Results are provided in Table 9. When assumed increase in sales is halved to 3%, and all other factors remain unchanged, the project continues to show a favourable return on investment.

<sup>2</sup> Assumptions used to assess the rate of adoption between 2016-2020 are described in Table 6.

Table 9: Sensitivity to Increase in Turf Sales with Investment Erosion Control RD&E (Total investment, 30 years)

| Investment Criteria             | Increase in Turf Sales |           |      |
|---------------------------------|------------------------|-----------|------|
|                                 | 3%                     | 6% (base) | 9%   |
| Present Value of Benefits (\$m) | 0.29                   | 0.57      | 0.86 |
| Present Value of Costs (\$m)    | 0.16                   | 0.16      | 0.16 |
| Net Present Value (\$m)         | 0.13                   | 0.42      | 0.70 |
| Benefit-cost ratio              | 1.81                   | 3.62      | 5.43 |

A final sensitivity analysis tested profit earned on additional turf sales. The results (Table 10) show that if profit on additional sales is as low at \$0.17/m<sup>2</sup>, then project benefits will approximately equal project costs.

Table 10: Sensitivity to Profit Earned on Additional Turf Sales (Total investment, 30 years)

| Investment Criteria             | Farmgate Profit on Additional Turf Sales |                       |                              |
|---------------------------------|--|-----------------------|------------------------------|
|                                 | \$0.17/m <sup>2</sup>                    | \$0.30/m <sup>2</sup> | \$0.65/m <sup>2</sup> (base) |
| Present Value of Benefits (\$m) | 0.15                                     | 0.27                  | 0.57                         |
| Present Value of Costs (\$m)    | 0.16                                     | 0.16                  | 0.16                         |
| Net Present Value (\$m)         | -0.01                                    | 0.11                  | 0.42                         |
| Benefit-cost ratio              | 0.95                                     | 1.67                  | 3.62                         |

### 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 11). 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 11: Confidence in Analysis of Project

| Coverage of Benefits | Confidence in Assumptions |
|----------------------|---------------------------|
| High                 | Medium-Low                |

Coverage of benefits valued was assessed as High, the key impact (additional profitable turf sales) was valued. Confidence in assumptions was rated as Medium-Low, key data was estimated by the analyst.

### Conclusion

Investment in TU13034 has delivered an Australian Standard for the use of turf in erosion control which will provide confidence that turf can be used to minimise the environmental damage caused during construction and operation of relevant engineered works. When outcomes from TU13034 are combined with previous work aimed at demonstrating and training in the use of turf for erosion control, it is likely that the turf industry will secure additional sales of turf to the erosion control market.

Total funding from all sources for the project was \$0.16 million (present value terms). The investment produced estimated total expected benefits of \$0.57 million (present value terms). This gave a net present value of \$0.42 million, an estimated benefit-cost ratio of 3.62 to 1, an internal rate of return of 14.5% and a modified internal rate of return of 8.8%.

As three environmental and social impacts identified were not valued, the investment criteria estimated by the evaluation may be underestimates of the actual performance of the investment.

## 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

|       |   |
|-------|---|
| CRRDC | Council of Research and Development Corporations                      |
| DAWR  | Department of Agriculture and Water Resources (Australian Government) |
| GDP   | Gross Domestic Product  |
| GVP   | Gross Value of Production   |
| IRR   | Internal Rate of Return   |
| MIRR  | Modified Internal Rate of Return                                      |
| OCS   | Office of Chief Scientist Queensland                                  |
| PVB   | Present Value of Benefits   |
| R&D   | Research and Development  |
| RD&E  | Research, Development and Extension                                   |
| SIP   | Strategic Investment Plan   |