Erosion control - turf research and development facility

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Summary

The turf industry levy-funded project, *TU12022 Erosion control - Turf research and demonstration facility*, has been building awareness of the use of natural turfgrass for erosion control for the past two years. The large-scale demonstration facility has successfully engaged policy and decision-makers from federal, state and local governments, and has also provided hands-on education on erosion control to members of the local government, construction, landscaping and mining sectors.

After the initial two years of operating the site (under project TU10025), the project was redesigned to further enhance the effectiveness and benefits of the demonstration facility. In addition to the regular on-site demonstration workshops, interstate visits were promoted to increase attendance to the site, and demonstration and training materials were developed for dissemination to those who could not attend the facility.

The outputs from the project have surpassed those originally planned. Twenty-one (21) training/demonstration events have been delivered to over 500 attendees, and 500 information packs have been distributed. A number of technical reports have been produced, including a detailed description of the process for developing an Australian Standard for 'Turf for Erosion control' and a cost comparison of the use of turfgrass against other erosion control methods.

A number of industry and interstate presentations were made, including a poster presentation at the International Horticultural Congress 2014 in Brisbane, a presentation at the International Erosion Control Association 2013 conference and the Stormwater Association annual conference in New South Wales and a council gathering in Victoria. ABC rural news program *Landline* also featured the facility in an April 2014 episode, filming the demonstration and presentation and interviewing the Project Leader as part of their segment on the Australian turf industry.

Eight professionally-produced training videos have been made available on the Turf Australia website (www.turfaustralia.com.au) and have been distributed to the Federal Environment Minister, national organisations including the International Erosion Control Association, and councils in Tasmania, New South Wales, Queensland, Victoria, South Australia, Western Australia, the Northern Territory and the ACT. A number of media and journal articles have been printed and a refereed journal article was presented at the International Turf Research Conference in Beijing 2013. Other promotional material has included media releases and an information and extension pack, as well as an advertisement available in print and web formats which turf producers can use in their promotions and communications.

It was anticipated that an increase in turf sales of two per cent (or around $10 million) would be delivered within five years as a direct result of this project. Although it is too early to determine the success of this outcome, the anecdotal evidence observed by the project team during the course of the project, coupled with formal feedback received via the two participant and industry surveys, suggests that a 2 per cent increase is likely.

It is recommended that a number of initiatives be pursued after the completion of the project, in order to maintain the momentum of promoting turf as an effective tool in erosion control. This will maximise the benefits achieved from the direct contact that has been made with commercial customers (including local councils and construction, landscaping and mining companies) and will capitalise on the industry's substantial investment in the development of this market. Further detail on the recommendations developed from the project is summarised in the table below.

Recommendation	Action
Recommendation 1	The information pack should be provided to levy payers in electronic format for use in their promotional and consumer education efforts. The information should also be sent out widely to educators, consultants and councils for their ongoing use in training or as reference materials for practitioners.
Recommendation 2	The results from the economic analysis should be widely communicated and further economic analyses should be undertaken. These figures should form a central part of a communication, marketing or promotional effort aimed at commercial users and could be developed into a decision-making tool to assist clients to select and budget for turf installation and maintenance.
Recommendation 3	The characteristics of different cultivars should be better promoted to clients who are currently largely unaware of new and different cultivars that have been selected to deal with hostile environments. This will help to overcome the problem that turf is currently not often considered, as clients assume it will not tolerate anything but optimal growing conditions and environments.
Recommendation 4	There is a demand for native turfgrass cultivars and this represents an opportunity for growers to expand further into this market. Commercial clients currently have reservations about using turfgrass in natural or environmentally sensitive areas.
Recommendation 5	Quality was raised as an issue, usually in terms of spreading and introducing weeds into an area where they were not previously present. The national implementation of the Turf Accreditation Process (TAP) would begin to address this issue, by ensuring turfgrass of a specified quality or purity could be purchased for erosion control in areas like national parks and government land.
Recommendation 6	There is a substantial opportunity to communicate, educate and market the use of turf directly to many people in the commercial sectors who are also often influential in purchasing decision-making within these organisations.

Keywords

turf, turfgrass, erosion control, sediment control, extension

Introduction

The *Erosion and Sediment Control Demonstration Facility (TU12022)* project was commissioned by the Australian Turf Industry to build a demonstration and training facility at Cleveland, Queensland to display the use of turf for erosion control compared to other commonly available measures. The project was funded by the Australian turf production levy and administered by Horticulture Australia Limited (HAL), now Horticulture Innovation Australia Limited (HIA). The facility ran successfully from February 2013 until December 2014 and met all of its predicted milestone achievements, including a number of attendees and workshops. The project also developed a number of educational and extension tools (information packs, reports, videos, print advertisements and articles) aimed to educate the target industries about the project and the use of turf to control erosion and sediment. A number of technical reports concerning specific aspects of the project were also produced.

The project's original strategy was to extend the research results from HAL-funded project *Optimising Turf Use to Minimise Soil Erosion on Construction Sites (TU08033*) so that the maximum return on investment could be derived for the turf levy payers and HAL from that study. The results from TU08033 identified turf as an effective measure for the control of erosion in areas such as construction sites (e.g. motorways, housing estates). However, the scope of that project did not allow for a concerted extension/education effort. This project has aimed to address the outstanding issues raised in the concluding remarks from the report, where it was stated that:

"…it is highly desirable that efforts be focused on encouraging turf use for erosion and sediment control on building sites. As shire and regional councils tend to have a primary role in enforcing erosion and sediment control, expansion of efforts should focus on those organisations and broader local government groups. There would also be value in extending the project information to the various State environmental protection agencies." (Loch, 2010)

The demonstration facility allowed the training and demonstration of this concept to decision-makers and specifiers in the building/construction industry, the mining and landscape industries, representatives from local and state governments, and erosion and environmental consultants. The project ran demonstrations for representatives from councils across Queensland and New South Wales, and with some limited representation from all other states. The project has also conducted a number of workshops for construction companies, mining company staff and specialised erosion training organisations, where it was used as a 'field trip' for their certified training courses. This has included over 500 participants attending the site during 21 workshops from key target groups of the private and public sectors, including representatives from:

- International Erosion Control Association
- Greening Australia
- SEQ Catchments and SEQ Water
- local councils
- State Government departments including agriculture, natural resources, roads and infrastructure and public works

- A number of environmental and training consultants
- construction, landscaping and mining companies
- the Australian Defense Force facilities management
- State government ministers, members of parliament and senior ministerial staff from departments of environment, natural resources and mines.

The project team also undertook a number of activities to ensure that the project's message and benefits would be extended nationally to the benefit of as many levy payers as possible. This included presenting at industry conferences and meetings, presenting virtual 'road show' demonstrations, conference and scientific journal papers, industry reports, magazine articles for turf, landscaping, mining, construction and government sector journals and the release of media articles. Presentations to local governments were conducted in appropriate conferences and forums as well as on an individual basis throughout Queensland, Victoria, Northern Territory and New South Wales.

NOTE: The original variant of this project was adversely affected by the Queensland Department of Agriculture Fisheries and Forestry (DAFFQ) decision to disinvest in Lifestyle Horticulture Research, Development and Extension, which included all turf activity. This resulted in the termination of the previous project (TU10025) as of 1st February 2013 and necessitated a renegotiation of a new project under new leadership (BioScience Australia Pty Ltd). The construction of the facility was completed and had been hosting regular workshops successfully throughout 2012 under this arrangement, the results of which were reported to HAL in January 2013. This report therefore does not discuss nor consider the site's design or construction, nor does it discuss the workshop and participant numbers from the earlier, terminated project (although they are noted in Appendix 1). In total, the two projects hosted 35 workshops with a total of 766 participants.

Methodology

The project was led and conducted by project staff Shane Holborn and Will Pearce under BioScience Australia Pty Ltd, with guidance from members of the project Steering Committee who ensured the project continued to focus on achieving commercial outcomes for levy payers. The Steering Committee was comprised of the project staff, a Turf Australia representative (Richard Stephens), turf growers (John Keleher and Lyn Davidson), an industry representative (Ashleigh Botha from John Holland) and a HAL representative who acted as an observer. The project secured an 'industry champion' from the construction industry in order to provide advice on the project's focus and direction, generate support from within that industry for turf as an erosion control measure, and raise the profile of and drive demand for the product within this sector by its members.

The project staff undertook all activities within the project, including securing attendees for demonstration training days, liaising with training organisations for use of the site, running demonstration days, generating project materials, and managing project communications and project reporting. A major part of this activity was conducting interstate visits to garner support for attendance at the site and to deliver demonstration and training materials to those unable to attend. Visits included attendance at turf industry events and trips to four major centers to present a 'virtual demonstration' of the project, utilising extension materials and video footage to convey the message. This also included presenting at relevant conferences and hosting specific workshop days with interstate partners.

As part of the wider 'Turf for Erosion Control' initiative, the project also developed a number of materials and reports including:

- the attendee information pack a cost/benefit analysis of the use of turf as an erosion control method, commissioned by the project and conducted by DAFFQ agricultural economist Bill Johnston and his team member Sarah Goswami, with assistance from the project staff; this was delivered July 2013 (Appendix 6)
- a feasibility study outlining the process and costs involved in developing an Australian Standard for the use of turf for erosion and sediment control (Appendix 7). The report determined the requirements for the development of a standard as well as the costs and commitments expected from the turf industry. The project made a commitment to assist the development process which was begun in mid 2014
- participant feedback survey report (Appendix 3)
- spreadsheet of attendees (provided to HIA and Turf Australia)
- Steering Committee terms of reference (Appendix 8)
- a 'Legacy Pack' for use by the industry (i.e. the national and state associations and individual growers) to continue achieving results from the project after its completion. The pack includes educational and media materials including videos, specification sheets, images and data that could be used by individual levy payers or the industry in the future.

Assessing effectiveness of the project was undertaken via ongoing and final monitoring of the success of the project's impact on participants to initiate change (i.e. the increased use of turf) within the erosion and sediment control sector. The project conducted two surveys of participants and turf producers to measure the impact of the first year of the project and again at the end of the project, to gauge overall effectiveness. Although this sort of monitoring is notoriously difficult to accurately determine a project's impact, the survey incorporated a number of questions to obtain useful information from the participants, including:

1. whether their use of turf for erosion control had changed as a result of the workshop;
2. what was the percentage of turf used for this purpose after the workshop, compared to what it was previously;
3. if turf use had not increased, why not, and what were the limiting factors;
4. whether they were using other measures, and if so, what they were and what was driving their decision making;
5. whether their use of turf had increased and by how much;
6. what other information did they need to confidently utilise turf for erosion and sediment control.

Feedback was also secured in discussions with regular attendees and with target groups such as local councils during interstate visits. From these, recommendations for the turf industry's future investment in this area have been formulated and provided within this report. This includes options for future R,D&E and a summary of important observations and comments received during the project from erosion practitioners.

User-pays training events were negotiated with existing training provider site users. A proposal was forwarded to both companies with any potential revenue raised to go to Turf Australia (TA) to be used for related activities deemed appropriate by the TA board. However, the use of the site in this manner did not eventuate, as the training providers were unwilling to pay.

The project was varied on three occasions to accommodate continued demand and also to accommodate an illness with the Project Leader towards the original end date of the project. This extended the project's end date from February 2014 to June 2014 and then until December 2014. The initial variation was proposed to ensure continuity of the project and the availability of project staff and to fund the maintenance of the demonstration site, which at that point had been budgeted within the industry's Strategic Investment Plan (HAL 2012) for continued funding for an additional three years. The idea behind the variation was to continue to add value to the industry by continuing the work of the project as it was originally designed, to increase sales. It was also to benefit the industry by ensuring that access to the Queensland Government site was maintained under the current project (as new activities on that part of the Redlands Research Station site were being denied with the Erosion site being provided access on the condition it was an existing activity) and the project committed to undertake additional activities including demonstration workshops. The variations also allowed for the maintenance of the site so that the industry's investment in its construction was not lost by letting it fall into disrepair.

Outputs

The project successfully delivered all of the promised outputs outlined in the original proposal and subsequent variations. This included hosting demonstration events, producing extension materials and issue-specific reports, industry and interstate presentations and the continued maintenance and operation of the facility until December 2014.

Demonstration events and attendee numbers

The proposed 20 workshops and training days were delivered, with four (4) of those delivered as part of the March 2014 variation and renegotiation. In total, 21 workshops were hosted between February 2013 and September 2014, with a total of 503 attendees at the events. Of these, two conference field trips were included form the Turf Australia 2013 National Conference (pre-conference tour) and the International Erosion Control Association (IECA) 2014 conference (post-conference tour). This represents a delivery of results that exceed those originally proposed for this output (Appendix 1).

Extension and information materials

The project also produced a number of extension and educational tools based on previous research reports and also developed as part of the research component for this project. This included the attendee information pack, of which 500 copies were distributed over the course of the project. The pack was redesigned outside of the constraints of the Queensland Government corporate identity restrictions to give it a more modern and professional appearance.

The information pack was presented in a printed folder containing the following information:

a. *Using Turf for Erosion and Sediment Control* (four page specifications and guidelines)
b. *Turf for Erosion and Sediment Control – Getting the Best Results* (two-page research summary of TU08033)
c. *Turbidity Demonstrations at the Erosion Control Demonstration Facility* (two-page summary of turbidity readings from demonstration events)
d. *Testing Sediment Load at the Erosion Control Demonstration Facility* (two-page summary of sediment run-off measurements from demonstration events)
e. directions and map to the site
f. Facebook page promotional flyer
g. promotional brochure for future events, facility contacts and Turf Australia weblink
h. invitation to the next event
i. feedback form.

The pack also contained the Turf Australia brochure Turf – Environmental Benefits, and for Queensland events, the Turf Accreditation Program (TAP brochure from Turf Queensland) was also included. When visiting council officers or presenting to members of parliament or other influential people, the pack also contained a full copy of the TU08033 research report and a 4GB USB drive containing all of the videos created for the project. Information packs were also provided to Richard Stephens from Turf Australia, Dave Raison from Turf NSW and Jim Vaughan from Turf Queensland for distribution as they saw fit in their day-to-day activities. Packs were also posted and distributed personally to key contacts in government and target industries. An electronic version of the pack and the videos was also sent to David Rickard of Metropolitan South Institute of TAFE who will now be using it as part of his teaching

materials in his horticulture course (for landscapers).

These materials have been collated and included in this report and also presented to Turf Australia as a 'Legacy Pack' from which information can be utilised in further research, extension and marketing or promotional initiatives undertaken by the industry in relation to turf for erosion control. In all materials, only the HAL and Turf Australia logos are included.

The project maintained a facebook page (https://www.facebook.com/pages/Erosion-and-Sediment-Control/250427301723607) which contained updates on the project, an event calendar and various related information and links that reinforced the 'Turf for Erosion Control' message. This page will be handed to Turf Australia for future management as part of the Legacy Pack. Additional material was also provided to Turf Australia for inclusion on their webpage, including the educational materials such as factsheets and specification guides as well as links to the training videos.

The project also produced eight professionally-produced training videos (filmed and edited by production company Mooncog.com). These were designed to firstly promote the facility and the message in a user-friendly, non-technical format and also to allow each attendee to view or circulate the videos to colleagues and clients. They were also designed to be used as part of the virtual demonstration or 'roadshow' materials for interstate events. The series included the following:

a) Video #1 Introductory video: http://www.youtube.com/watch?v=owif7vzEqTo
b) Video #2: Coir logs: http://www.youtube.com/watch?v=buHQ8GnqAiU
c) Video #3: Turf strips: http://www.youtube.com/watch?v=crL1L-sc_4s
d) Video #4: Fully turfed plot: http://www.youtube.com/watch?v=C4FFtkvm-xE
e) Video #5: Bare earth: http://www.youtube.com/watch?v=Yd9qgZ2uBEM
f) Video #6: Silt bags: http://www.youtube.com/watch?v=dOg3f4s-FE4
g) Video #7: Hydro mulch: http://www.youtube.com/watch?v=wg9yHPv-JD4
h) Video #8: Channel demonstration: http://www.youtube.com/watch?v=-ElHaBOGxsw

All videos were made available on the Turf Australia webpage www.turfaustralia.com.au/associationnews/erosion-and-sediment-control-demonstration-facility as well as on YouTube and the Bioscience Australia website www.bioscienceaustralia.com/erosion-control-demonstration-facility.html. Regular reposting of links to the videos was also undertaken on the project's facebook page.

Interstate and industry presentations

In total, four interstate visits were conducted. A three-day trip to New South Wales during April 2013 was designed to: 1) engage local levy payers; 2) identify key clients and contacts; and 3) visit key contacts and other council representatives to convey the information from the project and attempt to secure their participation in a future demonstration days, or gauge their interest in hosting future or regular 'virtual' demonstrations locally for their region. The trip to NSW consisted of a tour around the Windsor area visiting local turf producers, the Turf Australia BIDM as well as one council visit. Day two and three were made up meetings with Hawkesbury, Hornsby, Parramatta, Penrith, Liverpoool, Fairfield and The Hills councils as well as a meeting with a representative from the Institute of Public Works and Engineering and NSW State Government to identify their needs and information interests. These visits were followed up where appropriate and contact was maintained with the most interested councils. Information packs including a USB containing the training videos were distributed to attendees of all meetings.

The Victorian visit was conducted in May 2013 primarily to present the project at a field day for councils in regional Victoria who have been brought together as a group by turf producers Brad and Suzie Shearer from Coolabah Turf. The meeting of the Victorian and Southern NSW Regional Councils Parks and Recreation Discussion Group allowed the Project Leader to distribute the information packs and present a 30-minute summary of the research results, current project activities and the issues of specifying turf for erosion control for councils. The event attracted 60 representatives from 14 councils with 55 from regional Victoria and 5 from NSW including Bendigo, Shepparton, Moira, Murray, Campaspe, Albury, Wodonga, Berrigan and Central Gold Fields.

The opportunity to promote the project via Federal Member Greg Hunt MP (Minister for the Environment) arose and a meeting was conducted with his Chief of Staff (Wendy Black) and a local turf producer to determine the potential to raise the profile of turf as an erosion and sediment control measure via a joint media release and raise awareness/education about the role that turf could play in the Port Philip Bay Clean Up the Bay campaign. A draft release was sent to the Minister's office but to the Project Leader's knowledge, it may not have been released.

A visit was also made to NSW in September 2013 to present the project and results at the Stormwater Association Conference 2013 at Katoomba, NSW. The Project Leader presented the research results, the outcomes of the project including extension videos and conducted a discussion on the use of turf for this purpose. The conference attracted 130 attendees from state and local government as well as representatives from water authorities, consultants and researchers/academics. Promotional fliers (x 50) as well as information packs (x 20) were distributed to interested attendees to attract them to attend the site.

A final visit was conducted to CanTurf in Canberra, ACT April 30th 2014. The Project Leader presented the research and project results to approximately 50 local landscapers and government officials from ACT and southern NSW.

All Microsoft PowerPoint presentations from these events have been included in the Legacy Pack for Turf Australia. This pack also includes presentations from the project staff at all other events conducted as part of this project, including those outlined below.

1. A poster presentation (*Turf for erosion control – The Erosion and Sediment Control Demonstration Facility*) was presented at the International Horticulture Congress 2014 describing the site, including a description of the role of turf as an erosion control measure. This was presented by Project Team Member Will Pearce in Brisbane on Tuesday 19th, 2014.

2. The Project Leader presented an update and observations from council meetings and interactions as well as feedback from attendees titled "*The current research and potential new market opportunities for turf as an erosion control measure*" to the National Turf Conference 2013 at Mantra Legends Resort, Gold Coast, Queensland on May 2nd 2013.

3. A poster presentation was submitted and accepted to the International Turf Research Conference in Beijing July 2013. The Turf Australia BIDM was able to attend the conference and spoke to the poster during the poster session on behalf of the project staff.

4. The Project Leader made a presentation at the 2013 Stormwater Conference in NSW, titled *Turfgrass: Addressing concerns via research, product development and a national demonstration facility*, with attendee numbers of approximately 130.

5. Two conference abstracts were submitted and accepted for the IECA 2013 conference. These were: 1) *Turf for erosion and sediment control: The construction of a demonstration facility* - Shane Holborn; and 2) *Cost effectiveness of erosion and sediment control measures* – Will Pearce and Sarah Goswami. NOTE: complimentary satchel inserts were negotiated with the organisers to include site information and details about "Turf for Erosion Control" (http://www.gemsevents.com.au/iecaconf2013/proceedings.php) to attract attendees.

6. A conference presentation was also conducted at the Water Sensitive Urban Design conference (WSUD 2013), entitled *Turf for erosion control: A review of the evidence* – Shane Holborn.

The project was also required to conduct at least two presentations at turf industry events (e.g. national and state conferences). In total, three events were attended where the Project Leader formally presented the project to the industry and updated levy payers of their investment. These included a presentation at the Turf Queensland Summer Field Day (hosted on-site) in February 2013, the Turf Australia Annual conference on the Gold Coast during April 2013, QLD and the Turf NSW members at their Annual General Meeting in December 2013. Presentations and project updates were also provided to the HAL Turf Industry Advisory Committee on two occasions during the course of the project.

All Microsoft PowerPoint presentations related to the project have been included in the Legacy Pack for Turf Australia.

Reports

A number of reports were generated throughout the course of the project. These were designed to address specific information gaps and progress the 'Turf for Erosion Control' message by addressing the needs of the target group. These included:

1. *Turf for Erosion Control - Australian Standard Development Summary*

A feasibility study was prepared outlining the process and costs involved in developing an Australian Standard for the use of turf for erosion and sediment control. This report was presented to the project Steering Committee, Industry Advisory Committee (IAC) and HAL to assist in determining the future course of industry investment in this area. The report recommended a presentation from Standards Australia be requested at a turf industry board meeting and consultation of the industry's support for the initiative be gauged and secured. If both of these activities resulted in positive support for the concept, then it was further recommended that TA identify the potential for support from Horticulture Australia Limited (utilising levy funds), secure the resources to develop a proposal for Standards Australia and follow the Standard development process outlined in the report from that point.

It was recommended that the process be driven by an individual (who if not working within Turf Australia should be commissioned by them) to ensure the proposal is not sidetracked/distracted or derailed, since it is a substantial undertaking to both coordinate and drive the proposal, the Standard drafting and the associated consultative processes. This provided the catalyst for the subsequent development of an industry-led project (Project TU13034 - Developing a National Standard for Turf as an Erosion Control Measure) conducted by Graeme Drake from GED Advisory who has developed a proposal for submission to Australian Standards at the end of 2014.

2. Turf for Erosion control – Economic Analysis

A cost comparison analysis was commissioned by the project to be conducted by government economists working within the Queensland Government's Department of Agriculture Fisheries and Forestry (DAFFQ). This was done to ensure the analysis was independent and could be promoted by the industry with confidence that the figures were generated officially through a state government body.

The analysis compared turf as an erosion control measure to other common measures within a scenario-based approach. The first scenario compared three erosion control approaches on an average residential home building site. Namely, these were turfing the perimeter of the property boundary with a 2m strip of turf, compared to a sediment fence only around the perimeter and then a combination of both measures.

Will Pearce presented the results at the International Erosion Control Association (IECA) national conference on the Gold Coast on November 6th 2013.

3. Steering Committee Terms of Reference

The Terms of Reference (TOR) guiding the scope of deliberations of the Steering Committee were drafted and ratified by the committee during the meeting on March 25, 2013 at Redlands Research Station. The final TOR is included in Appendix 8.

The project was guided by the project Steering Committee which ensured the project continued to focus on achieving commercial outcomes for levy payers. The Steering Committee was comprised of the project staff as well as a Turf Australia representative (Richard Stephens), turf growers (John Keleher and Lyn Davidson), an industry representative (Ashleigh Botha from John Holland) and a HAL representative who acted as an observer. The project secured an 'industry champion' from the construction industry in order to provide advice on the project's focus and direction, generate support from within that industry for turf as an erosion control measure, and raise the profile of and drive demand for the product within this sector by its members.

The Steering Committee met at regular intervals throughput the project (teleconference and face-to-face) and each milestone report was circulated for approval by all Steering Committee members before being submitted to HAL for official approval. The Steering Committee also discussed and endorsed a user-pays approach for the site for companies (training) that were charging their attendees for a certified course and coming to the site as part of that course. The issue of whether and how much to charge external parties for the use of the site subsequently diminished as a result of declining interest in the site from service providers. A costing was provided to two training companies (O2 and Absorb Environmental Solutions) to use the site for a flat rate of $1,500 per event for the first 12 months. Concern about this figure was raised by the IAC with a suggestion was that it was too low. This became a moot point as both training companies did not utilise the site once a charge was proposed.

Participant surveys

Two surveys were provided to previous demonstration participants and turf producers in order to solicit their feedback and attempt to begin the process of determining the success/impact of the demonstration. The survey asked a number of questions relating to their experience on the day, their

attitude toward the use of turf for erosion control, barriers to the use of turf and their purchasing habits and perceptions of turfgrass for erosion control as a result of their attendance at the site. This included questions relating to their attitudes towards turf for erosion control before the event and their intentions for the future use of turf. The aim was also to capture financial information where possible, to support the project's aim of increasing turf's erosion market share.

The first survey was conducted in March 2013 to capture feedback from attendees from the previous project so that the project team could utilise their feedback to improve future demonstrations, under this current project round. The second survey was conducted in July 2014 to garner feedback from all previous attendees, including those from the current and previous projects. The project survey was sent to 150 previous attendees to the site.

The surveys averaged a total of 43 responses (28% response rate) from the mix of attendees from different professions and backgrounds. A summary report of the surveys is available in Appendix 3.

Awards

The project's characteristics and achievements as well as the industry's substantial investment in the site were unique and warranted nominations in the following state and national awards:

1. QLD Premier's Sustainability awards, www.ehp.qld.gov.au/premiersawards/
2. Prime Minister's UNAA World Environment Day Awards 2013 under the Sustainability Education Award category, www.unaavictoria.org.au/awards-programs/world-environment-day-awards/award-categories/.

The project received confirmation that its nominations had been accepted for both awards. Although unsuccessful in winning the awards, these nominations were significant for their benefits in raising the profile of the project and of turf as an important tool in environmental sustainability.

Variations

Variations were submitted and accepted in November 2013, February 2014 and August 2014. The first two variations were to continue the project, deliver additional results and ensure the site was maintained and operational for the 2104/2015 financial year. Selected details of the variations are outlined below.

1. Continue site operation and maintenance
2. Conduct an additional four (4) workshops/demonstrations (making a total of 20)
3. Conduct two (2) additional interstate visits (making a total of 4)
4. Develop two (2) media articles to promote the 'Turf for Erosion Control' message
5. Continued management of the project's Facebook page
6. Presentations delivered to at least one turf industry event
7. Milestone and final reporting according to HAL requirements.

The final variation was submitted to extend the final reporting due date and allow the Project Leader to recover from an operation. It also ensured that the maintenance of the Erosion and Sediment Control Demonstration site continued until December 2014. This allowed HAL, the Turf IAC and Turf Australia to

determine the site's future based on initial outcomes from the Standards Australia process (Project *TU13034 - Developing a National Standard for Turf as an Erosion Control Measure*). The request was made to ensure that the facility remained functional into 2015 so that its future use to support the Australian Standard development process would be secured for the industry. The variation allowed for the basic maintenance of the site so that the industry's investment in the construction of the site was not lost by letting it fall into disrepair.

Legacy/handover pack provided for Turf Australia

The Legacy Pack was designed to enable the continuation of the project in its various extension guises by Turf Australia and the state associations after the official completion of the project. This was to ensure that the information and materials developed throughout the project were not lost to the industry, but could be reused or reprinted at a later date if necessary.

The Legacy Pack includes:

1. A hard and electronic copy of all of the information materials included in the demonstration attendee folder
2. A copy of every PowerPoint presentation including the event presentation and all conference presentations
3. Original copies of all promotional and educational videos
4. The original electronic copy of the 'Turf for Erosion Control' print and online advertisement (in two corresponding formats) and on-site signage
5. Media releases and articles
6. All photographs and images produced by the project including the print and online advertisement for future use
7. Handover of the 'Erosion and Sediment Control' Facebook page and passwords.

Articles (refereed and non-refereed)

1. Holborn, S. & Pearce, W. (2013) *Turf for erosion and sediment control – construction of an Australian National Demonstration Facility*. Short Communication - International Turfgrass Society Research Journal, Volume 12 and Poster presentation for International Turf Research Conference – Beijing 2013.
2. Village Crier newsletter for Village Green Turf Western Australia Autumn 2013 edition. Village Crier is a hard copy newsletter that is distributed to 2000 people in turf-related industries and organisations across NSW, Victoria and WA, including local government and state associations such as landscape architects as well as individual businesses in the construction industry; http://www.villagegreenturf.com.au/commercial/newsletters.

3. A joint press release was written and released with Redland City Council to promote turf as an erosion control measure; http://news.redland.qld.gov.au/2013/04/council-witnesses-erosion-control-in-action/.

4. An article was submitted by the Project Leader and accepted by the Irrigation Australia Limited nation industry journal, titled '*Soil loss from excessive run off*' which reinforced the message and the ability of turf to stabilise soil and prevent erosion in agricultural enterprises.

5. An article was printed in the Local Government Association magazine, LGAT News, which featured an advertisement designed by the project and also included a 12-month listing in the Tasmanian government purchasing classifieds. The June 2013 issue in which it appeared

coincided with the national conference and was distributed to their regular subscribers as well as the conference attendees in the delegate pack.

6. An article on 'Turf for Erosion Control' was printed in Hortlink, the quarterly e-magazine published on the Horticulture Australia website and distributed to a wide number of their stakeholders.

7. Project summaries provided to HAL each year for annual reporting.

8. An article describing the project was printed in the Turf Producers International *TPI News* magazine, Sept/Oct 2013 issue.

9. An article in Australian Turfgrass Management Journal, Volume 15 Mar-Apr 2013, 'In Control'.

10. An article in Master Builder June/July 2014, 'A hands-on approach to sediment and erosion control'.

11. A three-page feature article was printed in the Turf Australia industry magazine, Winter 2013, and a feature within an article on the environmental benefits of turf in the Autumn 2014 edition.

12. Inclusion of project introductory video on TurfMate website and featured in one of the weekly e-newsletters in September 2013, www.turfmate.com.au.

Other media activities

1. ABC Television's rural news program Landline attended the December 5th 2013 demonstration spending 2 hours filming the demonstration and presentation as well as a further 2 hours interviewing the Project Leader and discussing turf and turf research more generally. This included an interview among the turf plots, turf tubs and more generally around Redlands Research Station. The program aired on March 30, 2014 which included a segment on the erosion site, www.abc.net.au/landline/content/2014/s3974354.htm.

2. The project was mentioned in Turf Australia E-News Editions 11 and 12 to promote the pre-conference demonstration days.

3. Informal updates via email and telephone to HAL staff, Steering Committee members and members of the Turf Australia board (via the BIDM) and Turf Queensland (via the CEO).

4. A media release was distributed prior to Christmas (December 12th 2013) titled: *'Cover your earth with turf' is the message for landholders this storm season* and was picked up for publication by at least four media outlets.

National Media Famil

The national media day or 'Media Famil' was hosted at the site in conjunction with Turf Australia and the HAL marketing committee on February 19, 2013. Media company IMPACT Communication Australia organised the event which was attended by local and interstate media. Media materials and project information was provided to IMPACT in preparation for the event, as was assistance to draft the media release, hire a photography, organise catering and build the 'media kit'.

The event generated the following articles:

1. A print article in the local newspaper Bayside Bulletin;

www.baysidebulletin.com.au/story/1316847/redlands-leads-turf-and-erosion-research/

2. An online article in the Brisbane-based online news outlet, the WestEnder; www.westender.com.au/news/1436

3. A reprint of the WestEnder article in TurfMate electronic industry newsletter; www.turfmate.com.au/article/684/turf-to-the-rescue

4. Turf War article in Landscaping Magazine

5. An article in the industry journal Australian Turfgrass Management, Volume 15.2 (page 62).

IMPACT Communication Australia was requested to provide a summary from the results of the event which should have been presented to Turf Australia in 2013.

Outcomes

Throughout the project, participants of the workshops and training days were provided with follow-up surveys as a tool for the project team to collect feedback about the effectiveness of the demonstration facility. The aim was to gain an understanding of the actions of participants as a result of the demonstrations, to gauge any increase in turf use, and to preferably develop some dollar estimates relating to the impact of the project activities.

The original proposal anticipated that as a direct result of the project, an increase in turf sales of 2% (or around $10 million) would be achieved within 5 years of the project's completion. It is inherently difficult to accurately measure an increase in turf sales, particularly when trying to relate it to a specific use (erosion control) and also to the influence of a particular activity (this project). The feedback survey asked attendees a number of questions to try and determine any change in perception of turf as an erosion control measure, their intentions regarding turf since the demonstration and any dollar value estimates they could provide on their purchasing of turf (actual or anticipated) since the demonstration. The full survey questions and responses are presented in Appendix 3.

The survey responses were as varied as the demonstration attendees themselves, who ranged from regulators and specifiers who do not directly buy turf or implement erosion and sediment control projects but heavily influence those who do through the key purchasers in construction, mining and landscaping organisations, to those who work for those companies in a non-decision making, operational role. This influenced the results in some areas, such as for the question asking how much additional turf had been purchased by them since their demonstration attendance. In this case, some answered 0% extra as it is not their role. Three questions asked whether the demonstration had influenced the respondent's intention to use turfgrass and how they were currently using it. The response to all of these questions was very positive, indicating that the demonstration event had positively influenced their opinion of turf as an erosion and sediment control measure and that they intended to use it for that purpose.

When asked whether their use of turf had increased, the majority (60%) said 'Yes', a large proportion (30%) said they 'Didn't Know' with just (10%) responding that 'No' it hadn't increased. A further question asked attendees the level of influence the demonstration specifically had had on their thinking about turf for erosion and sediment control. Even including the few 0% responses (some of which were erroneous as mentioned above) the average across all responses was that the site had influenced 52.38% of their actions in using turf since their attendance. This is a positive sign and indicates that the turf industry's investment in the site has on average, had a positive influence on those who attended. However, the one question that was designed to garner some harder dollar figures and perhaps some case-study material to illustrate the effects of the site did not achieve that result as well as hoped. The question that asked respondents to estimate the impact the demonstration had on changing their business' financial spend on turf resulted in a variety of responses, from 'No increase' to $200 per month, $5000 to $150,000. Unfortunately there is little that can be extrapolated from those figures in gauging the project's effectiveness.

However, the survey results on the whole were positive, indicating that the demonstration facility has achieved its purpose to a point which is possible at this stage. Anecdotal evidence similarly suggests a positive response was achieved, with 'large' projects reported and comments such as "we now suggest turf from the outset, especially where they'll end up doing it anyway", suggesting that the message has

penetrated in critical areas of those the project influenced. Similarly, the use of turfgrass in large and small projects in areas where it may not have been previously used was observed by the project team and reported back via industry members in Queensland and New South Wales. Again, this anecdotal evidence does not adequately quantify the return on the investment to the industry, but does suggest a positive result for the industry more generally.

Although many of the responses were positive and certainly appear to be heading in the right direction, ultimately, any sustained increase in sales (industry-wide) as a result of the industry's investment in this and previous activities are likely to be noticed over time and are probably best measured post-project (i.e. 3-5 years after) by Turf Australia's regularly monitored industry metrics or as a specific, short-time task conducted at that time.

Evaluation and Discussion

The process of undertaking the project resulted in extensive discussions with key commercial turf consumers, which unearthed a number of common issues and concerns experienced by that group. These were related to the factors limiting their willingness or ability to use turf for erosion and sediment control. This provided a list of potential issues that the turf industry might consider for future investment.

Information and extension

The project and previous turf industry funded projects have developed a substantial amount of practical, research-based information which has been handed over to Turf Australia as part of the project's 'Legacy Pack'. This information will remain relevant for some time and positions turfgrass ahead of many of the other commercially available measures currently on the market. Often these other measures may well work, but do not have any credible figures supporting their application in the field. This information will undoubtedly provide a solid platform from which to develop and launch any future Australian Standard on this topic.

The extension pack should be provided to growers in electronic format for use in their business promotions and consumer education efforts as they see fit. The information should also be sent out widely to educators, training companies and councils for their ongoing use in training or as reference materials for their hand-on practitioners. Efforts should also be made to further incorporate this information into existing reference materials utlised by the erosion control industry, and also within council and community group fact sheets.

The extension/training videos can also be utilised without the existence of a physical demonstration site and could be used by industry members or consultants in training events in the future, anywhere within Australia.

Economic analysis

The survey found that the price of turf was one the main limiting factors in promoting turf as an option within the erosion control market. It was found that for just over 50 per cent of respondents, cost was a major consideration. The project activities included a cost analysis of turf compared to other measures and economists were commissioned from the Queensland Government to ensure it was done objectively and independently of the industry and project staff. The full report is available in Appendix 6. In both of the scenarios, the analysis found turf to be far more economically competitive with the other erosion and sediment control options than originally expected. In the example of the home building site, it was substantially more affordable than the sediment fence option (probably the most commonly used measure). The results of the economic analysis were surprising for demonstration attendees and were eagerly received, being an area where most measures are not adequately costed in a way that consumers can use to assist them in their decision making. This is an area where the turf industry is more advanced than other erosion and sediment control product providers and represents a competitive advantage.

Similarly, preliminary work was undertaken to measure and compare turfgrass coverage with hydro mulch products used within the project. The results from this investigation highlighted that consumers essentially get what they pay for when opting for the lower-priced hydro mulch alternative. The project

team's measurements determined that while turf provided 100% vegetative cover once laid, hydro mulch took a substantial amount of time to even begin to provide vegetative cover (even under the ideal conditions of the demonstration site, where weekly irrigation was provided to the entire site including the hydro mulch).

It is recommended that the economic analysis conducted as part of this project should be widely communicated and further economic analyses should be undertaken to better educate potential users of the economic feasibility of utlising turf for erosion and sediment control. These figures should also form a central part of a communication, marketing or promotional effort aimed at commercial users and may even be developed into a decision-making tool over time, which will assist commercial users to select and budget for turf installation and maintenance.

Turf types and quality

Throughout the demonstration workshops and discussions with councils, there were a couple of themes that emerged that were constraining the use of turf for erosion control. The first was the limited understanding of different turf varieties and their characteristics for use in different environments and situations. The vast majority of the audience did not realise that there were so many commercially available turfgrass cultivars and that there were substantial differences between them in their ability to tolerate 'hostile' environments. Some were aware of more shade-tolerant varieties and substantially fewer were aware of the more drought-tolerant cultivars. There was no recognition of the wear-tolerant grasses or salt-tolerant grasses, which were required by a number of attendees.

Generally speaking, there was limited knowledge of any of the newer cultivars, yet a relatively high demand for them by councils and private companies who are currently seeking solutions for these areas outside of the turf industry. Therefore, the characteristics of different cultivars should be better promoted to commercial clients who are currently largely unaware of new and different cultivars that have been selected and commercialised to deal with the sometimes hostile environments. Currently turf is not considered, as they assume it will not tolerate anything other than optimal growing conditions and environments.

The most frequently asked question was in regards to native turfgrass cultivars for use in natural or environmentally sensitive areas. Although native turf cultivars are currently available and new cultivars are being released, clients are, again, largely unaware of them. Many commercial clients currently have reservations about using turfgrass in natural or environmentally sensitive areas, as they perceive some turfgrass cultivars as being a foreign 'weed'. There is a demand for native turfgrass cultivars and this represents an opportunity for growers to expand further into the erosion and sediment control market.

Quality was raised as an issue on a number of occasions, but usually in terms of the potential to introduce and spread weeds into an area where they were not previously present. One client that manages very large tracts of land for the Australian defense force commented that the use of turf in one of his natural areas introduced 12 new weed species that were previously not present. In his words, this represented a substantial extra cost to manage and eradicate those weeds over time. The national implementation of the Turf Accreditation Process (TAP) would begin to address this issue by ensuring turfgrass of a specified quality or purity could be selected for erosion control in areas such as national parks and government land.

Recommendations

The project made direct contact with and built relationships with commercial turf clients in the local government, mining, landscaping and construction sectors. The process of developing these relationships highlighted the lack of knowledge within some of these groups relating to a number of turf-related issues, not just erosion and sediment control.

Recommendations summary table

Recommendation	Action
Recommendation 1	The information pack should be provided to levy payers in electronic format for use in their promotional and consumer education efforts. The information should also be sent out widely to educators, consultants and councils for their ongoing use in training or as reference materials for practitioners.
Recommendation 2	The results from the economic analysis should be widely communicated and further economic analyses should be undertaken. These figures should form a central part of a communication, marketing or promotional effort aimed at commercial users and could be developed into a decision-making tool to assist clients to select and budget for turf installation and maintenance.
Recommendation 3	The characteristics of different cultivars should be better promoted to clients who are currently largely unaware of new and different cultivars that have been selected to deal with hostile environments. This will help to overcome the problem that turf is currently not often considered, as clients assume it will not tolerate anything but optimal growing conditions and environments.
Recommendation 4	There is a demand for native turfgrass cultivars and this represents an opportunity for growers to expand further into this market. Commercial clients currently have reservations about using turfgrass in natural or environmentally sensitive areas.
Recommendation 5	Quality was raised as an issue, usually in terms of spreading and introducing weeds into an area where they were not previously present. The national implementation of the Turf Accreditation Process (TAP) would begin to address this issue, by ensuring turfgrass of a specified quality or purity could be purchased for erosion control in areas like national parks and government land.
Recommendation 6	There is a substantial opportunity to communicate, educate and market the use of turf directly to many people in the commercial sectors who are also often influential in purchasing decision-making within these organisations.

Scientific refereed publications

Holborn, S., Pearce, W., 2013. Turf for erosion and sediment control – construction of an Australian national facility. *International Turfgrass Society Research Journal* **12**, 2-4.

A paper relating to the poster presentation (*Turf for erosion control – The Erosion and Sediment Control Demonstration Facility*) was presented at the International Horticulture Congress 2014.

IP/Commercialisation

Nil

Acknowledgements

We would like to thank and acknowledge members of the project Steering Committee, Lynn Davidson (Jimboomba Turf Group), John Keleher (Australian Lawn Concepts), Richard Stephens (Turf Australia) and Ashleigh Botha (John Holland Group). The Steering Committee's involvement and advice has immeasurably improved the project's focus, direction and results.

The Project Leader would like to thank HAL (now HIA) and the Turf Industry Advisory Committee (Turf IAC) for the understanding and flexibility that was provided during an illness towards the end of the project.

We also gratefully acknowledge Dr Rob Loch, Cyril Ciesiolka, Geoffery Titmarsh and Matthew Roche for their advice and guidance in relation to initial planning and setting up of the facility. Thanks are also due to Redlands Research Station Field Staff Larry Cooper, David Flatley and David Olsen for their assistance during construction and operation of the facility. Janelle Dahler has also given her time freely throughout the project to assist with editing of written papers, reports and presentations.

Finally we would like to thank the hundreds of attendees who have come through the facility for a training and demonstration event, including federal, state and local government officers, mining, construction and landscape industry staff, and training providers and consultants.

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Appendices

Appendix 1 – Events details and cumulative attendee numbers for current and previous projects

Appendix 2 – Event invitation and educational materials examples

Appendix 3 – Survey questions and responses

Appendix 4 – Examples of project media

Appendix 5 – Site and event photographs

Appendix 6 - Turf for Erosion Control - Economic Analysis Report

Appendix 7- Turf for Erosion Control - Australian Standard Development Summary Report

Appendix 8 - Steering Committee Terms of Reference (TOR)

Appendix 9 - ITRC paper imprint

APPENDIX 1 – Event details and cumulative attendee numbers for current and previous projects

Project TU12022 numbers Feb 2013 – Dec 2014		
Event details	**Attendees**	**State breakdown**
1. Thursday 7 February 2013: SEQ-IF board members	35	QLD:29; NSW:6
2. Tuesday 19 February 2013: Turf Australia Media famil	21	QLD:6; NSW:15
3. Wednesday 10 April 2103: Redland City Council day	16	QLD: 16
4. Wednesday 1 May 2013: Pre-conference and council demonstration	27	QLD: 7; NSW: 18; SA: 1; Vic: 1
5. Thursday 30 May 2013: John Holland day	21	QLD: 21
6. Thursday 20 June 2013: Open demonstration day	26	QLD:22; NSW:4
7. Thursday 5 September 2013: Open demonstration day	25	QLD: 25
8. Thursday 12 September 2013: The Landscape Construction Company	20	QLD: 20
9.Friday 20 September 2013: Absorb Environmental Solutions training day	CANCELLED BY CLIENT	CANCELLED BY CLIENT
10. Thursday 26 September 2013: Open demonstration day	21	QLD: 21
11. Friday 11 October 2013: Landscape Queensland Ind. Association day	19	QLD:19
12. Thursday 17 October 2013: Open demonstration day	21	QLD: 21
13. Thursday 24 October 2013: Open demonstration day	16	QLD: 15; NSW: 1
14. Thursday 28 November 2013: Open demonstration day	25	QLD: 23 NSW: 2
15. Thursday 5 December 2013: IECA members demonstration day	36	QLD: 23; NSW: 7; Vic: 4; SA: 1; TAS: 1
16: Thursday 6 February 2014: Open demonstration day	19	QLD:16; NZ:2; UK:1
17. Thursday 21 March 2014: Master Builders demonstration day	26	QLD: 26
18. Friday 2 May 2014: Open demonstration day	15	QLD: 14; NSW:1
19. Thursday 26 June 2014: Open demonstration day	28	QLD: 28
20. Friday 1 August 2014: Master Builders demonstration day	30	QLD: 30
21. Thursday 11 Sept 2014: Open demonstration day	56	QLD: 48; NSW: 5; WA: 2; SA: 1
Total	**TU12022**	**503**

Previous project numbers from TU10025		
Event details	**Attendees**	**State breakdown**
1. Thursday 31 May 2012: Open demonstration day	29	QLD: 29
2. Thursday 28 June 2012: Open demonstration day	CANCELLED DUE TO RAIN	CANCELLED DUE TO RAIN
3. Thursday 26 July 2012: Open demonstration day	21	QLD: 21
4. Friday 27 July 2012: Open demonstration day	21	QLD: 21
5. Friday 24 August 2012: Producer demonstration and inspection	12	QLD: 12
6. Thursday 30 August 2012: Absorb Environmental Solutions day	17	QLD: 13; NSW:3; SA:1
7. Thursday 20 September 2012: Turf Queensland Field Day	25	QLD: 25
8. Thursday 27 September 2012: John Holland day with LendLease	21	QLD: 21
9. Thursday 25 October 2012: Absorb Environmental Solutions day	15	QLD:15
10. Wednesday 7 November 2012: Absorb Environmental Solutions day	25	QLD: 12; NSW:5 ; VIC:5; WA:3
11. Thursday 29 November 2012: Open demonstration day	23	QLD: 23
12. Friday 7 December 2012: Turf Queensland Ministerial Day	20	QLD: 20
13. Thursday 13 December 2012: Absorb Environmental Solutions training day	16	QLD: 7; NSW:3; VIC:3; WA:2; SA:1
14. Thursday January 2013: Turf Queensland Ministerial Day II	18	QLD: 18
Total	**TU12025**	**263**
Total for both projects	**TU12022 & TU12025**	**766**

APPENDIX 2 – Event invitation and educational materials examples

Erosion Control Demonstration Facility

John Holland Demonstration

Thursday 20th June 2013

Workshop registrations are FREE

Redlands Research Facility
Macarthur Street entrance
Alexandra Hills QLD 4163

The aim of the facility is to demonstrate erosion in action highlighting how different erosion control measures perform in the field. In simulating the processes of nature, the facility profiles a 1 in 100 year rainfall event on six different demonstration plots including:

- Turf strips
- Full turf
- Bare soil (zero mitigation)
- Hydro mulch
- Silt fencing or silt bags
- Coir logs

The site also runs higher volumes of water down the demonstration channel containing vetiver grass as well as turf strips in combination with rock-check walls to demonstrate the performance of measures in higher velocity flows.

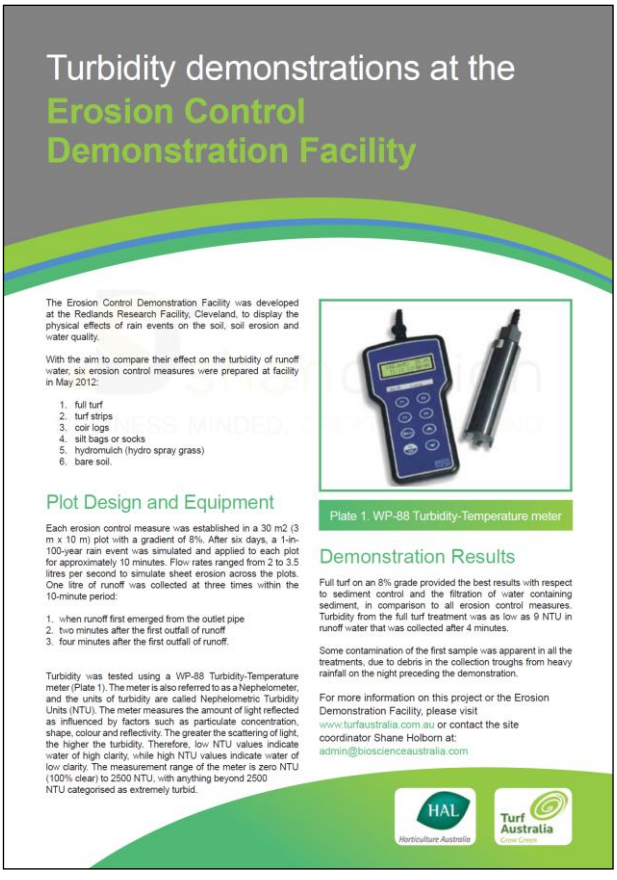
The demonstration event will begin at **1:30pm and continue until 3:30pm** with a light snack provided afterwards. Please bring a hat and wear appropriate shoes and clothing for an outdoor event.

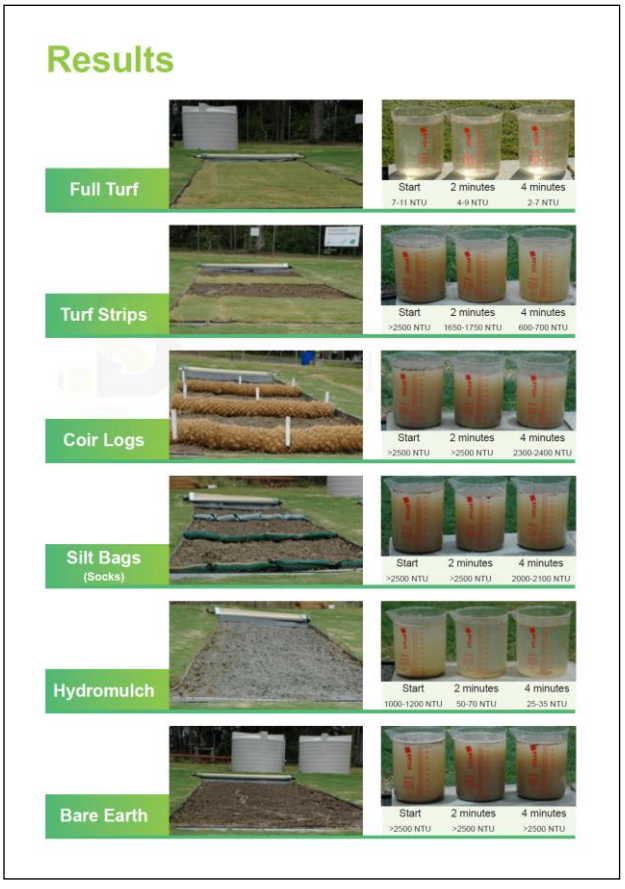
Please RSVP at your earliest convenience to Ashleigh Botha on 0403 368 403 or email ashleigh.botha@jhg.com.au.

For more information visit our Facebook page by scanning the QR code or search for 'Erosion and Sediment Control'.

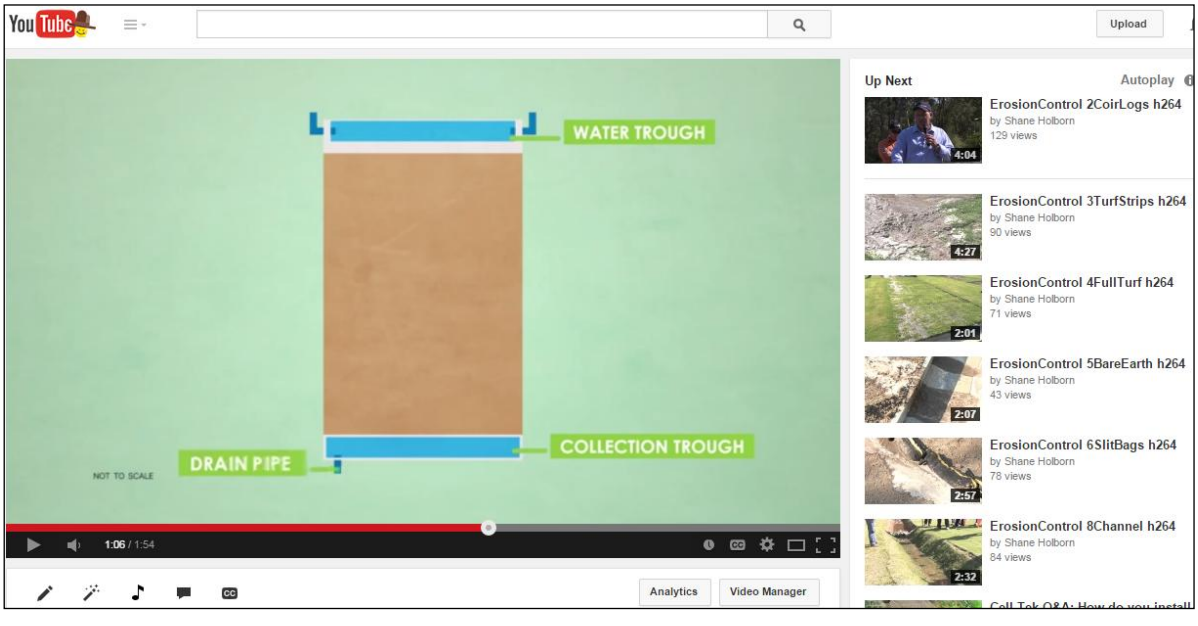
HAL Horticulture Australia

Turf Australia Grow Green





Above: Example factsheet produced as part of the project (above left is Page 1, above right is Page 2)



Above: Screen grab of the Erosion and Sediment Control Demonstration Facility YouTube channel

APPENDIX 3 – Survey questions and responses

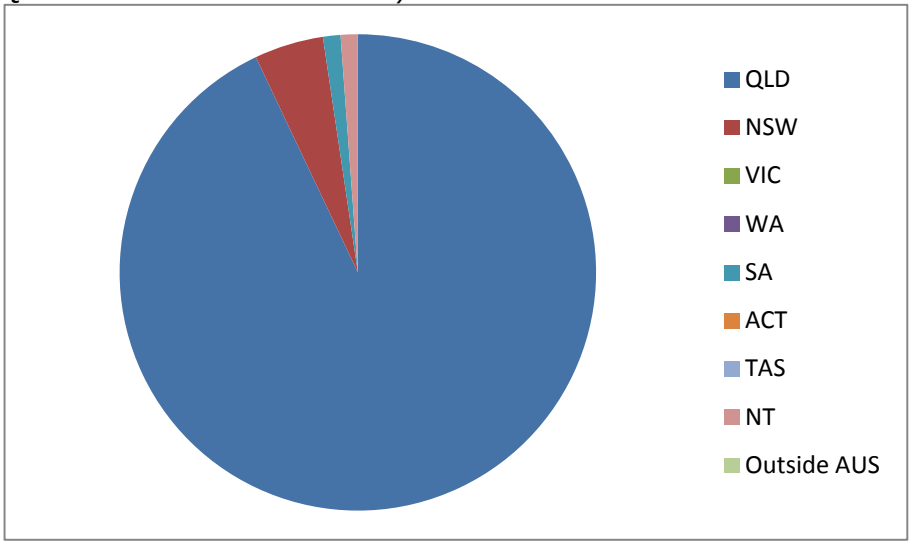
Note: these results represent the results of both surveys. Respondents n=85

The turf industry has funded a number of research and extension activities to promote the use of turf as an erosion and sediment control measure in order to protect Australia's soil and water resources.

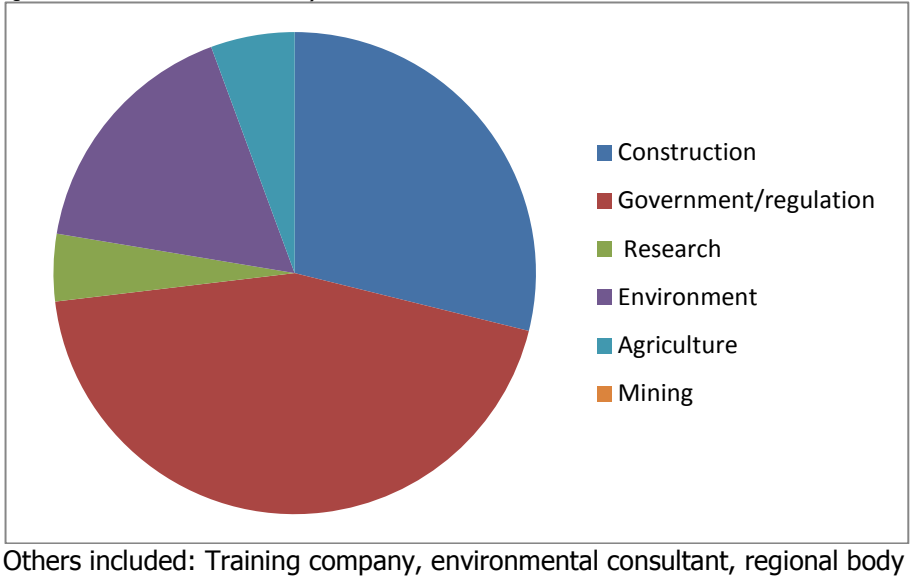
Our records indicate that you attended a demonstration event at the Erosion and Sediment Control Demonstration Facility at Cleveland Queensland during the past two years. The purpose of this survey is to gain feedback from you about the demonstration facility, its impact on attendees such as yourself and how it could be improved to maximise its benefits to future attendees.

The survey is being run by an independent company – BioScience Australia Pty Ltd – who will group and analyse the results. Your individual responses will not be linked to the report provided or passed onto a third party. The results of the surveys will be available from BioScience Australia later in 2013.

Q1. Please indicate in what state your business is based:

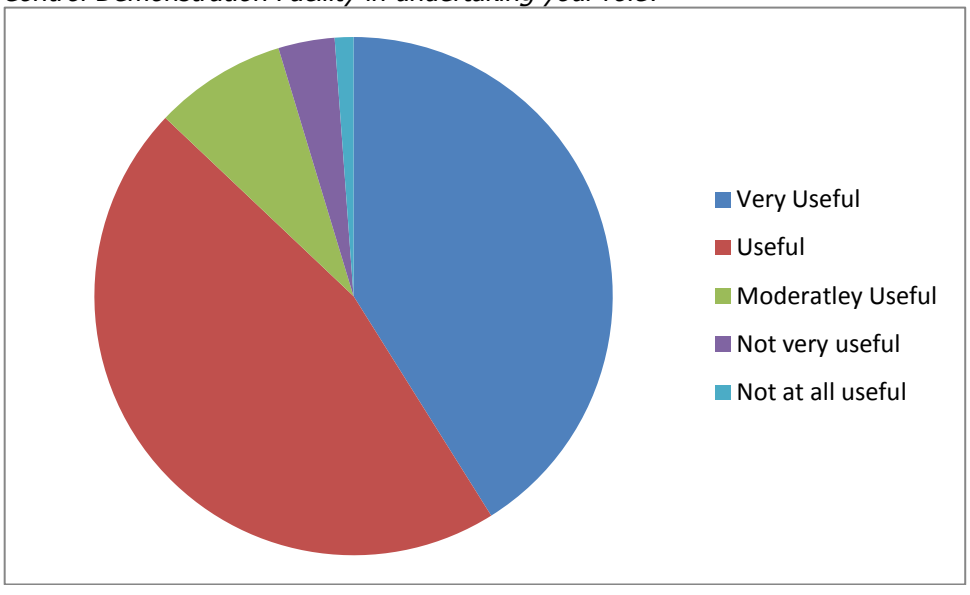


Q2. Which best describes your business?



Others included: Training company, environmental consultant, regional body representative and farmer.

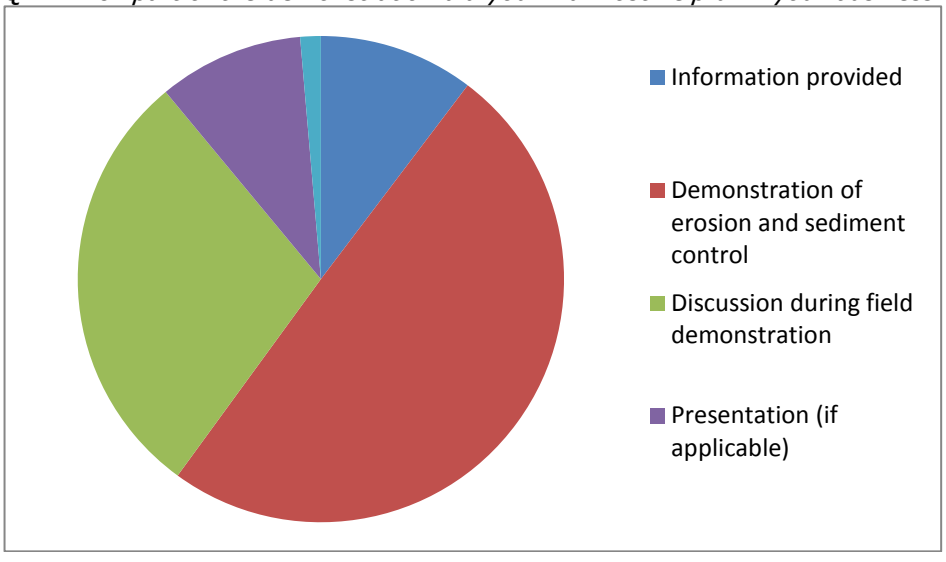
Q3.How useful did you found the information and demonstration provided by the Erosion and Sediment Control Demonstration Facility in undertaking your role?



Please comment on your rating:

Excellent practical demonstration, perfect for field staff
Already aware
As always, it is important to know the options that area available in regards to techniques and materials available on the market which could improve the efficiency/quality of our on-ground works: particularly when you can observe a firsthand demonstration
Useful to be aware of technologies/practices which are available for ESC
This type of facility is unique and very valuable training tool. It is something I have envisaged creating myself. Thank you for creating my ream facility.
See in reality how works each system
I am currently an environmental advisor so have a lot to do with ESC
Not useful for my training area
There was nothing new for me as a Soil Con. Officer but its useful to see practical demonstrations
A practical demonstration of what I kind of already knew
The demonstration of how water behaves was really good
It was interesting to see erosion control measures in situ that I would not have otherwise been able to see due to prohibitive costs associated with implementation
It was interesting to see how little changes can help the overall problem
Visual in the field backed up by analysis (field testing) clearly illustrates what works and what does not
Basic comparison of buffer strips vs exposed soils
Very innovate display of products for erosion and sediment control

Q4. Which part of the demonstration did you find most helpful in your business?



Q5. Please comment on your choice:

The first hand demonstration is vital as a determination can be made as to the effectiveness of the product for your business/organisation based on real time/first hand "evidence"
Good to see theory in practice
With limited knowledge of sediment control measures I found the demonstration helped me to conceptualise the measures compared in the literature I had been reading
All are important but the actual seeing is most powerful
The field day was well planned and useful information was gathered
Would be an advantage to send new employees to the demo to give the man understanding of what concentrated flow paths of water can do
One can see erosion happening
I missed the discussion session
The demonstration was the best most beneficial
The speakers were very knowledgeable
As above
Presentation was a god refresher on general erosion and esc

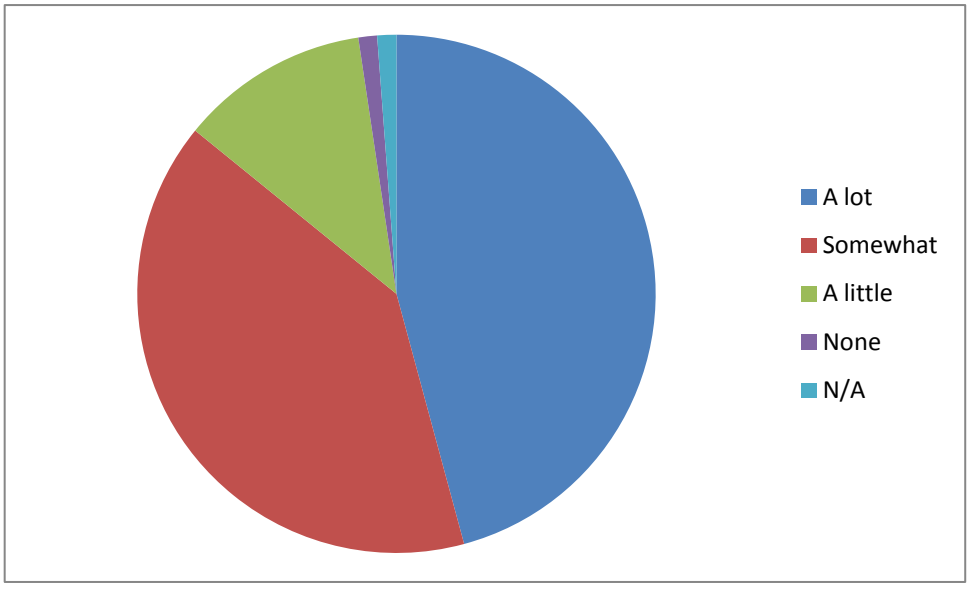
What else would have been helpful to you?

Perhaps going into detail on the cost benefit ration of each measure. Using turf across a massive industrial construction area, whilst more effective, is not practicable. There was a strong emphasis on the use of turf
Trial a known concentration of dirty water running onto the trials. To determine the change in concentration.
Shade umbrellas
More hands on input from us
Nothing really
Great setting
Nil
More shade
Demonstration of other products or control techniques
People from various industries sharing experiences
Discussions with other participants - what works and what doesn't
More examples
Active participation in workshop on installation / maintenance - possibly some what not-to-do

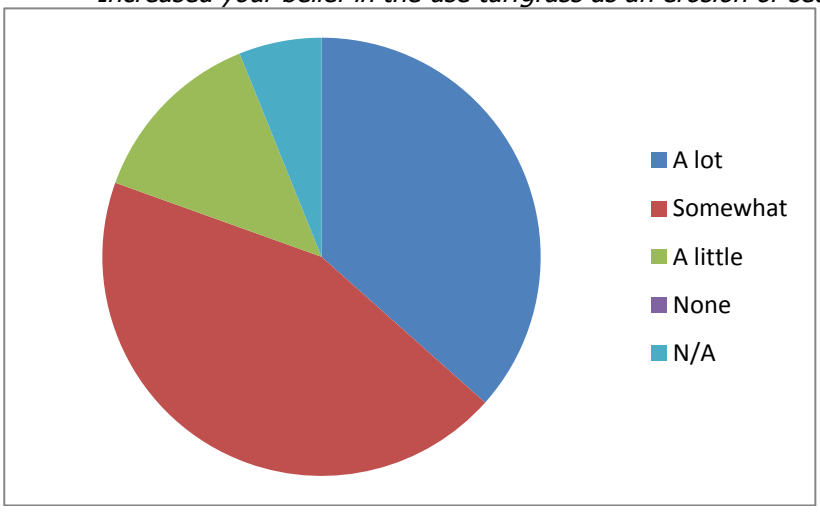
demonstrations
Further information on a range of erosion control technologies and strategies
Follow up documentation specifically outlining the demonstration outcomes with sharable illustrations (under creative commons)
Case studies
A greater number of control measures
Perhaps a broader range of products available on the market – a comparison – which could offer the client/confirm the choice they have made is appropriate
It was OK
It would have been good to hear the message that prevention is better than control, as in although turf is an effective prevention measure thoughtful planning of development sites which looks to reduce the level of clearing and soil disturbance should be sought
Possibly a wider range of E & S features such as a detention pond
Networking
Trials of additional E & S controls for comparison
The effect that incorrectly installing controls has on soil
Practical applications using silt fencing vs bidim fabric
Networking
More discussions and presentation in regards to native seed mixes in hydromulching for use in sensitive environmental areas
Demonstration of sediment fences, I was surprised that this was not included as it I the most commonly used ESC measure
Turbidity measures in comparison to some real life situations

Q6. To what extent has the demonstration or information provided:

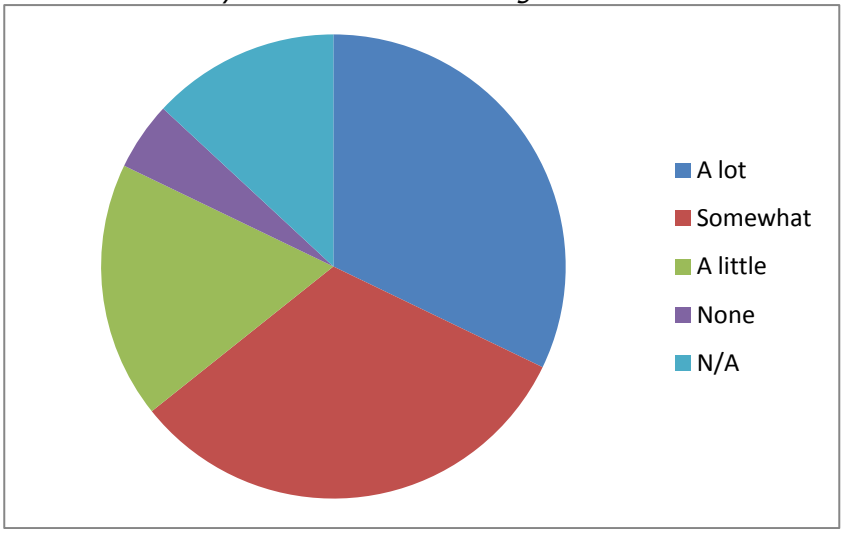
- *Increased your understanding about the use turfgrass as an erosion or sediment control measure?*



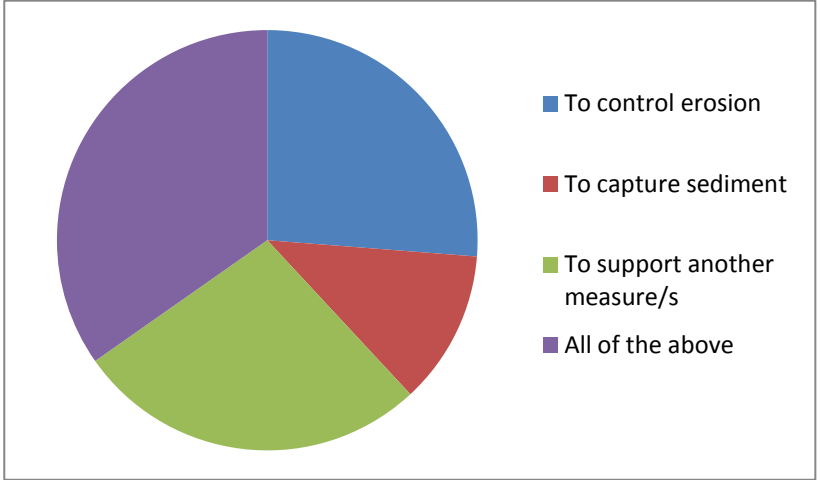
- *Increased your belief in the use turfgrass as an erosion or sediment control measure?*



- *Increased your intention to use turfgrass as an erosion or sediment control measure?*



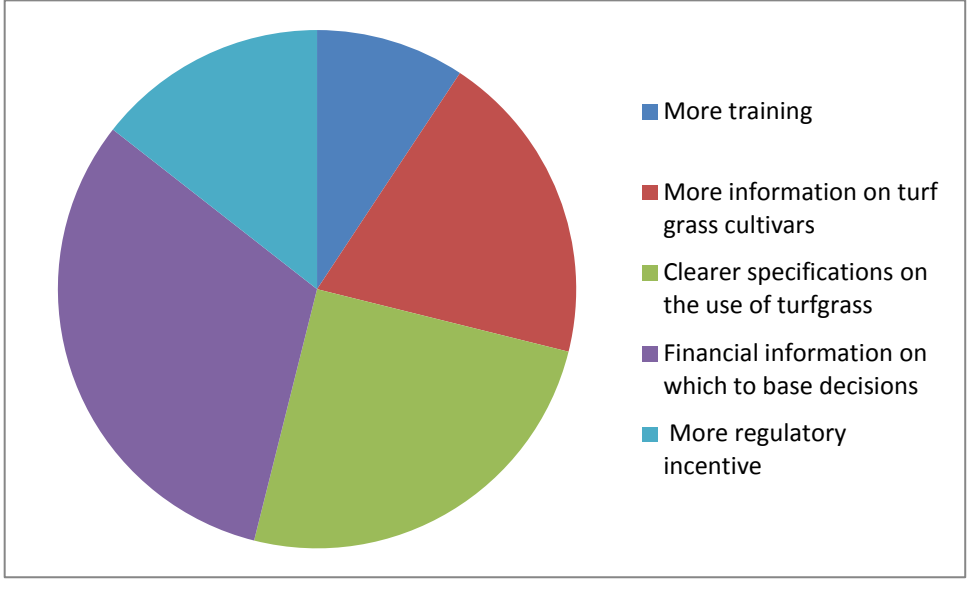
Q8. If you have used turfgrass as an erosion or sediment control measure, please indicate in which capacity:



Please briefly explain what you have done with the information (or provide one example if possible):

Encourage the use of turf within the industry.
Turf producer and contractor, we promote turf as an erosion control measure.
Installed turf within the mouths of all batter drains
Not recommend the use of coir logs anymore. I had this idea that coir was the way to go however your demonstration proved they weren't that good.
The use of turf as an erosion control is now a part of our Cert I; IV and Diploma courses in Environmental Management as a result.
Strategy shift to move turfing to the earlier dates within construction programs.
Continued to use turfgrass as an erosion control method in appropriate situations.
Useful on larger blocks but almost impossible to use on the current miniscule residential lots being approved by Councils
It all comes down to funding turf where applicable
Recommended turf in some areas of a development where erosion was proving a problem and repeated efforts had so far failed
Used turf with site erosion plans
Great permanent option -natural materials which provide habitat however -no cheap decent native options available -natives have deeper roots and are more drought resistant -mixtures appeared to be contaminated / contained 'pest' species
The demonstration has increased by belief that turf coverage is the best form of erosion control. However, there are instances where turf is not practical and/or economically viable (eg. temporary stockpiles). Turf can be considered one of many potential options.
Communicated outcomes in Singapore and India
I work in riparian restoration areas to improve waterways, so will not be using turf in those areas. I have sent maintenance officers and drainage officers to this training as they would use it.
Where appropriate it is used
Encouraging 2 strips or full turfing of verges during the on maintenance period when houses are being constructed
The information was relayed to other groups in my org for on ground roll-out

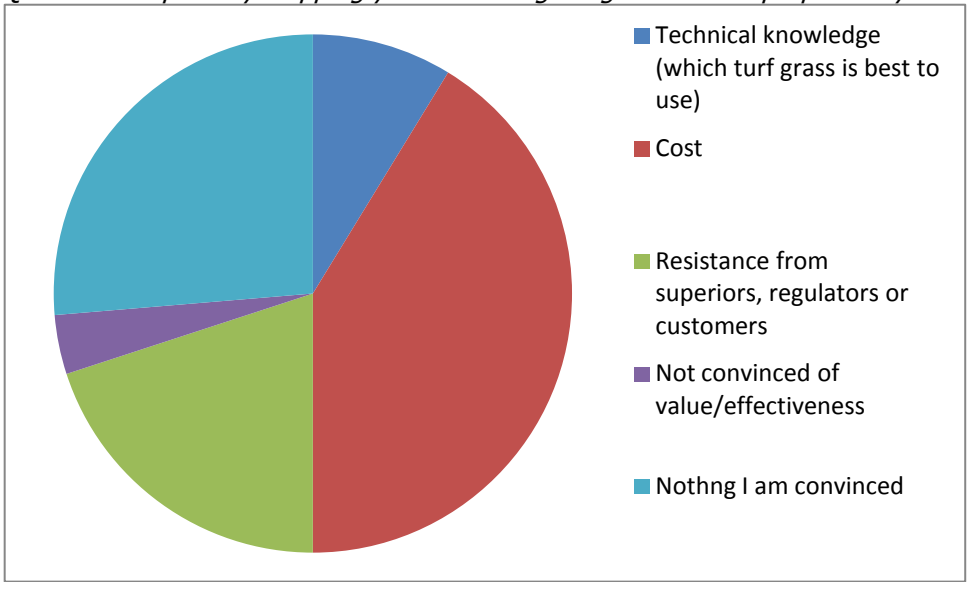
Q9. What extra assistance do you need to help you to better use turfgrass as an erosion or sediment control measure effectively? (tick as many as you think are applicable)



Other :

Turf using native grasses for use in sensitive areas e.g. Commonwealth Heritage Listed areas to ensure weeds are not introduced to an area creating an ongoing management cost
More info on how turfgrass is the best to be made public

Q10. What is possibly stopping you from using turfgrass for this purpose in your business?



Please provide comments relating to your answer:

Often not appropriate in bushland setting
(Cost) In comparison to other methods available
I am a turf supplier
Size of the sites
Turf is not the best technical option in all circumstances
Right seed mixes for right areas

Q11. If you have started to use or increased your use of turf as a result of the facility's demonstration, what impact has this made to the amount of turf you use in projects? (% increase/yr): actual or estimate

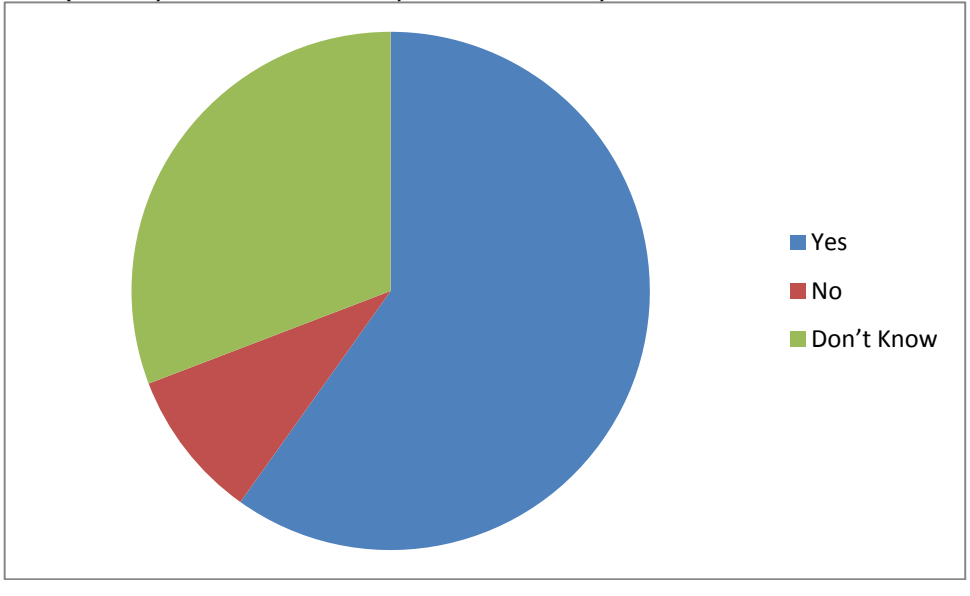
The same
None
The will depend on the circumstances. Some projects prefer revegetation
I can't unfortunately make the decision to use turf on projects
100%
50%
10%
As a regulator, not directly using turf, but encouraging its use. Greater areas are beingn used in regards to buffer zones
One-off projects
10%
Not sure - I undertake development assessment of a range of types of applications and don't monitor

this. Just the outcomes of the effectiveness.
Same level, depending on the project
0%
None as I work in a Park environment
Unknown
Not sure
No increase
Unknown, depends on the project

Q12. If you have started to use or increased your use of turf as a result of the facility's demonstration, what impact has this made to your financial spend on turf for this purpose? ($): actual or estimate

As Above
$5000
$200 per month
Depends on the project and costed with it
$0
Unknown
Not sure
No Increase
Increased by unknown amount
No impact
Depend on the project. On a recent project approximately $50k was spent
I can't unfortunately make the decision to use turf on projects
$150K

Q13. Has your use of turf increased the effectiveness of the control of erosion and sediment on your sites (i.e. do you believe it has improved how well you control erosion and led to a better result?)



Please explain you response:

Recommendation via training only
Didn't handle sodic soil conditions
Still waiting on job to be completed

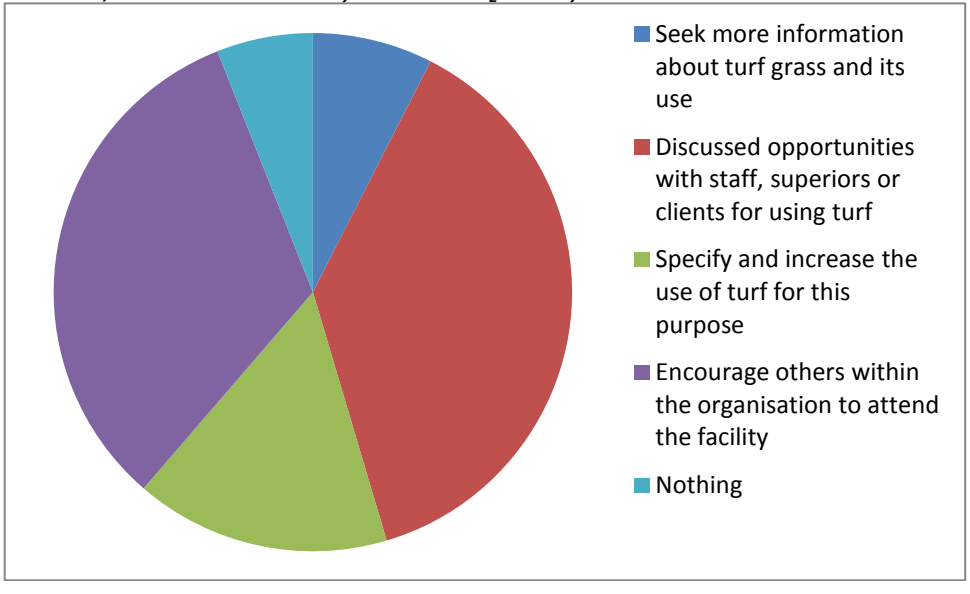
Q14. How much influence do you consider that the Erosion and Sediment Demonstration Facility has had on the actions that you have taken in relation to using turf as an erosion and sediment control measure?

- [Please provide a % figure where 0= no influence at all and 100 = It only happened through my involvement with the project and/or the information it provided]
  Average percentage influence of the demonstration on attendees use of turf from 40 respondents that provided a parentage number = 52.38%

I will recommend the use of turf more of 10%
The demo is great, but it is about using turf where appropriate. Some people have now suggested using turf along major stretches of riparian areas. This should not be encouraged as a complex vegetation community is needed in these areas generally
Reinforce the use of turf
None
The facility has changed my view from one of a range of options, to the first option
Yes, turf also to the "perceived" duty of care to control S&E
Significant
It is a good alternative product. It is not my decision. I can suggest use.
Already using turf where requested by client
I will always suggest the use of turf in the first instance
Moderate
Will influence regulators
Nil at this stage
Hammers the importance on ESC for the crews on the ground
Sales have not increased
Has made me look at options other than pipes
Good influence
20%
40%
I was already sold on the use of turf, however the facility has significant influence on many of my colleagues and the wider industry, in which I was encouraged to attend
10%
75%
50%
60%
50%
Not yet implemented
50%
95%
80%
30% only confirmation of use
75%
40%
75%
95%
5%
50%
1% - but only because of the attitudes of the regulators and the complete lack of space to implement this in the vast majority of residential constructions
None as we were already using it as erosion control
7%
50%

53%
70%
60%
65%
80%
85%
20%
70% Still gathering information about a hierarchy of control options where turf is one of many options
75%
80%
80%
None
50% As mentioned my work is indirectly involved with Sed + Erosion control, thus I hope my referral to other officers to attend this training have paid off
10%
70%
95%
65%
99%

Q15. As a result of the Erosion and Sediment Control Demonstration Facility program information or activities, what actions have you taken – [or do you intend to take over the next 12 months]?

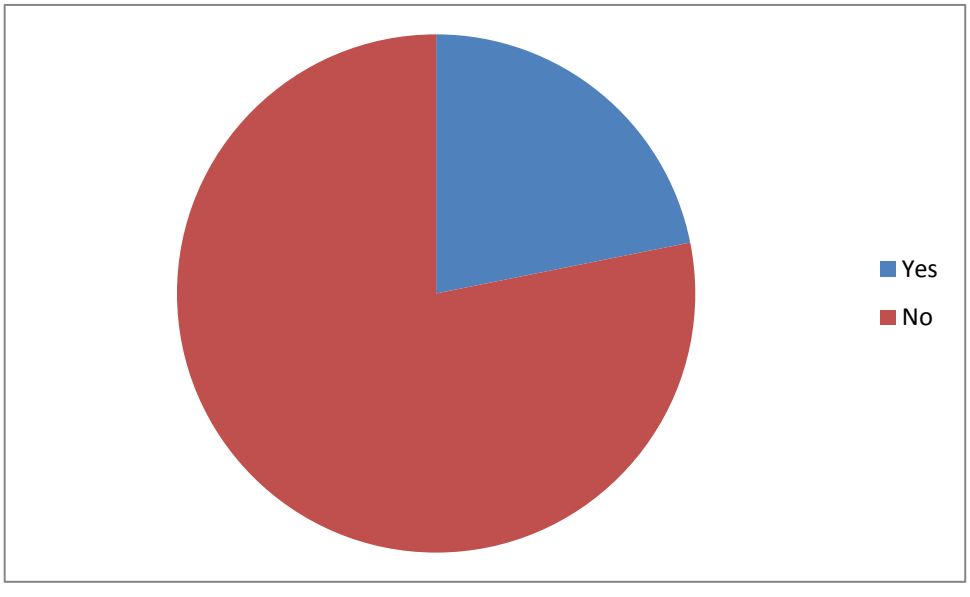


Q16. What other comments do you have about the demonstration facility and/or the use of turfgrass for erosion control?

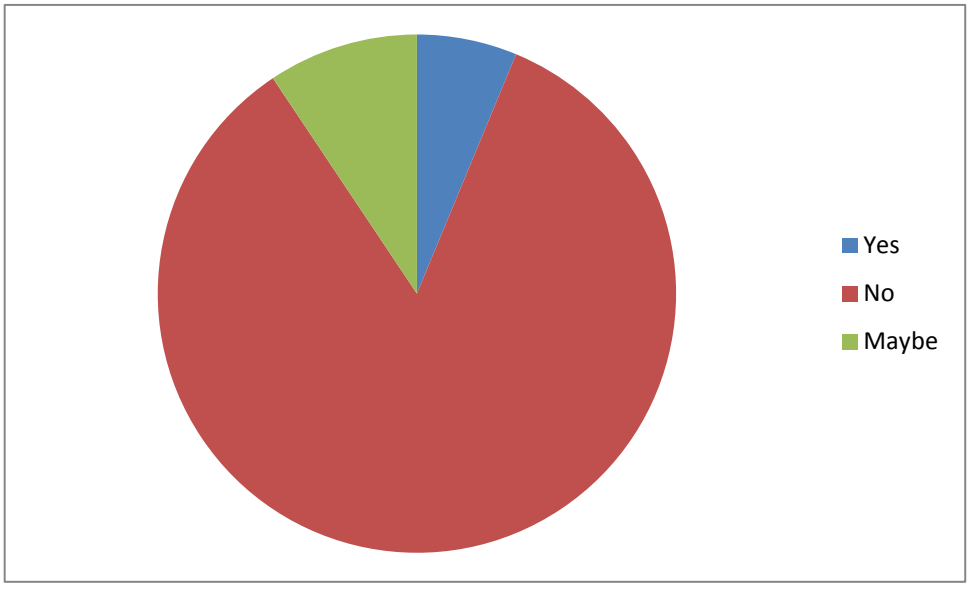
Great facility
Great morning tea
Think it is a very good installation
Very helpful, heading in the right direction
This is a wonderful resource and must be retained.
Good Facility, Hort students should attend
The supplied lunch and refreshments were a nice touch
Very well researched

Very professional, ideally suited to field staff (outdoors and practical)
These are important training sessions for those dealing with these issues on the ground. Council does not supply their own training of this nature
Real-world setting - excellent staff - food was refreshing Turf- would like native options
I think the facility is invaluable and should continue indefinitely. One recommendation would that the facility be granted increased funding to increase it's capacity to not only a demonstration facility but also a research facility
Keep it going
Good presentation
Very good for someone who has no experience
A great tool for increasing awareness about the efficacy of different control measures
Only drawback is the geographic reach of the site. Should replicate in other cities.
Excellent
Clean water was not appropriated. Water with sediments perhaps, you can see the benefit to use grass as a filtration media
Good basic overview of erosion processes plus practical demo of turf working as erosion control. Was hoping to send some people along to a session, could someone email me some info on future session? [email withheld]
Tell Can Do to keep the place going
I think it is excellent to see what water can do on un-stabilised slopes for people who are new to the industry
Get more regulators attending more regularly
It is useful for people with limited soil con knowledge
Maybe add a few more demonstration areas to assess the effectiveness of other methods
Research into the cost of maintaining large areas of grass/turf in comparison with other ESC ,measures

Q17. Would you be interested in being contacted to provide more detailed information about your sue of turf fro erosion and sediment control that we could use as a case study and present it to the turf industry?



Q18. Would you interested in undertaking a joint media promotion with the Australian Turf industry on an example or case study of one of your projects?



APPENDIX 4 – Examples of project media

environment

Turf for Erosion and Sediment Control

The Australian turf industry has established a training and demonstration facility to communicate the results from recent Australian research which found turf to be an effective erosion and sediment control measure.

The Australian turf industry has established a training and demonstration facility to communicate the results from recent Australian research which found turf to be an effective erosion and sediment control measure. The research, *Optimising Turf Use to Minimise Soil Erosion on Construction Sites,* conducted by Dr Rob Loch of LandLoch Consulting in partnership with the Queensland Government, found that turfgrass acts to effectively prevent erosion and also provides an effective sediment capture mechanism.

The study found that when turf is planted to resist erosion, it requires just seven days to bond to the underlying soil. This was found with all turf varieties tested but establishment time did vary slightly with season in coolers areas. Once fully rooted into the underlying soil, all turf grass species were highly effective in resisting detachment or tunnel development. In cases where turf is being planted during highly erosive times of the year, the species with the most rapid root growth were recommended.

As a site evolves, subsequent site rehabilitation by turfing steep and erosion-prone banks was found to be valuable in reducing overall erosion potential of the work site. Turf was also effective in stabilising areas of concentrated flow such as channels and drains. The results highlighted that turf grass can be used to control erosion on batters of relatively high gradients of up to 33.3%.

The study also found that turf was highly effective in trapping sediment. Although there is a risk that if hillslope erosion rates are quite high, the turf could be flooded by deposited sediment. For example, it was observed that sediment deposited to a depth slightly less than the full height of the turf was optimal, so that, for example turf 75mm high could retain a deposited layer of sediment approximately 65mm deep and continue to be effective into the future.

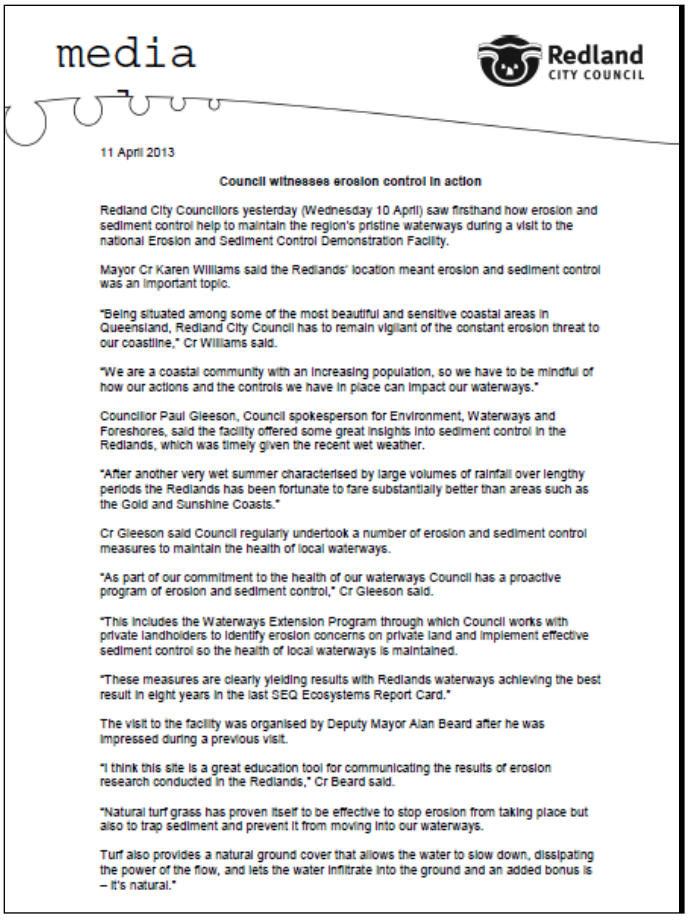
The use of turf for primary trappings of large volumes of coarse sediment is more effective in situations where erosion rates are relatively low. However, turf was very effective when used in conjunction with other measures, such as sediment (silt) fences and other products, such as coir logs and filter socks, in areas experiencing higher rates of erosion.

The results of the research were so encouraging, the turf industry funded the construction of a large-scale erosion control demonstration area. The facility simulates overland water flow of 200mm / hr, showing the movement of sediment following heavy rainfall events down an 8% hill slope. The demonstration displays the effectiveness of natural turf compared with other erosion control measures, such as silt fencing, hydro mulch, silt bags, coir logs, as well as bare earth.

The facility is used as a training and demonstration site, where members of the building and construction industry, Local Government, mining and landscape industries can witness the performance of natural turf in comparison to various other applications.

The facility hosts regular open days and private training events can be booked through the Turf Australia website at www.turfaustralia.com.au. A series of training videos are available online from the Turf Australia website, or via email from admin@bioscienceaustralia.com.

Above: Example of media article (with advertisement) in Local Government Association magazine



media

Redland CITY COUNCIL

11 April 2013

Council witnesses erosion control in action

Redland City Councillors yesterday (Wednesday 10 April) saw firsthand how erosion and sediment control help to maintain the region's pristine waterways during a visit to the national Erosion and Sediment Control Demonstration Facility.

Mayor Cr Karen Williams said the Redlands' location meant erosion and sediment control was an important topic.

"Being situated among some of the most beautiful and sensitive coastal areas in Queensland, Redland City Council has to remain vigilant of the constant erosion threat to our coastline," Cr Williams said.

"We are a coastal community with an increasing population, so we have to be mindful of how our actions and the controls we have in place can impact our waterways."

Councillor Paul Gleeson, Council spokesperson for Environment, Waterways and Foreshores, said the facility offered some great insights into sediment control in the Redlands, which was timely given the recent wet weather.

"After another very wet summer characterised by large volumes of rainfall over lengthy periods the Redlands has been fortunate to fare substantially better than areas such as the Gold and Sunshine Coasts."

Cr Gleeson said Council regularly undertook a number of erosion and sediment control measures to maintain the health of local waterways.

"As part of our commitment to the health of our waterways Council has a proactive program of erosion and sediment control," Cr Gleeson said.

"This includes the Waterways Extension Program through which Council works with private landholders to identify erosion concerns on private land and implement effective sediment control so the health of local waterways is maintained.

"These measures are clearly yielding results with Redlands waterways achieving the best result in eight years in the last SEQ Ecosystems Report Card."

The visit to the facility was organised by Deputy Mayor Alan Beard after he was impressed during a previous visit.

"I think this site is a great education tool for communicating the results of erosion research conducted in the Redlands," Cr Beard said.

"Natural turf grass has proven itself to be effective to stop erosion from taking place but also to trap sediment and prevent it from moving into our waterways.

Turf also provides a natural ground cover that allows the water to slow down, dissipating the power of the flow, and lets the water infiltrate into the ground and an added bonus is – it's natural."

Above: Example of project media release – Joint release with Redland City Council

Above: Project Facebook page to be handed over to Turf Australia

APPENDIX 5 - Site and event photographs

Above: Erosion and Sediment Control Demonstration Facility, Redlands Research Station, Cleveland, Queensland 2013

Above: Erosion and Sediment Control Demonstration Facility training room

Above: Site signage – erosion bays

Above: Site signage detail with QR code which linked to each corresponding video for participants to scan and email to colleagues and clients

Above: Erosion and sediment control demonstration event for John Holland, 2013

Above: Erosion and sediment control open demonstration event, 2014

Above: Will Pearce carrying out turbidity demonstration, Minister's Day, February 2013

Above: Media Famil – media day with project staff Shane Holborn (left), Will Pearce (centre) and Federal MP Andrew Laming (right), 2013

Turf for erosion and sediment control

Construction of an Australian demonstration facility

Shane Holborn and William Pearce

BioScience Australia Pty Ltd, PO Box 2590, Wellington Point, Queensland 4160, Australia
admin@biosciencealustralia.com

Controlling erosion with natural turf

Turfgrass as an erosion control measure has been found to be effective by a number of studies in Australia and internationally. These include examinations of the effect of turfgrass coverage on soil loss in production properties, in natural areas, and forestry plantations as well as in urban areas such as construction sites . Australian turfgrass producers through Horticulture Australia Limited (HAL) have funded research and development activities aimed at identifying and quantifying the efficacy of turfgrass for erosion control and also to identify market opportunities available for turf grass in Australia.

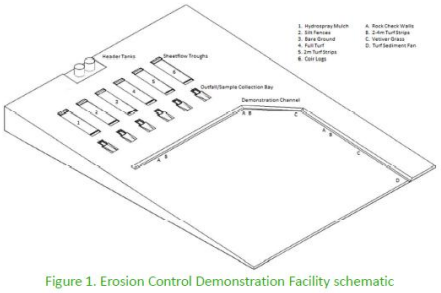


Figure 1. Erosion Control Demonstration Facility schematic

Figure 2. Demonstration results with turbidity readings (scan QR codes to watch video of each bay)

The facility

The facility consists of six erosion demonstration bays and one demonstration channel (Figure 1). Each bay is 12 m long and 3 m wide allowing 1 m for run-on water from an outlet trough at the top of the bay and a 1 m long catchment trough at the end of each bay. The bays are 100mm deep and run lengthways down the slope so that, as much as possible, water flows in a sheet manner across the site.

The channel is designed to simulate large volumes of water with a concentrated faster flow, and winds down the natural slope of the site over a 90 m length. The trapezoidal shaped channel is 500 mm wide in the base and 1500 mm across the top opening with 1:1 v-h (vertical:horizontal) sides at a 100% slope. The channel runs along the contour of the slope for 35 m at a slight (<1%) slope, and then turns across the contour at a 3-4% slope before running the final 35 m down the natural site slope (8%).

Figure 3 .(Top) Demonstrating sediment capture capabilities of turf (Bottom) measuring turbidity

Results and conclusions

Demonstrations at the facility have clearly displayed that full turf performs better than all of the other measures. The significant functional benefits of turfgrass are often overlooked by turf producers and event participants, who tend to focus only on its aesthetic qualities. This perception has limited the use of turf for erosion and sediment control purposes. Another barrier to the wider adoption of turfgrass for erosion control is the expectation that the costs of establishment and ongoing maintenance will be high.

Although the value of the Australian turf industry is not well documented estimates range from A$188.4 million to A$235.7 million. This project aims to effect a market increase of 2% nationally or approximately A$10 million dollars within 5 years. For this to be achieved the facility and demonstration events must necessarily focus on effecting a paradigm shift whereby the natural resilience of turfgrass and its ability to function in ways beyond the aesthetic are more widely recognised.

More information
www.turfaustralia.com.au

Find us on Facebook

Find us on Facebook search for 'Erosion and Sediment Control'

Turf Australia Grow Green

Horticulture Australia

This project has been funded through HAL using the Turf Industry Levy and matched funds from the Australian Government.

Above: Erosion and Sediment Control Facility poster presented at the International Turf Research Conference

APPENDIX 6 - Turf for Erosion Control - Economic Analysis Report

Turf for Erosion Control

Economic Analysis



This publication has been compiled by Industry Analysis, Queensland Department of Agriculture, Fisheries and Forestry.

Contents

List of figures

List of tables

Summary

Residential Construction Site

In the residential construction scenario, turf strips are the preferred option from a cost comparison point of view, being six to six and a half times cheaper than the use of silt fences. Turf strips are the preferred erosion and sediment control measure as turf strips in this role only add marginal costs to the total build. The cost of turf strips is equal to the cost of maintenance only, given that for a residential build turf would be purchased and installed for reasons other than erosion and sediment control.

Conducting sensitivity analysis on the cost of turf strips when considering turf strips as a sediment control measure still results in turf strips being the lowest cost control measure. When the cost of turf strips was varied upwards by $1.50, the difference between the high and low cost estimates for turf materials and installation, turf strips were estimated to be between 53 and 66 percent cheaper than the use of silt fences alone.

Roadside Construction Site

Hydromulch is the most inexpensive erosion and sediment control option. Turf strips are also a relatively inexpensive option when considered against other options of silt bags and full turf. Conducting sensitivity on the price of turf strips and hydromulch shows that the most inexpensive erosion and sediment option can change easily depending on the ratio of area to be turfed to the area to be hydromulched. Reducing this ratio from the initial 3m turf swath:10m hydromulch swath to a 2.5m turf swath:10m hydromulch swath changes the result; turf strips are now the most inexpensive option at the high cost end of the prices analysed.

Hydromulch and turf strips are both cost effective options; yielding a high level of effectiveness at a low cost. As such, determining the right erosion and sediment control option for a specific construction site must move beyond scientific technical feasibility and economic cost effectiveness considerations to consider less quantifiable benefits. Such considerations could includ; failure rate of the measure, the end use of the site and the values of the company commissioning or conducting the construction. For example if a site is adjacent to community facilities such as a school, park or hospital turf strips may be considered the optimal choice due to aesthetic value. Additional value may be placed on environmental benefits, with a construction company choosing the most effective measure so as to differentiate itself in the market.

Background

Importance of erosion and sediment control

For the Environment

Soil and sediment from construction sites can be major sources of stormwater pollution and have a detrimental impact on the health of Australia's waterways. In particular it can cause; negative impacts on the recreational and commercial fishing industry; the movement of nutrients and sediment build-up, which can contribute to weed growth and algal blooms in waterways and ultimately significant harm to the environment of freshwater and marine systems through the loss/change of habitat as well as reduced recreational opportunities due to increased turbidity.

In addition to waterway impacts, soil and sediment movement from construction sites can cause a loss of valuable topsoil which results in safety issues when washed onto roads and the subsequent blocking of stormwater drains, which can also increase public maintenance costs. These environmental and societal costs are borne by taxpayers or society in general. They are external to the decisions made by the construction industry and businesses. As such there is a range of laws, regulations and guidelines in place to internalise some of these costs to the polluter, i.e. the construction sector.

For the Construction Industry

Erosion and sediment control are integral parts of the construction process not simply because they protect the integrity and stability of the site but appropriate erosion and sediment control also ensures the works meet regulatory requirements and avoids fines.

There are many laws, regulations and guidelines in place to help protect the environment across Australia. These mechanisms give guidance to business and industry around the requirements for, and methods of, prevention of erosion and sedimentation.

Before construction on any site in Australia one of the most important factors is to identify the Water Quality Objectives (WQOs) for the site. WQOs are normally assigned by the State or local government. If WQOs are not followed serious fines and charges apply.

In QLD for example fines are charged under the *Environmental Protection Act 1994* (Section 2.1.3) - Adverse or potential adverse effect on an environmental value (includes environmental nuisance). These fines come in 3 categories;

- Environmental Nuisance
- Material Environmental Harm (where the cost to prevent, contain, or rehabilitate the harm is $5,000 to $50,000)
- Serious Environmental Harm (where the cost to prevent, contain, or rehabilitate the harm is >$50,000)

Value of Erosion and Sediment Control

There has to date been limited valuation of erosion and sediment control in the context of construction sites. There are however, a significant number of studies which have attempted to quantify the value of erosion and sediment control measures in the agricultural context. Such work includes studies by the US department of Agriculture and that of Tegtmeier and

Duffy 2004 and Pimentel et al 1995[1]. The larger body of work in the agricultural setting could in part be due to the nature of the erosion problem. In an agricultural setting while some of the benefits of erosion and sediment control are offsite or external to the farmer, there is still significant benefit to the farmer from implementing control measures; benefits such as increased productivity and higher value land. In contrast, there is little incentive for construction industries to conduct erosion ad sediment control measures which exceed mandatory requirements. This is due to the lack of benefit for the polluter.

Scenarios

This analysis comprises of two typical development site scenarios; that of a residential construction site and that of a roadside construction site.

[1] Tegtmeier, E. and M. Duffy (2004). 'External costs of agricultural production in the United States', *International Journal of Agricultural Sustainability*, Vol. 2, No.1.
Pimentel, D., Harvey, C., Resosudarmo, P., Sinclair, K., Kurz, D., McNair, M., Crist, S., Shpritz, L., Fitton, L., Saffouri, R., and Blair, R. (1995). 'Environmental and economic costs of soil erosion and conservation benefits', *Science*, New Series, Vol. 267, No. 5201, pp.1117-1123.

Cost Comparison Analysis

Scenario 1 – residential construction site

Scenario 1 is based on an average sized construction site for a domestic house. The scenario is based on Australian Bureau of Statistics (ABS) figures of an average Australian land area for a new house construction of 735m2 (or 25m x 29.4 m) with the house footprint of 240m2 (ABS 2010). The block is sloping at 8% from back to front. The build time of 2.4 quarters average from the ABS has been rounded to 7 months (2008). For the purpose of this scenario the soil is assumed to be a highly erodible loam to sandy-loam.

In this scenario three treatment options are examined. They are:

- Silt fence – around the perimeter, excluding an entry of 3 metres;
- 2 metre turf strips – around the entire site boundary, excluding an entry of 3 metres;
- Combination – 2 metre turf strip and silt fence (See Figure 1 from left to right).

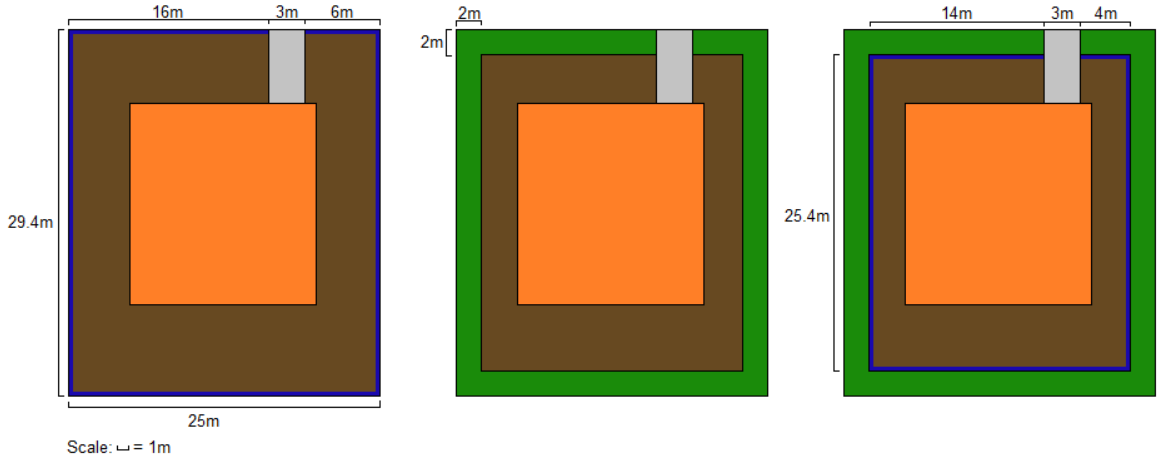


Figure 1: Treatment options (from left to right), silt fence, turf strips and combination.

Scenario 1 Input Parameters

Input parameters were gained from consultation with industry, erosion and sediment control suppliers and BioScience Australia. This information was cross checked with secondary sources - mainly data contained in relevant Horticulture Australia Limited (HAL) project documents[2].

Table 1 details the input parameters used in Scenario 1, which are in addition to the site descriptors already outlined in the scenario section of this report. High and low values have been used for key cost variables to account for price variability across Australia and between those obtained for different sized orders.

Table 1: Input parameters used in Scenario 1

Turf Costs	
Materials Cost $/m^2 (low)	2.5
Materials Cost $/m^2 (high)	3.5
Installation Cost $/m^2 (low)	2
Installation Cost $/m^2 (high)	2.5
Waterings	12
Amount of water/watering (KL)	0.025
Total Water (KL)	0.025
Water $/KL (low)	1.19
Water $/KL (high)	1.69
Area Watered (m)	201.6
Water applied/watering (KL)	5.04KL
Total Water Cost (low)	$71.88
Total Water Cost (high)	$102.44
Total Cost $/m^2 (low)	0.35
Total Cost $/m^2 (high)	0.51
Mowings	6
Cost/hr (low)	30
Cost/hr (high)	35
Area mowed m^2/hr	320
$/m^2 (low)	0.56
$/m^2 (high)	0.66

Silt Fence Costs	
Costs - Material + Install $/l m (low)	4.5
Costs - Material + Install $/l m (high)	5.5
maintenance hours/month/105.8m (low)	2
maintenance hours/month/105.8m (high)	3
maintenance min/month/l m (low)	1.13
maintenance min/month/l m (high)	1.7
cost $/hr	50
cost $/min	0.83
number of months maintenance	7
TOTAL cost $/l m (low)	6.62
TOTAL cost $/l m (high)	9.92

Combination Costs	
Costs - Material + Install $/l m (low)	4.5
Costs - Material + Install $/l m (high)	5.5
maintenance hours/month/89.8m (low)	1.5
maintenance hours/month/89.8m (high)	2
maintenance min/month/l m (low)	1
maintenance min/month/l m (high)	1.37
cost $/hr	50
cost $/min	0.83
number of months maintenance	7
TOTAL cost $/l m (low)	5.85
TOTAL cost $/l m (high)	7.8
Materials Cost $/m^2 (low)	2.5
Materials Cost $/m^2 (high)	3.5
Installation Cost $/m^2 (low)	2
Installation Cost $/m^2 (high)	2.5
Waterings	12
Amount of water/watering (KL)	0.025
Total Water (KL)	0.025
Water $/KL (low)	1.19
Water $/KL (high)	1.69
Area Watered (m)	201.6
Water applied/watering (KL)	5.04KL
Total Water Cost (low)	$71.88
Total Water Cost (high)	$102.44
Total Cost $/m^2 (low)	0.35
Total Cost $/m^2 (high)	0.51
Mowings	6
Cost/hr (low)	30
Cost/hr (high)	35
Area mowed m^2/hr	320
$/m^2 (low)	0.56
$/m^2 (high)	0.66

Watering the turfgrass was calculated by taking the average cost of water for Brisbane ($1.19 - $1.69/KL). It was then assumed that 25mm of water is applied for the first 4 weeks of establishment then fortnightly for the following 16 weeks. 25mm was chosen because it is generally accepted that turfgrass requires a minimum of 25mm of water a week for adequate establishment and growth.

[2] Higginson, R. and McMaugh, P. (2007) *The optimal use of turf in minimising soil erosion on construction sites*, Horticulture Australia Limited, Project No. TU06018
Loch, R.J. (2010) *Optimising turf use to minimise soil erosion on construction sites, Horticulture Australia Limited*, Project No. TU08033

Mowing the turfgrass was calculated by mowing after 6 weeks than every month after that for a total of 6 mows. Mower companies generally charge between $30 - $35/hr. Roughly a 320$m^2$ lawn takes 60mins. Therefore 5.3m^2 is mowed per minute (320/6) and 201.6m^2 takes 38.03 minutes (201.6/5.3). To work out the costing at a charge rate of $30 to $35 per hour 60 minutes was divided by 38.03 minutes which equaled 0.63. 0.63 was then multiplied by the hourly rate ($30-$35) and was worked out to be $18 - $22/mow.

Scenario 1 Results

Under Scenario 1 'turf only' as a treatment option is the cheapest option being 8% and 9% cheaper then Silt Fencing at the low and high values respectively. The combination of using two sediment and erosion control measures is, as expected, the most expensive treatment option, ranging in cost from $2021 to $2639 (Table 2). This then raises the question of effectiveness of the respective treatment options; is a combination of measures more effective than either measure alone? Due to the lack of site specific data on the effectiveness of different erosion control measures this question has not been explored here. Cost effectiveness is however examined in the Cost Effective analysis section.

When reviewing the nature of turfgrass on a residential construction site it is generally expected that homeowners follow a build by landscaping the house surrounds with turfgrass. When referring to table 2, turf is 5 to 6 times cheaper (536.71% to 570.30%) than the use of silt fences (Table 3). This result occurs due to the shift of the cost of turf materials and installation from the end of the construction phase to the beginning. As such, using turf strips as erosion and sediment control on a residential construction site does not add significantly to the overall build costs. Thus, the cost of turf strips is assumed to equal the cost of maintenance only, as the maintenance costs of the turf strips is the only additional cost to the build, given that the turf would have been purchased and installed anyway.

Table 2: Scenario 1 results

Turf Results	
Materials and Install Total (low)	$907.2
Materials and Install Total (high)	$1209.6
Water (low)	$71.88
Water (high)	$102.44
Mowing (low)	$112.896
Mowing (high)	$133.056
Total Cost (low)	**$1091.976**
Total Cost (High)	**$1445.096**

Silt Fence Results	
Material and Install Total (low)	$476.1
Material and Install Total (high)	$529
Maintenance Total (low)	$700.396
Maintenance Total (high)	$1049.536
Total Cost (low)	**$1176.496**
Total Cost (high)	**$1578.536**

Combination Results	
Turf Results	
Materials and Install Total (low)	$907.2
Materials and Install Total (high)	$1209.6
Water (low)	$71.88
Water (high)	$102.44
Mowing (low)	$112.896
Mowing (high)	$133.056
Total Cost (low)	$1091.976
Total Cost (High)	$1445.096
Silt Fence Results	
Material and Install Total (low)	$404.1
Material and Install Total (high)	$493.9
Maintenance Total (low)	$525.33
Maintenance Total (high)	$700.44
Total (low)	$929.43
Total (high)	$1194.34
Total Cost (low)	**$2021.406**
Total Cost (High)	**$2639.436**

Table 3: Scenario 1 results, assumption that turf cost = maintenance only

	Low	**High**
Turf	184.78	235.50
Silt Fence	1176.50	1578.54
Turf +Fence	1114.21	1429.84

Sensitivity

Sensitivity was conducted on the turf only treatment option and the combined turf plus silt fence option. The cost of turf strips was varied upwards by the difference between the high and low cost estimates for turf materials and installation; a cost of $1.50. This figure was used as it was assumed that the purchase and installation price for the smaller amount of turf required for the turf strips at the start of the build may be more expensive, than the cost of purchasing and laying a larger quantity of turf in one installment at the end of the build.

Even when the cost of turf is raised to account for the possibility of higher purchase and installation costs (arising due to the smaller order size) turf strips are still the lower cost control measure (Table 4). Turf strips are estimated to be between 141 percent (low turf estimate vs. low silt fence estimate) and 193 percent (high vs. high) cheaper than silt fences alone.

Taking more conservative figures in the same comparison, using the high cost estimate for turf maintenance and accounting for increased turf materials and installation versus the lowest cost estimate for silt fences turf strips are still the optimal choice; 119 percent cheaper than silt fences.

Table 4: **Scenario 1 results, assumption that turf cost = maintenance + higher material and install rate**

	Low	High
Turf	487.18	537.90
Silt Fence	1176.50	1578.54
Turf +Fence	1416.61	1732.24

Scenario 2 – roadside construction site (drain)

Scenario 2 is based on a 100m long stretch of road that has a 10m wide shoulder cleared of vegetation (i.e. is bare earth) containing a drainage channel spanning the middle 3m of the site. The slope is based on 8% fall. For the purpose of this scenario the soil is assumed to be a highly erodible loam to sandy-loam.

The treatment options examined in this scenario are:

- A 3 metre wide turf strip running in the apex of the drain along the length of the roadway;
- A fully mulched area (i.e. 10 metre x 100m) hydromulched with grass seeded mulch mix;
- A combination of 3 metre turf strip in the centre of the drain and hydromulch across the remaining area (See Figure 2 from left to right).

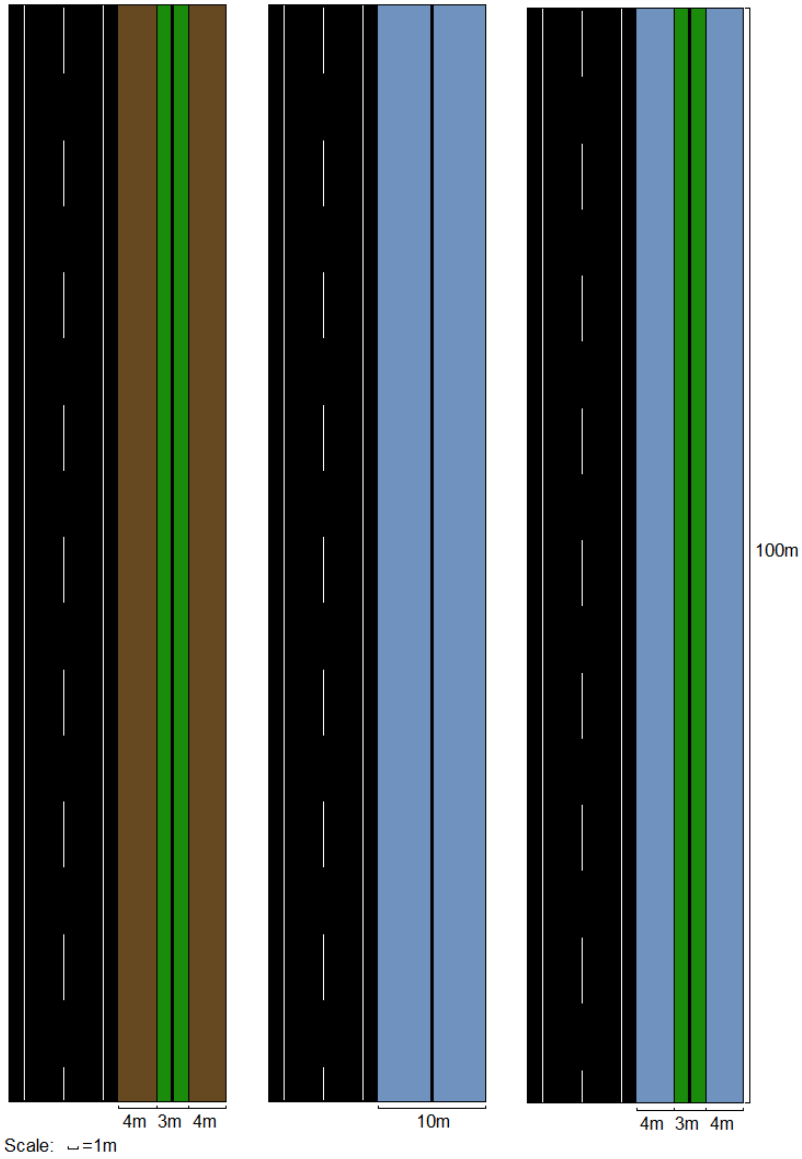


Figure 2: **Treatment options (from left to right), turf strip, hydromulch and combination.**

Scenario 2 Input Parameters

Table 5 details the input parameters used in Scenario 2, which are in addition to the site descriptors already outlined in the previous section of this report. High and low values have been used for key cost variables to account for price variability across Australia and between those obtained for different sized orders.

It was assumed that one watering was undertaken for both turf and hydromulch measures and no mowing was undertaken during the construction phase as such measures are generally installed at the conclusion of the build.

Table 5: Input Parameters used in Scenario 2

Turf Costs	
Materials Cost $/m^2 (low)	2.5
Materials Cost $/m^2 (high)	3.5
Installation Cost $/m^2 (low)	2
Installation Cost $/m^2 (high)	2.5
Waterings	1
Amount of water/watering (KL)	0.025
Total Water (KL)	0.025
Water $/KL (low)	1.19
Water $/KL (high)	1.69
Total Cost $/m^2 (low)	0.02975
Total Cost $/m^2 (high)	0.04225
Mowings	0
Cost/hr (low)	30
Cost/hr (high)	35
Area mowed m^2/hr	320
$/m^2 (low)	0
$/m^2 (high)	0

Hydromulch Costs	
Costs - Material + Install $/m^2 (low)	0.7
Costs - Material + Install $/m^2 (high)	1.5
waterings	1
amount of water/watering (KL)	0.025
total water (KL)	0.025
Water $/KL (low)	1.19
Water $/KL (high)	1.69
Total cost $/m^2 (low)	0.02975
Total cost $/m^2 (high)	0.04225

Combination Costs	
Materials Cost $/m^2 (low)	2.5
Materials Cost $/m^2 (high)	3.5
Installation Cost $/m^2 (low)	2
Installation Cost $/m^2 (high)	2.5
Waterings	1
Amount of water/watering (KL)	0.025
Total Water (KL)	0.025
Water $/KL (low)	1.19
Water $/KL (high)	1.69
Total Cost $/m^2 (low)	0.02975
Total Cost $/m^2 (high)	0.04225
Mowings	0
Cost/hr (low)	30
Cost/hr (high)	35
Area mowed m^2/hr	320
$/m^2 (low)	0
$/m^2 (high)	0
Costs - Material + Install $/m^2 (low)	0.7
Costs - Material + Install $/m^2 (high)	1.5
waterings	1
amount of water/watering (KL)	0.025
total water (KL)	0.025
Water $/KL (low)	1.19
Water $/KL (high)	1.69
Total cost $/m^2 (low)	0.02975
Total cost $/m^2 (high)	0.04225

Scenario 2 Results

Under Scenario 2 hydromulch is the most inexpensive option in three of the four possible price combinations[3], being between 15 and 46 percent cheaper than turf strips alone (Table 6). A turf strip in the drain apex however, becomes the optimal option when turf material/installation and maintenance costs are at the low end of estimated prices and hydromulch costs are at the high end of estimated prices. Turf strips in this instance are 13 percent cheaper than hydromulch.

As seen in Scenario 1, using a combination of sediment and erosion control measures is more expensive than using a single measure alone. It should be noted however, that this is based purely on a cost comparison and does not take into account the effectiveness of measures in controlling sediment and soil erosion.

Table 6: Scenario 2 results

Turf Results	
Materials and Install Total (low)	1350
Materials and Install Total (high)	1800
Maintenance Total (low)	8.925
Maintenance Total (high)	12.675
Total Cost (low)	**1358.925**
Total Cost (High)	**1812.675**

Hydromulch Results	
Material and Install Total (low)	700
Material and Install Total (high)	1500
Maintenance Total (low)	29.75
Maintenance Total (high)	42.25
Total Cost (low)	**729.75**
Total Cost (High)	**1542.25**

Combination Results	
Turf Results	
Materials and Install Total (low)	750
Materials and Install Total (high)	1050
Maintenance Total (low)	8.925
Maintenance Total (high)	12.675
Hydromulch Results	
Material and Install Total (low)	490
Material and Install Total (high)	1050
Maintenance Total (low)	20.825
Maintenance Total (high)	29.575
Total Cost (low)	**1269.75**
Total Cost (High)	**2142.25**

Sensitivity

Given the overlap in the cost estimates of the turf only option and the hydromulch only options sensitivity has been conducted on both of these scenarios. The total cost of turf material, installation and maintenance has been decreased by using a 2.5m turf strip and a 2m turf strip in the drain apex[4].

With a 2.5m turf strip in the drain apex turf becomes the optimal choice of sediment and erosion control measure at the high price range (Table 7a). Hydromulch remains the cheapest option at the lowest estimated price. If however, hydromulch is obtained at the highest estimated price, turf becomes the preferred option at both the high and low end of estimated turf prices.

Decreasing the turf strip to 2m width increases the price competitiveness of turf at the high price end; turf becomes 28 percent cheaper than hydromulch (Table 7b). At the low price end hydromulch remains the cheapest option. As the case with the 2.5m strip, if hydromulch is obtained at a high price, turf becomes the preferred option at all estimated prices.

[3] The price combinations are as follows: low turf price and low hydromulch price, low turf / high hydro, high turf / high hydro and high turf / low hydro.

[4] These reductions are from the initial scenario of a 3m turf strip in the drain apex of a 100m stretch of road; 300m^2 of turf.

Table 7: **Scenario 2 sensitivity of turf price results**

a) 2.5m turf strip in drain apex

	Low	High
Turf	1132.43	1510.56
Hydro	729.75	1542.25

b) 2m turf strip in drain apex

	Low	High
Turf	905.95	1208.45
Hydro	729.75	1542.25

In addition, conducting sensitivity by varying the price of hydromulch upwards may also see a change in the optimal choice of sediment and erosion control measure. The price has been varied upwards in this case to reflect a range of factors that may occur and cause the total price to increase. Such factors could include the use of native seeds and the failure of some parts of the site to germinate. Price has been varied upwards by 10 and 20 percent respectively (Table 8). Hydromulch remains the most inexpensive option when prices are increased by 10 percent. Raising the price of hydromulch to 20 percent however leads to turf strips becoming the most inexpensive option in 2 out of the four possible combinations; the high turf/high hydro cost option and the low turf/high hydro price option (Table 8).

Table 8: **Scenario 2 sensitivity of hydromulch price results**

a) 10% increase in hydro cost

	Low	High
Turf	1358.925	1812.675
Hydro	800.00	1692.00

b) 20% increase in hyro cost

	Low	High
Turf	1358.925	1812.675
Hydro	870.00	1842.00

Cost Effectiveness Analysis

Scenarios

This analysis examines five scenarios each of which are conducted on a 30 metre square (3 x 10m) plot with a gradient of 8 percent. These are listed below and shown in Figure 3 from left to right:

- Bare earth – do nothing
- Full turf
- Turf strips
- Coir logs
- Hydromulch

Figure 3: Scenarios (from left to right), bare earth, full turf, turf strips, coir logs and hydromulch

Input Parameters

Cost data

Cost data for these scenarios has been taken from the prior cost comparison analysis, with the exception of coir logs. The figures include materials, installation and maintenance; 3 waterings and zero mows in the case of turf and turf strips (at $0.03 - $0.04 per watering), 1 watering for hydromulch (at $0.03 - $0.04) and no maintenance for coir logs (Table 9).

Table 9: Cost data

	Min	Max	
Turf	4.59	6.13	$/m^2
Coir Logs	20.54	27.78	$/linear m
Hydromulch	0.73	1.54	$/m^2

Table 10 shows the total costs for each of the five scenarios being analysed. It is assumed that the entire 30 square m plot (3x10m) is turfed under the full turf scenario. Under the turf strips scenario 12 square metres are turfed (2 turf strips each of 2 x3m). Under the coir logs scenario it is assumed that 9 linear metres of logs are required (3 coir logs each spanning 3m across the plot). In the hydromulch scenario the entire plot is assumed to be covered (30 sq m).

Table 10: **Total costs for each scenario**

	Min	Max
Bare Earth	-	-
Full Turf	$137.68	$183.80
Turf Strips	$55.07	$73.52
Coir Logs	$184.82	$250.06
Hydromulch	$21.89	$46.27

Benefit / Outcome data

This analysis utilises sediment load results from field trials undertaken at the 'Erosion Control Demonstration Facility' developed at the Redlands Research Station, Cleveland Queensland by BioScience Australia[5].

The benefit data is obtained from each of the scenario plots, whereby after six days, a 1-in-100 year rain event was simulated and applied to each plot for approximately 10 minutes. Flow rates ranged from 2 to 3.5 litres per second to simulate sheet erosion across the plots. One litre of runoff was collected at three times within the 10 minute period, as follows:

1. When runoff first emerged form the outlet pipe
2. Two minutes after the first outfall of runoff; and
3. Four minutes after the first outfall of runoff (Figure 4).

Figure 4: **Collected runoff at the three intervals for the bare earth and full turf scenarios**

Sediment load was tested by agitating the one litre beaker and taking a one in one hundred millilitre sample in a previously weighed beaker. The sample was then dried in an oven at 100°C until all moisture was removed. The remaining weight was recorded and the difference between the initial beaker tare weight and new weight is recognised as the sediment load.

The outcome data used is shown in Table 11 below. These figures are an average of the three sediment load measures obtained at each of the time intervals on a single plot, as described previously.

[5] http://www.bioscienceaustralia.com/erosion-control-demonstration-facility.html

Table 11: **Outcome data, sediment load**

Scenario	Avg. Sediment Load
Bare Earth	15424
Full Turf	33
Turf Strips	1882
Coir Logs	7267
Hydromulch	61

Method

Cost Effectiveness Analysis (CEA) values the costs of implementing a particular measure (in this case soil and erosion control) and relates this cost to the total quantity of outcome generated, to produce a "cost per unit of outcome" estimate. In this analysis the result measure utilised is the cost per one percent decrease in sediment load. The cost per unit of outcome will be compared between each of the scenarios from the base case outcome; i.e. the sediment load produced with no measure in place, the bare earth scenario.

CEA is distinct from Cost Benefit Analysis (CBA) which goes a step further than CEA, placing a monetary value on the change in outcome. In the case of this report CBA was not conducted due to time constraints and data limitations. Valuing lost sediment from construction sites is not well researched, and would require the addition of numerous benefits as well as avoided costs. Benefits may include; increases in, waterway biodiversity and ecosystem function, waterway aesthetic values, the value of recreational activities such as recreational fishing and increases to the value of the commercial fishing industry. Avoided costs may for example, comprise of reduced public maintenance costs from a reduction in blocked drains/roadways and reduced costs in water channel dredging/ waterway cleanup.

These benefits and avoided costs are particularly difficult to value as for this to occur causality must be established and then the change in the effect resulting from the event must be able to be quantified.

Results

When assessing all the scenarios against the base case of 'bare earth', hydromulch is the most cost effective scenario, costing between $0.22 and $0.46 per percentage change in sediment load (Table 12). Turf strips also come out as a cost effective option, costing between $0.63 and $0.84 per percentage change in sediment load. While the is little difference between the max cost for full turf and the minimum cost for coir logs, full turf is approximately 2.5 times more cost effective than coir logs, reflecting the high effectiveness of turf as an erosion and sediment control measure.

Table 12: **CEA results against base case, bare earth**

Scenario	$/% change in sediment load	
	Min.	Max.
Full turf vs. Bare Earth	1.38	1.84
Turf Strips vs. Bare Earth	0.63	0.84
Coir Logs vs. Bare Earth	3.49	4.73
Hydromulch vs. Bare Earth	0.22	0.46

Figure 5 plots the CEA results from Table 9 on a cost effectiveness plane. The plane consists of four-quadrants, ranging from more effective and more expensive (QI) to less effective and less expensive (QIII). Quadrant II options with high effectiveness and low cost are generally seen as always acceptable, with quadrant IV options (low effectiveness and high cost) seen as never acceptable. Options within quadrants I and III can be both acceptable and not acceptable depending on whether outcomes outweigh costs or not. The plane clearly shows the two aforementioned options (turf strips and hydromulch) as being the most cost effective options situated in quadrant II (Figure 6).

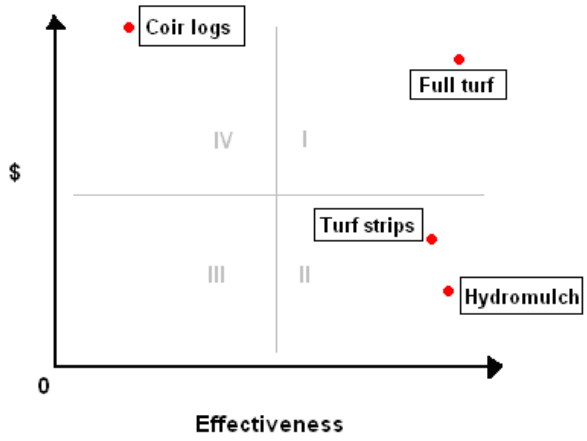


Figure 5: **CEA results on cost effectiveness plane**

Sensitivity

Sensitivity has not been conducted in this analysis due to the lack of output data. While cost data can easily be changed, altering the outcome data is more problematic as there is a lack of consistent data available for different erosion and sediment control measures. Furthermore, there is a lack of knowledge about the relationship between area/length of erosion and sediment control measures and the expected change in sediment load. As such it is inappropriate to hypothesize a change in output given alterations to the specifications of the erosion and sediment control measures. This is one area that could warrant further study.

Discussion

While it is useful to compare all scenarios against the base case of bare earth, it may be more useful to compare scenarios that are commonly used in the same construction situations. In this comparison we have compared the erosion and sediment control options examined in the two applied construction scenarios of the earlier cost comparison analysis. The comparisons are as follows:

- Residential construction site: turf strips vs. coir logs
- Roadside construction site: turf strip vs. hydromulch

When comparing turf strips to silt fences they are comparable on a purely cost basis, as was demonstrated in scenario 1 of the cost comparison analysis. For silt fences to be more cost effective than turf strips, silt fences need to be more effective than turf strips as they are

more expensive. Results from the field trials undertaken at the 'Erosion control demonstration facility' developed at the Redlands Research station show that this is unlikely to occur. The results found turf strips to be nearly 80 percent more effective than silt fences at reducing sediment load. Even if this set up underestimates the potential of silt fences and/or overestimates the potential of turf strips we can reasonably conclude that turf strips would be more cost effective than silt fences.

When comparing turf strips to hydromulch, hydromulch is the cheapest option however, turf strips are still reasonably priced compared to other erosion and sediment control measures (Table 10). In terms of effectiveness, hydromulch is more effective than turf strips in reducing sediment load; hydromulch reduced sediment load by 99 percent from bare earth, whilst turf strips reduce sediment load by 88 percent from bare earth. Nevertheless both turf strips and hydromulch are cost effective options that should be considered when selecting erosion and sediment control measures in a roadside construction setting.

In a case such as this, where two measures (turf strips and hydromulch) have similar costs and furthermore, both measures are cost effective, the decision as to the optimal erosion and sediment control measure will vary according to the particular project to reflect additional considerations. Such considerations could include, failure rate of the measure, the end use or location of the site, the values of the company commissioning or conducting the construction. For example if a site is adjacent to community facilities such as a school, park or hospital turf strips may be considered the optimal choice due to aesthetic value. Additional value may be placed on environmental benefits, with a construction company choosing the most effective measure so as to differentiate itself in the market.

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APPENDIX 7- Turf for Erosion Control - Australian Standard Development Summary Report

Turf for Erosion Control
Australian Standard Development Summary

Compiled by Shane Holborn

As part of Milestone 102 requirements for project
TU12022 Erosion control - turf research and development facility

Turf for Erosion Control –
Australian Standard Development Summary

Introduction

The Australia turfgrass production industry has invested a significant amount of resources into determining the effectiveness of turf as an erosion and sediment control measure and subsequently extending that information out to key commercial consumer groups. Anecdotal evidence suggest that this approach is having an impact and ultimately appear to be garnering support for turf for this purpose and importantly, increasing sales.

This report compiles a summary of the requirements for the turf industry to develop an Australian Standard for the use of turf for erosion control. This forms part of the requirements for the turf production levy and Horticulture Australia (HAL) funded project *TU12022 Erosion control - turf research and development facility.*

Method

The majority of the report is derived in whole or part from information available from the Standards Australia website (www.standards.org.au) particularly the sections concerned with the process of developing a standard. These have been edited, summarised and added to in order to achieve brevity and clarity. A list of relevant publications available from Standards Australia pertaining to the standards development process has been provided in Appendix 1 which explain each stage of the process in detail.

Discussions with the national nursery industry were also undertaken to determine, from their experience, some of the issues that may arise for the turf industry should they chose to undertake this process (see Case Study page 9). A search for existing similar standards was conducted to determine if this process had been undertaken in Australia or overseas. No standards of the rigour required for an Australian standard was identified however a list of example standards has been provided in Appendix 2 to highlight some of the types of turf or erosion related standards topics that are currently covered overseas.

What is a Standard?

Standards are published documents setting out specifications and procedures designed to ensure products, services and systems are safe, reliable and consistently perform the way they were intended. They establish a common language which defines quality and safety criteria.

Standards can be guidance documents including:

- Australian Standards;
- International Standards and Joint Standards;
- Codes;
- Specifications;
- Handbooks and guidelines.

These documents are practical and based on sound industrial, scientific and consumer experience and are regularly reviewed to ensure they keep pace with new technologies. They cover topics ranging from consumer products and services, construction, engineering, business, information technology, human services to energy and water utilities and the environment.

Net Benefit

Every Australian Standard, regardless of who develops it, must demonstrate positive Net Benefit to the community. All Australian Standards must provide a value or benefit that exceeds the costs likely to be imposed on suppliers, users and other parties in the community as a result of its development and implementation.
For simplicity and to align the Productivity Commission's recommendations Standards Australia has defined Net Benefit to mean *"having an overall positive impact on relevant communities"*.

Net Benefit takes into account the costs and benefits related to the following criteria:

- Public health and safety;
- Social and community impact;
- Environmental impact;
- Competition; and
- Economic impact.

They make a sustained contribution to generating national wealth, improving quality of life, increasing employment, improving safety and health and using resources more efficiently.

Standards and the Law

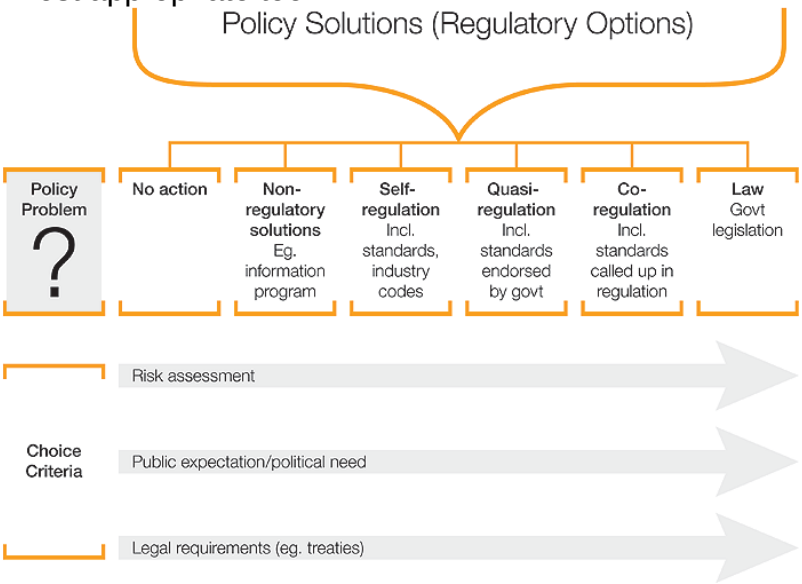
Standards Australia is not part of government, standards are not laws or regulations. Australian Standards are not legal documents but, because of their rigour, are often called up into legislation by government and become mandatory. This is a decision made by governments, not Standards Australia. Standards are also often incorporated into legal contracts and tender processes.

Standards and Regulation

Standards are voluntary consensus documents that are developed by agreement and their application is by choice unless their use is mandated by government or called up in a contract. Standards are one tool in a regulatory spectrum that may be applied by governments to provide a solution to a problem.

Depending on the issue, the optimal solution might be 'no action', or a non-regulatory solution like a publicity campaign, or self-regulation by means of a voluntary industry code or standard, or quasi-regulation such as a standard endorsed by government, or co-regulation such as a standard cross-referenced in a general or high-level regulation, or legislation.

Figure 1 illustrates the regulatory spectrum, identifying key 'Choice Criteria' to guide selection of the appropriate regulatory tool. The basic principle is that risk assessment should be applied to an issue to identify the most appropriate solution. The more risk attached to the behaviour or issue, the more government involvement is likely. In principle, progress to the right of the spectrum should be in response to increased risk to justify the increased cost and impact upon society. Standards are not always the most appropriate tool.



From the Standards Australia website (www.standards.org.au)

Benefits of Standards
Seven benefits of standards have been identified by Standards Australia, these are:

1. Standards protect Australians
Australians are made safer by Standards. Standards give businesses and consumers confidence that the goods and services they are developing or using are safe, reliable and will do the job they are supposed to do. Standards help consumers make everyday choices between one product and another.

2. Standards support Australian innovation
Standards provide a platform on which to build new ideas. New Standards are introduced to reflect the latest technologies, innovations and community needs - redundant Standards are discarded.

3. Standards boost Australian production and productivity
Australian manufacturing, materials handling, mechanical systems and components. Standards save businesses time and money. Standards can cut production costs. They can drive economies of scale, the use of common parts and specifications, help cut energy bills and foster new technologies.

4. Standards make Australian businesses more competitive
Products that comply with Australian Standards have a competitive edge over products that don't - consumers know the difference. Businesses know products

made to Australian Standards have more credibility - whether it's a helmet, baby capsule or complaints handling system.

5. Standards link Australia to the world
Standards ensure products manufactured in one country can be sold and used in another e.g. a nut made in Melbourne fits a bolt made in London.

6. Standards complement Australian regulation and make markets work better
Around a third of all Australian Standards form some part of Territory, State or Federal law. They are at the heart of the Australian Building Code and the Trade Practices Act. They help governments make laws to protect the community. Standards offer an alternative to regulation, with less red tape and business costs, while still providing security for consumers.

7. Working on Australian Standards rewards participants
Being a part of an Australian Standards development team has its own rewards - increased knowledge, stronger business networks and competitive advantages.

Development Pathways

Standards Australia's Development Pathways describe the allocation of responsibility and resourcing across the common Standards Development process. Standards Australia directs its resources to the core function of Standards Development through prioritised support of the following pathways.
Those wishing to propose a Standards Development project to Standards Australia are encouraged to discuss the pathway options with a National Sector Manager to determine the most appropriate pathway.

1. Standards Australia Resourced

This pathway provides Standards Australia's resources, project management and infrastructure. Standards Australia Resourced projects require commitment and active contribution from stakeholders over a defined period of time.

2. Committee Driven

Under this pathway, primary project management contribution comes from stakeholders. In addition to providing the subject matter expertise, an appropriately skilled and experienced Committee, takes on project management and secretariat responsibility for the project. Committee driven projects may be eligible for Standards Australia resourcing through the Prioritisation Process, however the main contribution comes from stakeholders.

3. Externally Funded

The Externally Funded pathway offers stakeholders ‘customised solutions’, ‘greater choice’ in resourcing levels and accelerated project timeframes, subject to Standards Australia Standards Development processes. While Externally Funded project proposals are subject to the same assessment requirements, this pathway is not part of the Prioritisation Process. Proposals for Externally Funded projects may be submitted to Standards Australia at any time throughout the year. Standards

Australia welcomes proposals for Externally Funded Projects; however the provision of external funding does not give the funding entity any preferential consideration in relation to the technical content and outcome of the Standard.

4. Accredited Standards Development Organisation

The Accredited SDO pathway is managed by the Accreditation Board for Standards Development Organisations (ABSDO) and allows organisations to be formally accredited as standards developers in their own right.

To discuss the most appropriate pathway for a proposed project contact should be made with the appropriate Standards Australia National Sector Manager.

Prioritising and Selecting Projects

To ensure a fair and equitable selection of Standards-related activities and projects that will be resourced by Standards Australia, an agreed Prioritisation and Selection Process is in place.
The process takes place twice a year and is designed to ensure Standards Australia's funds and resources are allocated where they can deliver greatest benefit to the community.

The selection process is competitive. Selection will be based on the strength of the Net Benefit case; robustness of the project proposal; stakeholder consultation and support; and above all the availability of Standards Australia resources.

Proposal review and approval

- Proposals received will be logged centrally and confirmation sent to the proponent. Proposals may also be made publicly available on the Standards Australia website.
- Once proposals are evaluated and reviewed, and a decision has been made by Standards Australia, the outcome will be communicated directly to the proponent and a list of approved projects published on the Standards Australia website.
- Project proponents and responsible Committees will be notified with details on project commencement activities.

Development Principles

The Standards Australia Standards development process is clear and rigorously defined and based on three internationally recognised principles:

- Openness and transparency of process
- Consensus
- Balance of representation.

1. Openness and transparency of process

Transparency is critical in the preparation of Standards. Transparency means that every act must follow a well-established procedure; that the procedure is equitable to

all parties; and that each step in the standardisation process is open and available for scrutiny.

2. Consensus

Consensus in standardisation is the process through which a technical committee, consisting of many different and sometimes opposed interests, arrives at a general agreement on the content and requirements of a Standard. This produces a Standard which best matches the expectations of society as a whole, and due to representation of a range of parties, broad community acceptance is assured.

3. Balance

The membership of a Standards Australia Committee is formally balanced as part of the constitution of the Committee to represent the broadest possible spectrum of stakeholder interests.

Development Phases

The Standards development process involves a number of stages.

1. Proposal for a new or revised Standard

A formal proposal comes from the Australian community, often from industry associations or government departments. Standards Australia does not initiate new Standard projects - it responds to requests from external stakeholders. A rigorous justification of the need for the project and a statement of its value to the Australian community in the form of a Net Benefit Case is required before Standards Australia approves the commencement of a new project.

2. Project approval

All proposed projects, including their Net Benefit Cases, are carefully assessed by Standards Australia. If necessary, further clarification will be sought from the proponent. Where a proposal for a new Standard is put forward by an external source and the subject area is covered by an existing Technical Committee; that Committee is consulted and their views on the proposal sought. Where no suitable Technical Committee exists, the project proponent needs to indicate a suggested constitution for the new Committee and also show that the proposal has the support of key stakeholders that are likely to be affected by the new Standard.

3. Formation of a Technical Committee

Every Standard published is prepared by a Technical Committee. Each committee is led by an appointed Chair. The Chair is supported by a Committee Secretary, responsible for co-ordinating committee work and ensuring the draft Standard, which emerges from the committee work, follows the basic principles of standardisation.

4. Drafting

The Committee meets to set a drafting schedule, discuss progress, co-ordinate activities and seek to establish consensus in the technical content of the emerging draft. Most of the necessary drafting work is done offline in Sub-Committees and expert Working Groups, using advanced web-based authoring, administration and balloting systems. Committees are obliged to ensure that proposed Standards will

not act as a barrier to trade, competition or innovative development, before any drafting work is undertaken. It is also a Standards Australia policy to adopt International Standards to the maximum possible extent. In the absence of an appropriate existing International Standard, and after verification that the proposed Standard will not be anti-competitive, the Committee proceeds to prepare a draft for a new Australian Standard.

5. Draft for public comment

This stage ensures that the broader community has an opportunity to review the content and direction of the Standard prior to its completion, and requires a draft document to be published and made available to the public for comment for nine weeks.

6. Consideration of comment

All comments from the public are considered in detail by the Committee and, if necessary, further drafting is undertaken to accommodate responses to the comments.

7. Draft for postal ballot

The Committee then votes on the final draft. For the Standard to be published, the ballot must demonstrate the consensus of the Committee that the content of the document is ready to be published.

8. The Published Standard

Final approval of the development process is given by, or on behalf of, the Standards Development Committee (SDC) and the Standard is ready for publication.

9. Revision of existing Standards

All Standards need to be reviewed regularly as technology, knowledge and community needs change. For this reason a review process exists to keep the Australian Standards catalogue up to date. Major Standards and those dealing with topics continually undergoing rapid change are normally revised and republished within a period of seven years and most others are revised within ten years of their publication date.

Assistance and Support

Standards Australia have a comprehensive set of resources available including extensive WebPages as well as downloadable guides for most aspects of the Standards proposal, development and publishing phases (see Appendix 1). Each industry sector also has a National Sector Manager who can be contacted for guidance and information or Standards Australia's Standards Information Service (SIS) by email or phone (1800 035 822).

Case Study Example

Nursery industry Example

The Australian nursery industry is currently in the process of developing a National Tree Standard. The standard is designed to fill a vacuum that exists in the industry nationally and provide a catalyst to:

1. Improve tree performance in the landscape;
2. Make it difficult for poor operators and move away from the "start-up" "cottage industry" attitude;
3. Raise the industry's profile internationally;
4. Develop a document with support from the industry and leading clients in the landscape sectors.

The standard document incorporates detailed descriptions and measures including definitions; above and below ground attributes of trees; tree balance; sampling and appendices.

The proposal was put forward by the Nursery & Garden Industry Australia (NGIA) based on a document drafted in 2008 that did not engage industry sufficiently to be successfully developed into a standard at that time. The process is being led by their National Research and Development Manager Dr Anthony Kachenko. The proposal was successful and the Net Benefit was assessed as sufficient for the project to fall within the Standards Australia Resourced category. A committee consisting of representatives from leading nursery businesses as well as other industry stakeholders (including consumers and technical experts from organisations such as Arboriculture Australia, Australian Institute of Landscape Architects, Institute of Australian Consulting Arboriculturists, Local Government Tree Resources Association and Australian institute of Horticulture) was formed to assist in developing the draft standards and to provide feedback on subsequent redrafting as required. The process to date:

Proposal submitted to Standards Australia
February 2012

↓

Notification that Grant was successful
June 2012

↓

Standards Development Committee Formed
NGIA National Tree Specification Steering Committee (NNTSSC)
January 2013

↓

First meeting of NNTSSC
March 2013

↓

Next Standards Development Committee Meeting
scheduled for July 2013

The final stages of the process include a round of public consultation before final sin off and publication. The process is continuing with an expected total completion time within approximately 18 months. For more information and to register for updates of the process go to the nursery industry levy information site:
http://yourlevyatwork.com.au/update-on-the-proposed-australian-standard-for-growing-trees/

Conclusions & Recommendations

The development of a standard to define the best practice of turf as an erosion control method would undoubtedly provide a number of benefits for the industry and the product within the erosion control market. However, the standard development process relies on a number of stages and levels of commitment in order to successfully progress to a finished, published standard. These include the identification of an appropriate pathway (and funding structure which may or may not be supported by Standards Australia); the development and acceptance of a proposal; the clear identification of the net benefit for the community; the identification of a group of industry and technical specialists to participate in the process (this is likely to include turf, soil, construction and erosion industry representatives as well as others) and revision and refinement of the standard through consultation processes including public consultation.

The final product will be controlled and determined by Standards Australia with Turf Australia one of a number of participants in that process, albeit the driver of that process. This introduces a level of risk in that the final standard will only include advice/guidance on the use of turf as an erosion control method that is well supported by evidence and/or is part of the general consensus of the steering committee. This may limit recommendations for its use in some or potentially many instances where it may currently be considered for use without the guidance of a standard. The standard may also highlight issues (e.g. the potential for weed seed loads in turf sod) and may require the imposition of industry standards (such as a formal quality certification process) as part of the final document.

However, given turf grass's efficacy as an erosion and sediment control measure and the level of existing research-based information and acceptance by the construction industry it is unlikely that the standards development process would result in an overall negative outcome for turf producers.

Therefore it is recommended that:

1. Turf Australia request more information and a presentation at a future board meeting from a Standards Australia representative and/or Dr Anthony Kachenko from the national nursery industry association to discuss their experiences with the Standards Australia process and requirements/commitment from a practical and financial perspective.
2. Consultation (formal or informal) occur within the turf industry to determine the level of support for a standard development project;

If both of these activities result in positive support for the concept then:

3. Identify potential support from Horticulture Australia Limited (utilising levy funds) be investigated/secured and directed to develop a proposal for Standards Australia;
4. If successful - follow the standards development process as determined by the eventual standards development pathway utilised.

This process should be driven by an individual who, if not working within Turf Australia should be commissioned by them, to ensure the proposal is not sidetracked/distracted or derailed as it is a substantial undertaking to both coordinate and drive the standard drafting and then development process. This is especially the case as there does not seem to be a similar or comparative standard on which to use as a guide or the basis for progressing into the future (refer Appendix 2).

Reference List

Gaffney, F.B. & Dickerson, J.A. (2005) Vegetative measures for erosion and sediment control. USDA—Natural Resources Conservation Service, Syracuse, New York. http://www.dec.ny.gov/docs/water_pdf/sec3.pdf (Cited June 2013)

Kachenko, A., (2013) Developing a Tree Standard. Presentation at the NGIQ Business Improvement Forum June, 2013.

Standards Australia (2013). Developing Standards. www.standards.org.au/StandardsDevelopment/Developing_Standards/Pages/default.aspx (Cited June 2013)

APPENDIX 1

Standardisation Guides

The policies and processes for the development of Australian Standards and joint Australian/New Zealand Standards are set out in a series of Standardisation Guides as listed below. These guides are revised from time to time as new policies and procedures are introduced.

Preparing Standards (SG-001)

This guide describes, from an Australian perspective, policies and general processes applicable to the development of Australian and joint Australian/New Zealand Standards by Standards Australia.

Structure and Operation of Standardisation Committees (SG-002)

This guide describes, from an Australian perspective, the basic structure of committees and the processes by which committees are set up and maintained. By ensuring committees are fully representational of all affected stakeholders in the Australian and New Zealand communities, Standards retain their widespread acceptance and relevance.

Standards and Other Publications (SG-003)

This guide sets out the range of outcomes from the standardisation process conducted by Standards Australia. It provides details on the purpose and structure of Standards and also describes other publications that either support Standards or are alternatives to the normal Australian Standard. Its purpose is to assist the readers of Standards and other publications in the use and understanding of these documents.

Roles and Responsibilities in Standardisation (SG-004)

Within the standardisation process, individuals and organisations have well defined roles and responsibilities. These have been developed and refined over many years to ensure the objectives of standardisation are met and to maintain the high reputation Australian Standards have in the community. This guide describes the operational roles and responsibilities of all participants, including committee members, nominating organisations and project managers, in the standardisation process used by Standards Australia.

Technical Governance of the Standards Development Process (SG-005)

Currently under review.

Rules for the Structure and Drafting of Australian Standards (SG-006)

This guide specifies rules for the structure and drafting of Australian Standards and joint Australian/New Zealand Standards where the secretariat is held by Standards Australia. The aim of this guide is to ensure that Standards Australia publications are drafted in as uniform a manner as practicable, irrespective of the technical content. This guide is based on but not equivalent to ISO/IEC Directives, Part 2, 2001, Rules for the structure and drafting of International Standards.

Preparation of Standards for Legislative Adoption (SG-009)

Reflects the need for consolidation of their relationship to enhance consistency between the Building Code of Australia and the Australian Standards which it references, and also to reflect the requirements of the community and governments of Australia.

Standards Referenced by Water Utilities (SG-018)
Sets out the criteria to be followed to ensure that the water utilities regulatory, contractual or guidance frameworks are met in the Standards.

APPENDIX 2

There are no current 'turf for erosion control' standards in Australia. A literature search identified one 'standard' that has been developed for turf grass sod in New York, USA (Appendix 3, Page 3.33 *Standard and specifications for stabilization with sod*). This standard, although robust for the purpose, for which it was developed is below the expected detail of a technical standard that would be considered for use as an Australian Standard.

A number of other turf-related (predominantly for the use of turf on sports fields) and erosion-related standards (for products such as silt fences) have been identified (again of varying robustness) that have been issued by different bodies internationally which are designed to place technical parameters around the products and their installation, testing or use.

Turf grass examples

American Society for Testing and Materials (ASTM) is responsible for the development and delivery of international *voluntary* consensus standards. Over 12,000 ASTM standards are used around the world to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence.

Committee F08 on Sports Equipment and Facilities was organized in 1969. The committee meets twice a year, in May and November, with approximately 100 members attending various subcommittee meetings over a four-day period. The Committee has a membership of 600 who participate on one or more of its 25 technical subcommittees. F08 has developed 125 standards that are published in the Annual Book of ASTM Standards (www.astm.org/BOOKSTORE/BOS/). F08's focus continues to be the development and review of standards for sports equipment, surfaces, and facilities to reduce inherent risk of injuries and promote knowledge as it relates to these standards. Examples of the sort of turf related standards the F08 committees develop are:

F2269- *Standard Guide for Maintaining Warm Season Turfgrasses on Athletic Fields*

F2060 - *Guide for Maintaining Cool Season Turfgrasses on Athletic Fields*

F2651 - *Terminology Relating to Soil and Turfgrass Characteristics of Natural Playing Surfaces*

Other standards developed by this organisation relate to the specification, installation and use of erosion control products. Some examples of these are:

ASTM D6462 - 03(2008) *Standard Practice for Silt Fence Installation*
Proper installation is critical to effective performance of silt fence. This practice presents procedures for installing silt fence that have been shown to result in silt fence installations that effectively redirect and impound surface runoff and, thereby, provide effective sediment control.

ASTM D6461 - 99(2007)e2 *Standard Specification for Silt Fence Materials*

This specification covers requirements and test methods for geotextile fabrics and associated components used in temporary silt fence applications. It is applicable to the use of a geotextile as a vertical permeable interceptor designed to remove suspended soil from overland, nonconcentrated water flow.

ASTM D6092 - 97(2008) *Standard Practice for Specifying Standard Sizes of Stone for Erosion Control*
The standard size designations listed in this practice are provided so that the design team, consumer, and the producer have a common reference in sizing stone materials used in erosion control.

ASTM WK7253 - *New Specification for Hydraulically Applied Blended Fiber Mulches*
This specification covers the composition and physical requirements of hydraulically applied blended fiber mulch for the purpose of revegetation, sediment and erosion control.

ASTM *Standards on Erosion and Sediment Control Technology: 3rd Edition (collection of standards)* - Contains 76 ASTM specifications, test methods, practices, and guides for minimizing soil erosion and controlling sediment delivery to lakes, streams, and other receiving water bodies. These standards address erosion and sedimentation processes caused by wind, rain, flowing water, and wave attack. They cover manufactured products and natural materials. Natural materials include soil, rock riprap, and live materials, such as willows and grasses used for erosion and sediment control. Manufactured products include mulches and tackifiers, biodegradable blankets, turf reinforcement mats, sediment retention and filtration devices, gabions, grout-filled mats, geotextiles, and articulating concrete block systems.

Appendix 3 –*Standard and specifications for stabilization with sod, New York, USA*

STANDARD AND SPECIFICATIONS FOR STABILIZATION WITH SOD

Definition

Stabilizing silt producing areas by establishing long term stands of grass with sod.

Purpose

To stabilize the soil; reduce damage from sediment and runoff to downstream areas; enhance natural beauty.

Conditions Where Practice Applies

On exposed soils that have a potential for causing off site environmental damage where a quick vegetative cover is desired. Moisture, either applied or natural, is essential to success.

Design Criteria

1. Sod shall be bluegrass or a bluegrass/red fescue mixture or a perennial ryegrass for average sites. (CAUTION: Perennial ryegrass has limited cold tolerance and may winter kill.) Use turf type cultivars of tall fescue for shady, droughty, or otherwise more critical areas. For variety selection, contact Cornell Cooperative Extension Turf Specialist.

2. Sod shall be machine cut at a uniform soil thickness of 3/4 inch, plus or minus 1/4 inch. Measurement for thickness shall exclude top growth and thatch.

3. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.

4. Sod shall be free of weeds and undesirable coarse weedy grasses. Wild native or pasture grass sod shall not be used unless specified.

5. Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its survival.

6. Sod shall be harvested, delivered, and installed within a period of 36 hours. Sod not transplanted within this period shall be inspected and approved by the contracting officer or his designated representative prior to its installation.

Site Preparation

Fertilizer and lime application rates shall be determined by soil tests. Under unusual circumstances where there is insufficient time for a complete soil test and the contracting officer agrees, fertilizer and lime materials may be applied in amounts shown in subsection 2 below. Slope land such as to provide good surface water drainage. Avoid depressions or pockets.

1. Prior to sodding, the surface shall be smoothed and cleared of all trash, debris, and of all roots, brush, wire, grade stakes and other objects that would interfere with planting, fertilizing or maintenance operations.

2. **The soil should be tested to determine the amounts of amendments needed.** Where the soil is acid or composed of heavy clays, ground limestone shall be spread to raise the pH to 6.5. If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply commercial fertilizer at 20 lbs. of 5-10-10 (or equivalent) and mix into the top 3 inches of soil with the required lime for every 1,000 square feet. Soil should be moist prior to sodding. Arrange for temporary storage of sod to keep it shaded and cool.

Sod Installation

1. For the operation of laying, tamping, and irrigating for any areas, sod shall be completed within eight hours. During periods of excessively high temperature, the soil shall be lightly moistened immediately prior to laying the sod.

2. The first row of sod shall be laid in a straight line with subsequent rows placed parallel to, and tightly wedged against, each other. Lateral joints shall be staggered to promote more uniform growth and strength. Ensure that sod is not stretched or overlapped and that all joints are butted tight in order to prevent voids which would cause air drying of the roots. On sloping areas where erosion may be a problem, sod shall be laid with the long edges parallel to the contour and with staggered joints.

3. Secure the sod by tamping and pegging, or other approved methods. As sodding is completed in any one section, the entire area shall be rolled or tamped to ensure solid contact of roots with the soil surface.

4. Sod shall be watered immediately after rolling or tamping until the underside of the new sod pad and soil surface below the sod are thoroughly wet. Keep sod moist for at least two weeks.

Sod Maintenance

1. In the absence of adequate rainfall, watering shall be performed daily, or as often as deemed necessary by the inspector, during the first week and in sufficient quantities to maintain moist soil to a depth of 4 inches. Watering should be done in the morning. Avoid excessive watering during applications.

2. After the first week, sod shall be watered as necessary to maintain adequate moisture and ensure establishment.

3. The first mowing should not be attempted until sod is firmly rooted. No more than 1/3 of the grass leaf shall be removed by the initial cutting or subsequent cuttings. Grass height shall be maintained between 2 and 3 inches unless otherwise specified. Avoid heavy mowing equipment for several weeks to prevent rutting.

4. If the soil must be fertilized before results of a soil test can be obtained to determine fertilizer needs, apply fertilizer three to four weeks after sodding, at a rate of 1 pound nitrogen/1,000 sq.ft. Use a complete fertilizer with a 2-1-1 ratio.

5. Weed Control: Target herbicides for weeds present. Consult current Cornell Pest Control Recommendations for Commercial Turfgrass Management or consult the local office of Cornell Cooperative Extension.

6. Disease Control: Consult the local office of the Cornell Cooperative Extension.

Additional References

1. Home Lawns, Establishment and Maintenance, CCE Information Bulletin 185, Revised November 1994. Cornell University, Ithaca, NY.

2. Installing a Sod Lawn. CCE Suffolk County, NY. Thomas Kowalsick February 1994, Revised January 1999. www.cce.cornell.edu/counties/suffolk/grownet

APPENDIX 8 - Steering Committee Terms of Reference (TOR)

Erosion and Sediment Control Demonstration Facility

Steering Committee Terms of Reference

Turf Australia
Grow Green

HAL
Horticulture Australia

BioScience Australia Pty. Ltd.

This committee has been formed as part of the requirements for project TU12202 Erosion Control Demonstration and Research Facility. For all enquiries please contact the Project Leader Shane Holborn (BioScience Australia Pty Ltd) on phone: 0403 018 625 or email: admin@bioscienceaustralia.com.

1. Background/Context

The Erosion and Sediment Control Demonstration Facility has been designed to demonstrate the ability of turf to control and minimise soil erosion compared to other measures currently available on the market. The project is funded by the turf levy via Horticulture Australia Ltd (HAL) under the title *Erosion control - turf research and development facility (TU12202)*.

The main outcome of the project (and the overriding focus of the steering committee is to ensure that the anticipated increase in turf sales of 2% (or around $10 million) is achieved within 5 years of the project's completion.

2. Function of the Erosion and Sediment Control Demonstration Facility Steering Committee

The function of the Erosion and Sediment Control Demonstration Facility Steering Committee is to provide strategic advice to HAL and the project team on the project. Any issues concerning the outputs and outcomes of the project will be reported to the Steering Committee.

3. Role of the Erosion Demonstration Facility Steering Committee

The Role of the Erosion and Sediment Control Demonstration Facility Steering Committee is to:

- ensure the project's scope aligns with the requirements of the stakeholder group/s;
- ensure priority areas of effort are appropriate to stakeholder expectations;
- address any issue that has major implications for the project;
- ensure project scope and focus is appropriately maintained as emergent issues may force changes to be considered;
- reconcile differences in opinion and approach between industry members, HAL and the project team and resolve disputes arising from them;
- scrutinise and approve milestone reporting and prior to submission to HAL.

4. Role of individual Steering Committee members

The Role of the individual members of the Erosion and Sediment Control Demonstration Facility Steering Committee includes:

- understand the strategic implications and outcomes of initiatives being pursued through the project;
- understand the significance of the project for all major industry sectors and represent their interests where required;
- be genuinely engaged in the initiative and the outcomes being pursued in the project;
- be an advocate for the project's outcomes;
- have a broad understanding of project management issues and the approach being adopted; and
- be committed to, and actively involved in guiding the project's outputs.

In practice, this means they:

- ensure the requirements of stakeholders are met by the project's outputs;
- help balance conflicting priorities and resources;
- provide guidance to the Project Team and users of the project's outputs;
- consider ideas and issues raised;
- review and objectively assess the progress of the project; and
- check adherence of project activities to standards of best practice, both within the participating research agencies and in a wider context.

5. Membership

The Erosion and Sediment Control Demonstration Facility Steering Committee shall be comprised of:

- Project Leader
- Project Scientist
- Turf Australia Representative x 1 – Industry Manager
- Turf Producers x 3 (from at least two states)
- Erosion Industry Representatives – up to 2 members (to be advised)
- HAL R&D Portfolio Manager

Staff from HAL, the project collaborators, students or members of the industry may be invited to meetings to provide specific information to the committee as requested.

6. Convenor/Chair

The Project Leader shall Chair Erosion and Sediment Control Demonstration Facility Steering Committee meetings.

If the designated Chair is not available, then the Portfolio Manager from HAL will be responsible for convening and conducting that meeting. The Acting Chair is responsible for informing the Chair as to the salient points/decisions raised or agreed to at that meeting.

7. Agenda Items

All Erosion and Sediment Control Demonstration Facility Steering Committee agenda items should be forwarded to the Project Leader by C.O.B. 5 working days prior to the next scheduled meeting.

The Erosion and Sediment Control Demonstration Facility Steering Committee agenda, with attached meeting papers will be distributed at least 3 working days prior to the next scheduled meeting.

The Chair has the right to refuse to list an item on the formal agenda, but members may raise an item under ‘Other Business’ if necessary and as time permits.

8. Minutes & Meeting Papers

The format of the Erosion and Sediment Control Demonstration Facility Steering Committee minutes shall be a true formal written record of the agenda and action items rising from the meeting.

The minutes of each meeting will be prepared by the Project Leader. Full copies of the minutes, including attachments, shall be provided to all Steering Committee members no later than 7 working days following each meeting.

By agreement of the Committee, out-of-session decisions will be deemed acceptable. Where agreed, all out-of-session decisions shall be recorded in the minutes of the next scheduled Steering Committee meeting.

The minutes of each Steering Committee meeting will be monitored and maintained by the HAL as a complete record as required under provisions of the *Archives Act 1983*.

9. Frequency of Meetings

The Erosion and Sediment Control Demonstration Facility Steering Committee shall meet a total of six times during the course of the project of which at least one should be a face-to-face meeting. These meeting will be conducted as per to the following schedule:

February 2013

April 2013

June 2013

August 2013

November 2013

February 2014

The Steering Committee may also agree to conduct out-of-session discussions or consider decisions via email for expediency or as required.

10. Quorum Requirements

A minimum of four of Erosion and Sediment Control Demonstration Facility Steering Committee members is required for the meeting to be recognised as an authorised meeting for the recommendations or resolutions to be valid.

The quorum must contain at least 2 member(s) from the industry (producers of Turf Australia), 1 member from the project team, and 1 member from Horticulture Australia.

11. Dispute Resolution

In the event of a dispute in relation to the project or its activities the project contract will be the original point of reference for resolution any issues that may arise.

12. Correspondence

All official correspondence in relation to the Erosion and Sediment Control Demonstration Facility Steering Committee of the project should be forwarded via the committee chair:

Shane Holborn (Project Leader)
BioScience Australia Pty Ltd
PO BOX 2590, Wellington point, Q 4160
Phone: 0403 018 625
Email: admin@bioscienceaustralia.com
Web: www.bioscienceaustralia.com

APPENDIX 9 - ITRC paper imprint

International Turfgrass Society Research Journal
Volume 12, 2013

TURF FOR EROSION AND SEDIMENT CONTROL – CONSTRUCTION OF AN AUSTRALIAN NATIONAL DEMONSTRATION FACILITY

Shane Holborn* and William Pearce

ABSTRACT

Turfgrass has been found to be an effective measure for the control of soil erosion and also for the capture of sediment. Previous research quantifying the capability of turfgrass for this purpose was undertaken and communicated, but did not lead to a substantial increase in market share for erosion control by turfgrass in Australia. The Australian turfgrass production industry has therefore invested substantial resources into the design, construction and operation of a new national Erosion and Sediment Control Demonstration Facility at Cleveland, Queensland, as a technical extension tool. The facility has been designed to demonstrate turf as an erosion control and sediment capture measure compared to other products available on the market including silt fencing, silt socks, coir logs and hydro-seeding. This is the only such facility in Australia and has been met with substantial enthusiasm by the turf and erosion industries as well as local and state government representatives. The construction of this facility presented a number of challenges (described in this paper), and is now becoming a critical extension tool for the turfgrass industry to build the erosion control market share for natural turf.

INTRODUCTION

Turfgrass as an erosion control measure has been found to be effective by a number of studies in Australia and internationally. These include examinations of the effect of vegetative or turfgrass coverage on soil loss in production properties (Martin and Aragao, 1996), in natural areas (Beard and Green, 1994), and forestry plantations (Sheridan et al., 1999) as well as in urban areas such as construction sites (Petrovic and Eastern, 2005, Higginson and McMaugh, 2007; Loch et al., 2010). Australian turfgrass producers through Horticulture Australia Limited (HAL) have funded a number of research projects and development activities aimed at identifying and quantifying the efficacy of turfgrass and also to identify market opportunities available in this area for turfgrass in Australia.

The first specific examination of turfgrass for this purpose in Australia was conducted by Higginson and McMaugh (2007), who reviewed the literature to compare turfgrass coverage to other land use coverage and also against other erosion control measures. Their study identified potential market opportunities for turfgrass in the erosion and sediment control area. They concluded that the major opportunities for turfgrass were that it would be ideally suited to four main applications: as vegetative buffer strips, on cut and fill batters, in drains, and as a vegetative ground cover within the general landscaping of completed construction sites. The final recommendation from the Higginson and McMaugh (2007) study was that these four areas all warranted further consideration and investigation by the turf industry to quantify the performance turfgrasses in that context and to use those data to realise the market potential for their turf products.

These recommendations led the industry to commission a study by LandLoch Pty Ltd which tested and measured performance of turfgrasses against a number of parameters which fundamentally gauged their ability to slow overland flow effectively, to trap sediment; and to resist detachment of sod from large flows of water (Loch et al., 2010). Specifically, this study examined four main areas:

1. Hydraulic roughness of different turfgrass types;
2. Measurement of the sediment trapping capability of turfgrass;
3. Assessment of the ability of higher flows to tunnel under turf sod of differing establishment age; and
4. Rates of root development, including seasonal effects on root development.

In all of these measured areas, turfgrass met or exceeded acceptable levels of performance under given conditions. For example, after an establishment period of eight days no “tunneling” was evident under sod that had been exposed to relatively high overland flows (i.e. 0.2 L/second for 1 hour, and then 5 L/second) on a variety of soil types. Similarly, the ability of turfgrasses to capture sediment was evident from the study for particle sizes >0.05 mm, and turf was also capable of causing some reduction in the loss of smaller particles in the 0.02-0.05 mm range (Loch et al., 2010).

These results and their potential application across the erosion and sediment control industry identified a substantial market opportunity. The report by Loch et al. (2010) acted as a catalyst for the industry to communicate the performance of turf in a number of ways, one of which is to demonstrate physically the performance of turfgrass in reducing soil loss by constructing a dedicated national Erosion and Sediment Control Demonstration Facility. This facility is now being utilised as a demonstration and training tool, and is currently the only facility of this kind in Australia.

FACILITY CONSTRUCTION

The facility is situated over an area of approximately 1 hectare situated at Redlands Research Station (RRS) (27º32'S

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Abbreviations: HAL, Horticulture Australia Limited; QLD, Queensland; RRS, Redlands Research Station; v-h, vertical:horizontal

Keywords: Australia, erosion, turfgrass

lat, 153º15'E long, 40 masl), Cleveland, QLD, Australia. Construction of the facility began in September 2011, with the facility fully functional for the first demonstration event hosted in May 2012.

The facility is situated on yellow Kurasol (podsolic) soil (Isbell, 2002) with a shallow A horizon overlying a mottled clay B horizon. The top soil layer in the erosion bays is very dispersive, erodes easily, and has poor internal drainage.

The facility consists of six erosion demonstration bays and one demonstration channel (see Figure 1). The erosion demonstration bays are each 12 m long and 3 m wide allowing 1 m for run-on water from an outlet trough at the top section of the bay which provides even distribution of water flow across the bay and a 1 m long catchment trough at the end of each bay. It was critically important that plots were level from side to side and that soil should be mounded up along the bay walls so that flow does not concentrate against the plot borders. (Routine maintenance is conducted to return each plot to a satisfactory level prior to each new demonstration date.) Each bay is approximately 10 cm deep and run lengthways down the slope so that, as much as possible, water flows in a sheet manner across the site. Rubber belting was installed as the border to each bay to keep plots separated from the surrounding turfgrass and to maintain preferential water flow within the bay. Between each bay is a 2 m area of turfgrass allowing a 'walk-between' area for maintenance, but more so for observational purposes during demonstration days.

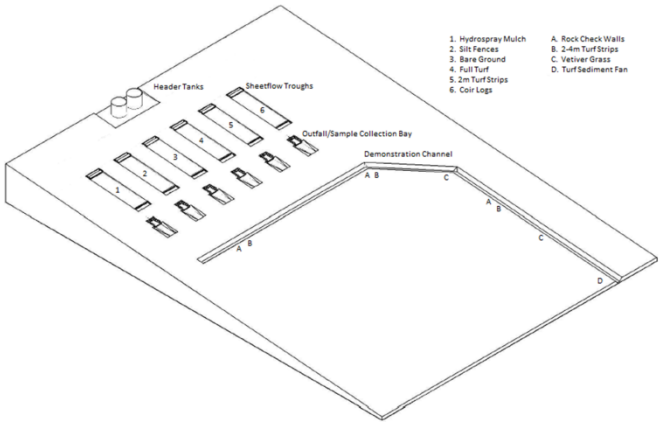

Figure 1. Plan of erosion bays and channel including water tanks collection trough and outfall bays.

The main water supply is located in 2 x 10,000 L polyethylene water tanks situated at the top of the site. The flow discharges into fabricated concrete outfall troughs (see Figure 2) at a higher gradient than the plot surface, and then runs down as a 'sheet' of water simulating overland flow.

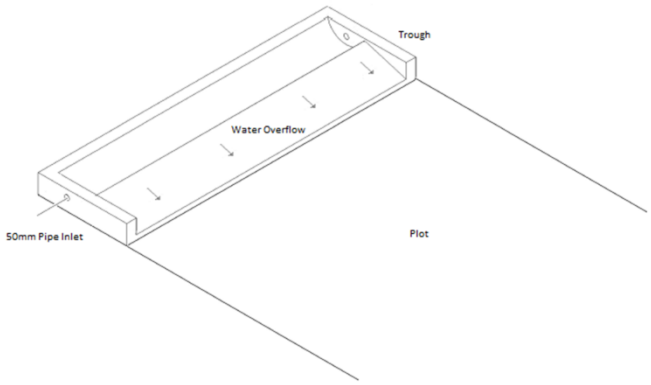

Figure 2. Fabricated concrete outfall troughs installed at the top of each bay.

Water is run onto each plot at similar rate (2 L/second) simulating the kind of run-off that would be expected in approximately 200-240 mm rainfall events, which are not uncommon in tropical and subtropical Australia. All water is gravity fed onto the site with the flow rate regulated by two inline electronic water meters between the water storage tanks and the outfall toughs. On average, each bay is run for 10 minutes to allow water to traverse the bay and then allow sufficient time to collect three samples of run-off water and eroded material at 1 minute intervals.

The bays are designed to be interchangeable and to demonstrate a number of erosion and/or sediment control measures. To date, each demonstration has included bays of full turf, bare earth, 2m strips of turf, coir logs (of various sizes), hydro-seeded material (Hydro Spray Grass, Alderley, Australia), and either silt fencing or silt bags (of various types). It is likely that, within the next 12 months, a variety of geotextiles or geofabrics, reinforced turf products and other measures will also be installed and demonstrated at various events.

Prior to each event, the material installed on each bay is removed; the bay is then rotary cultivated, raked flat, and the each measure reinstalled so that comparisons for demonstration purposes may be made more confidently. This includes the turf (which is replaced) as well as the hydro-seeded material. Exceptions have been made due to poor weather conditions as well as during the Australian spring and early summer to observe establishment of the hydro-seeded grass (i.e. different seed germination rates, percentage coverage, weed competition, breakdown of mulch material and binding agent).

The channel is designed to simulate larger volumes of water with a concentrated faster flow, and snakes down the natural slope of the site over a 90 m length. The trapezoidal shaped channel 500 mm wide in the base and 1500 mm across the top opening with 1:1 v-h (vertical:horizontal) sides at a 0.25% slope (see Figure 3). The channel runs along the contour of the slope for 35 m at a slight (<1%) slope, and then turns across the contour at a 3-4% slope before running the final 35 m down the natural site slope (8%).

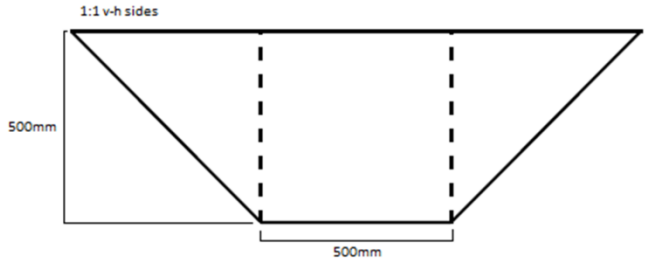

Figure 3. Channel design and dimensions.

The channel was excavated smooth, and erosive material (loose sandy loam) is added prior to each demonstration. Erosion control measures have, to date, been permanently installed in the channel with three sections of turf installations of 3 m length used in combination with rock-check walls before each strip. The channel also contains plantings of vetiver grass (*Vetiveria zizanioides* (L.) Nash) in each of the moderate and high flow areas. The channel opens onto an outfall area where turf is also installed to allow diffusion of the flow, settlement, capture of the larger entrained sediment and infiltration of the remaining silt.

Water is run onto the channel at 15 L/second regulated by an inline electronic water meter. The channel is run for 15 minutes while observers walk its length following the moving water front to observe concentrated flows of water through common control measures. Once the water is turned off, participants walk the length again to observe sediment settlement patterns before and after the rock check walls, sediment captured with the turfgrass and any rilling, scouring, or other observable phenomena of interest.

PRELIMINARY OBSERVATIONS AND CONCLUSIONS

The Erosion and Sediment Control Demonstration Facility has been well received by the turf production industry and attendees. Although it has been operational for less than a year, some preliminary observations can already be made. To date (Feb 2013), 16 demonstration events have been hosted with just over 250 participants from the building, road construction and mining industries, as well as local, state and federal government representatives ranging from cabinet ministers to senior bureaucrats and hands-on council practitioners. From these participants, the most common questions do not relate to the efficacy of the materials used (which are well illustrated by the demonstrations), but revolve around concerns as to the 'best' turfgrass to use and its up-front and on-going costs.

The site surrounds are installed with a 'premium' green couch/bermudagrass (*Cynodon dactylon* (L.) Pers.) variety (Oz Tuff™) which is well maintained to ensure that the site surrounds are presentable and can handle the wear and tear from intensive foot and vehicular traffic. The appearance of this area reinforces particpants' perceptions as to how well-maintained turf should appear. Although Loch et al. (2010) found minor but significant differences across some of the measured parameters between the tested varieties, the underling similarities revealed in their study (i.e. that all of the tested cultivars were effective) has underpinned the decision not to focus on the turf type used in sediment and erosion control in discussions of the site and during demonstration days. Similarly, specialised turf reinforcing products have been developed and marketed for this purpose (e.g. Coughlan et al., 2007), but again have been avoided to reinforce the basic message: natural turf works and is financially competitive against other options.

The turf type actually used for erosion control purposes has varied (according to local availability), but is usually the lowest priced turf available at the time. This is mostly a 'generic' *C. dactylon*: 'Wintergreen' (which can vary considerably in appearance from different growers – Loch, 2008) or 'Hatfield'. This provides an important point of illustration during the discussions at demonstration events by highlighting that 'turf' in the broad generic sense (i.e. all turfgrasses) is an effective erosion and sediment control measure and also provides a more favorable cost comparison with other measures.

Another issue that generates some discussion is the differentiation between functional or environmental turfgrass and aesthetic turfgrass. This mind set is apparent among both turf producers and event participants, and is a limiting factor on the use of turf for erosion and sediment control purposes. Turf establishment and maintenance and the expectation that inputs into that process will be very high initially and a significant ongoing cost thereafter represent a significant barrier to the wider adoption of turfgrass by the erosion and sediment control market. Most perceptions of turfgrass relate to lawns, parks and golf courses and the functional or environmental role that turfgrass plays appears to be taken for granted by many of the participants. Similarly, the ability of turfgrass to survive prolonged periods of stress such as drought or wear (albeit with temporarily reduced aesthetic appearance) is also not properly acknowledged among participants.

Although the value of the Australian turf industry is not well documented with estimates of annual turnover ranging from A$188.4 million to A$235.7 million (Horticulture Australia Limited, 2012), the project proposal predicted a (relatively moderate) market increase of 2% nationally or approximately A$10 million dollars within 5 years of the project's completion. For this to be achieved, the facility and the demonstration events must necessarily focus on effecting a paradigm shift whereby the natural resilience of turfgrass and its ability to function in ways beyond the aesthetic are more widely recognised.

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