FACILITY FOR ADVANCING WATER BIOFILTRATION, FAWB

ANNUAL REPORT 2005-2006

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WHAT IS WATER BIOFILTRATION?

Water biofiltration is the process of improving water (stormwater and wastewater) quality through the processes of filtration through biologically influenced media.

Stormwater biofiltration systems include:

- Bioretention systems
- Constructed surface-flow wetlands
- Constructed sub-surface-flow wetlands

The application of water biofiltration technologies to mitigate the impacts of catchment development on the health of urban waterways is becoming widespread - even though the technology is continually evolving both in its effectiveness and efficacy in water cleansing, and in its implementation in the urban landscape at a range of scales.

There have been a number of successful applications, but also as many poor outcomes owing to inappropriate utilisation of the technology, poor construction, operation and maintenance practices. There has also been insufficient understanding and dissemination of guidance borne out of successful applications, and research and development.

When used appropriately, biofiltration systems have been found to be viable and sustainable as a water treatment measure. Biofiltration systems also add to the quality of the landscape through the integration of these vegetated systems.

Hampton Park Wetland
(Melbourne Water)

Lynbrook Estate Wetland
(VicUrban)

All Nations Park Wetland
(City of Darebin)

NAB Building Forecourt Wetland

Blacken Ridge Bioretention Basin
(Brisbane City Council)

Baltusrol Estate
(Australand)

Victoria Park
(Landcom)

Cremorne Street
(City of Yarra)

Melbourne Docklands
(Lend Lease)

Baltusrol Estate
(Australand)

Bourke Street Tree Planters
(Lend Lease)

Building Bioretention Planters
(Portland, Oregon, USA)

BACKGROUND, MISSION AND MAIN AIMS

Background

The Facility for Advancing Water Biofiltration, FAWB, is an unincorporated joint venture between Ecological Engineering and Monash University, and was formed in mid-2005 following a successful application in the Victorian State Government's Strategic Innovation Initiative.

The following industry collaborators are also involved:

- Manningham City Council (Vic)
- Melbourne Water (Vic)
- Vic Roads (Vic)
- Landcom (NSW)
- Brisbane City Council (Qld)
- Adelaide and Mount Lofty Ranges Natural Resources Management Board (succeeding The Torrens and Patawalonga Catchment Water Management Boards) (SA)
- Auckland Regional Council (NZ) (to 30 June 2006)

FAWB is primarily funded through the Victorian State Government's Science, Technology and Innovation (STI) grant ($1.46 million), industry cash contributions ($0.5 million) and a direct cash contribution from Monash University ($0.35 million). The total value of the activities within FAWB, including both cash and in-kind contributions, is $4.3 million over three years.

As part of the STI Grant Application, FAWB developed a comprehensive Business Plan. This plan incorporates detailed research and marketing plans, with the opportunity to update the Plan on an annual basis.

Mission

The mission of the Facility for Advancing Water Biofiltration, FAWB, is to provide proof of concept, by developing and field-testing a range of biofilter systems that can be applied to specific market-based needs, and to facilitate industry-wide adoption and implementation of the technology through effective industry engagement and delivering industry capacity guidance and other adoption tools.

Main Aims

The main aims of FAWB are to:

- Provide scientific "proof of concept" for the application of stormwater biofilter technologies
- Facilitate industry-wide adoption and implementation of the technology

The specific outcomes of FAWB's work will be innovative stormwater biofilter technologies underpinned by:

- New scientific knowledge about the key physical, chemical, and biological performances which underpin the effectiveness of stormwater biofilters
- Design specifications for biofilters that form the basis for written technical design, construction and maintenance guidelines to accompany legislation/regulation
- Algorithms that assist the design of biofilters for a wide range of applications
- Prototypes of modular units for specific applications (e.g. devices for stormwater treatment and re-use at the level of an individual household or a single commercial site)

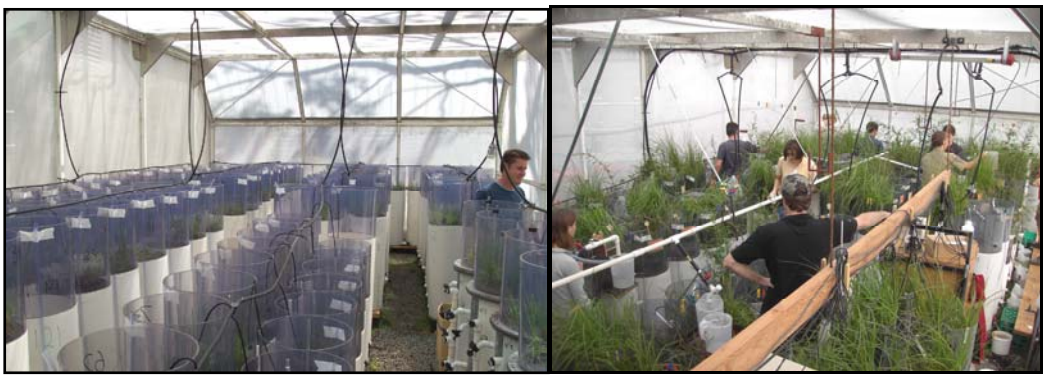
PROJECT HIGHLIGHTS

Laboratory Experiments - Optimising & demonstrating biofiltration technology

Laboratory studies of bioretention systems are being undertaken to determine the optimum design configuration (vegetation, media, outlet specifications) and operating conditions for achieving long-term, sustainable pollutant removal. The laboratory experiments involve 800 experimental-scale bioretention columns, which are being subjected to a range of test conditions.

Project 1: Technology

- The laboratory testing of the pollutant removal performance of 20 different plant species has been completed. All laboratory data have been collected, and are currently being analyzed. Preliminary results indicate that some species are more efficient at removing nutrients than others;
- A laboratory study of the performance of non-vegetated soil-based filter media has been completed. Non-vegetated soil media is highly efficient in terms of metals removal, but was shown to be a potential source, rather than sink, of nutrients. The importance of vegetation, as well as the influence of wetting and drying cycles on pollutant removal has been demonstrated; and
- A large laboratory set-up was established to optimise biofilter design. It consists of 140 standard and 18 advanced columns, representing different biofilter designs (with five replicates of each design). Regular dosing of the columns and monitoring of their treatment performance has commenced. Preliminary results are showing a high removal rate for all key stormwater pollutants, including 50% removal of total nitrogen.



Experimental-scale bioretention columns established to study pollutant removal performance of 20 different plant species.

Mapping Industry Capacity for WSUD

FAWB's research aims to assess the institutional factors that influence the opportunities and constraints within organisations for the implementation of Water Sensitive Urban Design (WSUD) technologies, of which biofilters are one.

The strength and relative importance of the relationships and inter-linkages between these factors differ between organisational types. These factors are investigated and mapped for industry sectors to determine the current institutional capacity trends for WSUD technologies.

Project 2: Policy and Risk

- A study of adoption of Water Sensitive Urban Design (WSUD) in Victoria has been completed and a draft report, Transition to Water Sensitive Urban Design: the Story of Melbourne, has been produced; and
- An on-line questionnaire has been designed and piloted to test the barriers and drivers for more sustainable urban water management

Building Industry Capacity for Biofilters: Adoption of Technologies

A central aim of FAWB is to promote the widespread adoption of biofilter technologies. Australia is in the early stages of a transition away from the traditional water servicing approach and towards more sustainable urban water management.

For this transition to become stable, with technologies such as biofilters being adopted as mainstream practice, industry capacity needs to be improved.

Project 3: Adoption Tools

- The project plan has been developed in consultation with Stakeholders. This project is scheduled to begin in 2007.

FAWB aims to build industry capacity for biofilter technologies by delivering a number of products and services to industry:

Modelling Tools

- Algorithms for improved prediction of the performance of biofilters including bioretention systems and constructed wetlands
- Implementation of enhanced algorithms in MUSIC

Technical Guidelines

- Design recommendations for multi-functional biofilter systems
- Design and construction guidelines for biofilter systems

Demonstration and Testing

- Building demonstration systems and showcasing applications
- Providing testing and certification facilities and advisory expertise to enable further WSUD technology developments by industry

Education/Capacity Building

- Training courses and seminars for industry and agencies
- Technical tours of demonstration sites
- Undergraduate and postgraduate teaching
- Presence in technical and scientific forums

Project 8: Commercialisation

- The substantial involvement and commitment of FAWB and its key staff to the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, Melbourne, Australia, 2-7 April 2006, has been a pivotal step in awareness raising of biofiltration technologies. This is seen as a strategic initiative in building industry networks across government and commercial enterprises as part of FAWB's initial commercialisation planning.
- Education and training proposals have been developed including Board endorsed courses on: 'Design of bioretention and wetland system's, and 'Water sensitive urban design (WSUD) for landscape architects'
- Postgraduates - Five postgraduates worked on PhD studies associated with FAWB and its staff.
- Involvement of postgraduates in conferences – Two postgraduates participated in the 10th International Conference on Urban Drainage. Copenhagen, Denmark, 21-26 August 2005. with two being lead authors for conference papers. Postgraduates also presented papers at the 7th Urban Drainage Modelling and 4th Water Sensitive Urban Design International Conference held in Melbourne in early April 2006.

Field Trials- Optimising & demonstrating biofiltration technology

A key aim of FAWB's research is to develop biofiltration technologies that provide effective and sustainable treatment of stormwater. Bioretention systems are a form of biofilter that are becoming widely used owing to their efficiency and adaptability to urban landscape design.

FAWB is using a combination of laboratory experiments and field trials of bioretention systems to test the influence of design configurations and operating conditions, and to demonstrate their full-scale applications. The field trials are being documented to provide guidance on construction, operation and maintenance of biofiltration systems, and for achieving long-term performance and sustainability.

Project 4: Demonstration and Testing

- A bioretention system was built in Second Pond Creeks, and important lessons learned on the implementation of biofilters in Western Sydney. A laboratory study is underway to investigate the environmental impacts and performance of biofilters built in saline soils in that region.
- The construction of the Monash University Car Park bioretention system has been completed. This system is equipped with monitoring instruments to enable field-based testing of different biofilter media and additives that may improve pollutant removal efficiency.

Construction of Monash University Car Park Biofilter

STRUCTURE AND MANAGEMENT

The Facility for Advancing Water Biofiltration, FAWB, a joint venture research facility between Ecological Engineering Holdings Pty Ltd and Monash University under the auspices of the Victorian Government's Science Technology and Innovation Initiative, operates in cooperation with industry collaborators and stakeholders.

FAWB commenced in July 2005 under the Grant Agreement between the State of Victoria and Monash University, the Joint Venture Agreement between Monash University and Ecological Engineering Holdings Pty Ltd, and Collaboration Agreements between Monash University and each of the following industry collaborators.

Industry Collaborators
Adelaide and Mount Lofty Ranges Natural Resources Management Board, SA
Auckland Regional Council, New Zealand (to 30 June 2006)
Brisbane City Council, Qld
Landcom, NSW
Manningham City Council, Vic
Melbourne Water Corporation, Vic
VicRoads, Vic

Organisation Structure

Board of Management

Independent Chairperson
Prof Russell Mein

Collaborator Representatives
Mr Claude Cullino, Manningham City Council, Collaborator Representative
(Alternate, Mr Graham Rooney, Melbourne Water)
Ms Armineh Mardirossian, Landcom – NSW, Collaborator Representative
(Alternate, Ms Marianne Robertson, VicRoads)

Ecological Engineering Representatives
Dr Peter Breen
Mr Malcolm Eadie

Monash University Representatives
Dr Tim Fletcher
Prof Bill Young

Board Meetings

FAWB Board Meetings for 2005-2006 were held on:

16 September 2005
24 November 2005
21 February 2006
25 May 2006

FAWB Management

Chief Executive Officer
Dr Tony Wong, Ecological Engineering

Research Manager
Dr Ana Deletic, Monash University

Project Leaders
Dr Rebekah Brown, Monash University (Project 2)
Dr Ana Deletic, Monash University (Project 3)
Dr Tim Fletcher, Monash University (Project 1)
Mr Justin Lewis, Monash University (Project 4)

Business Manager
Mr John Molloy, Monash University

Research Program - Projects

Project 1: Technology
Project 2: Policy and Risk
Project 3: Adoption Tools
Project 4: Demonstration and Testing

Research Advisory Panel

A FAWB Research Advisory Panel was formed under the arrangements in the FAWB Joint Venture Agreement, the purpose of the Panel being to provide independent peer review and to advise the FAWB Board (through the Research Manager) on the scientific merit and rigour of the research program.

Panel members for 2005-2006 included:

- Dr Simon Beecham (University of Technology, Sydney)
- Professor John Argue (University of South Australia)
- Mr Earl Shaver (Auckland Regional Council).

The appointment of possible other members of the Research Advisory Panel including an overseas panel member, was considered by the FAWB Board of Management at its September 2005 meeting. As noted by the Board, the composition of the Panel may need to change to match the particular aspects of research being conducted over the next three years.

Further membership proposals for the Panel are to be developed.

No meetings of the Research Advisory Panel was held in the 2005/06 period. A two-day research review of the research activities of FAWB by the Panel was scheduled for 25th and 26th September 2006 (and held on those dates).

Stakeholders Committee

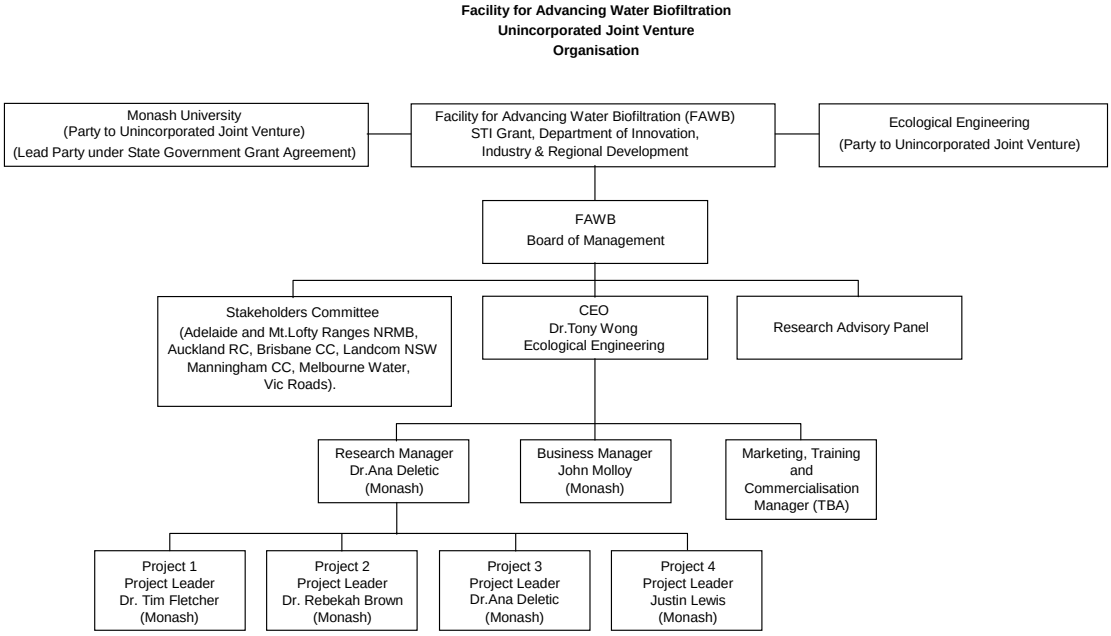
The FAWB Joint Venture Agreement provides for, as a central item, a Stakeholders Committee. The Stakeholders Committee advises the Board of Management (through the CEO) on Collaborator and end-user perspectives of the FAWB research program.

Stakeholder /Collaborator Representatives for 2005-2006 were:

- Mr Claude Cullino, Manningham City Council (Alternate Mr Chris Sfetkidis)
- Mr Keith Downard, Adelaide and Mount Lofty Ranges Natural Resources Management Board
- Ms Armineh Mardirossian, Landcom - NSW (Alternate, Mr Stuart McCowan)
- Ms Marianne Robertson, Vic Roads
- Mr Graham Rooney, Melbourne Water
- Mr Earl Shaver, Auckland Regional Council (Alternate Mr Geoffrey Hunter)
- Ms Anne Simi, Brisbane City Council (succeeded by Mr Stuart Hovermann)

Meetings of the Stakeholders Committee were held on:
4 August 2005
10 March 2006

FAWB Governance Structure



FAWB Office

The FAWB Office is located at:
Monash University, Department of Civil Engineering
Building 60, Clayton Campus
MONASH UNIVERSITY, VIC 3800, Australia
phone +61 3 9905 4957
fax +61 3 9905 5033
fawb@eng.monash.edu.au

COOPERATIVE LINKAGES

Local links

Participants and Collaborators
FAWB linkages between its Joint Venture Participants, Ecological Engineering and Monash University, were strengthened during the year.

All Collaborators:

- Adelaide and Mount Lofty Ranges Natural Resources Management Board, SA
- Auckland Regional Council, New Zealand (to 30 June 2006)
- Brisbane City Council, Qld
- Landcom, NSW
- Manningham City Council, Vic
- Melbourne Water Corporation, Vic
- VicRoads, Vic

completed FAWB Collaboration Agreements with Monash. The Auckland Regional Council (New Zealand) agreement applies to 30 June 2006.

FAWB linkages with stakeholders continue to be fostered. The major Australian urban water management agencies, Brisbane City Council and Melbourne Water continue to be key participants. Significant linkages and interaction with Landcom–NSW have been established and maintained, including a major demonstration site at Second Ponds Creek being provided by Landcom.

Joint activity - Research Planning Workshop
A one-day research-planning workshop was held on 16 December 2006. This workshop provided the forum for all four projects of the research program to be discussed amongst the R&D participants, to plan activities for the year ahead and to facilitate integration of these activities across the program.

FAWB team at Research Planning Workshop

International links

Collaboration with Lulea University of Technology (Lulea, Sweden)
Dr Ana Deletic visited Lulea in January 2006 (a condition of the Monash/Lulea grant awarded for work with FAWB).

Researchers from Lulea University visited Monash for discussions prior to their participation in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006, held in Melbourne. Conference participants from Lulea included: Godecke Blecken, Prof Maria Viklander and Ms K Karisson..

The Lulea collaborators refined with FAWB researchers the details of the planned joint laboratory work on the influence of temperature on biofilter activites. It is proposed that Godecke Blecken and FAWB postgraduate Yaron Zinger will work on these aspects when Yaron visits Lulea in 2006-2007.

Collaboration with INSA de Lyon (Lyon France)
FAWB is collaborating with this prestigious French research institution, the Institute National des Sciences Appliquées (INSA), on clogging of biofilters.

In particular Mr Sébastien Le Coustumer, of INSA in Lyon, arrived to spend one year of his PhD at Monash. He is examining the performance of infiltration and biofiltration systems, and particularly looking at the potential for vegetation to reduce or prevent clogging of the filter media. His work will therefore contribute significantly to FAWB.

Researchers from INSA Lyon visited Melbourne for discussions with FAWB and participation in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006. INSA Lyon participants included: Dr Sylvie Barraud, and Assoc. Prof Jean-Luc Bertrand-Krajewski (chair of the Joint Committee on Urban Drainage).

University of Belgrade, Serbia and Monte Negro
Dr Ana Deletic gave a lecture on 12 January 2006 at the University of Belgrade on Biofilters and FAWB. The lecture was attended by a large number of people from Serbian industry and academia. Since Serbian towns and cities are under reconstruction, the lecture generated lots of interest.

Dr Deletic renewed links with industry colleagues and researchers at the University of Belgrade during her visit.

UK delegation
A delegation from the House of Lords in the UK has visited Monash's Clayton campus and Ecological Engineering's office in late January 2006 as part of an Australian fact-finding trip to investigate the future management of water in the UK. In addition, members from FAWB accompanied the delegation to a number of field inspections of stormwater quality treatment facilities.

In particular, the group wanted to learn how integrated urban water management has transformed the way in which the Australian water industry develops solutions for the future which are economically, socially and environmentally acceptable. Led by Lord Selborne, the delegation was conducted on its trip by Prof Richard Ashley, Professor of Urban Water, Sheffield University.

Prof Ashley was also a participant in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006, in Melbourne.

RESEARCH

Project 1: Technology

Project Aim

To overcome technical barriers to wide adoption of biofiltration technologies, in particular to:

- develop new biofilter designs to facilitate long-term sustainability:
- develop biofilter designs to achieve multi-functionality:

Project Leader

Dr Tim Fletcher, Monash University

Project Output

Laboratory studies of bioretention systems are being undertaken to determine the optimum design configuration (vegetation, media, outlet specifications) and operating conditions for achieving long-term, sustainable pollutant removal. The laboratory experiments involve 800 experimental-scale bioretention columns, which are being subjected to a range of test conditions.

Choosing the best plant species to accommodate the wetting and drying pattern in a bioretention system is a pivotal issue. We also need to know which species will support the best long-term removal of pollutants.

We are testing 20 different species (including grasses, sedges, reeds, shrubs and trees) to find out, by dosing vegetated bioretention "columns" with stormwater, and measuring the growth rate and pollutant uptake of each species. We are also measuring the pollutant concentration in the filter media, and the stormwater effluent

Project 1 will be closely integrated with all other projects. For example, it will contribute technical issues of risk to the analysis of risk perception in Project 2 (Policy and Risk). The Design Tools developed in Project 3 will rely on the data collection, analysis and algorithm development undertaken in Project 1, whilst Project 4 (Demonstration and Testing) will build on the findings from this Project, to determine what configurations are to be demonstrated and tested at field scale.

Project highlights 2005-2006

A large part of the laboratory work within Activity 1.01 (Vegetation Trials) has been completed.

Activity 1.02 (Laboratory biofilter column experiments) is progressing well, with some strategic decisions being made to postpone stormwater application (to the lab columns) till May / June (mainly to allow enough time for plants to develop adequate root mass).

Two conference papers were presented at the 7th International Conference on Urban Drainage Modelling and 4th International Conference on Water Sensitive Urban Design held in Melbourne in early April 2006. (Postgraduates Belinda Hatt and Nilmini Siriwardene presented the highly regarded papers.)

Activity 1.01 Vegetation trials

Aim
To undertake pot trials to:

- measure growth rates under controlled watering regimes
- measure nutrient uptake

with harvesting and assays (plant and soil) to determine mass balance .

Achievements 2005-2006
The first 'phase' of the vegetation trials has been successfully completed. The first half of the plants were dosed with stormwater during a one-month period (April), and have now been harvested, for analysis.

Chemical analysis of the plants and soil is being undertaken, whilst the stormwater effluent collected is also being analysed, for a range of nutrients, metals, hydrocarbons, etc. Plant biomass is also being measured.

The remaining plants will be 'grown on', where they will be dosed and then harvested during winter. This will elucidate any seasonal effects.

Activity 1.02 Laboratory biofilter column experiments

Aim
To develop a standard experimental system for biofilter columns and:

- undertake basic mechanistic experiments - mass balance
- quantify variation in performance with different design elements
- test major design variations

Achievements 2005-2006
All basic and advanced columns were constructed and planted; they are awaiting the commencement of testing.

All the advanced columns are fully established and ready for pre-treatment phase. Saturated hydraulic conductivity tests have completed. Temperature logging equipment has been arranged to conduct tracer tests to determine detention time and water front behavior (e.g. macrospores flow due to the installed sampling pipes). Experiment soon due to start: optimization of submerged anoxic zone level in the biofilter.

A series of wetting and drying experiments currently being conducted, to assess the influence on (a) pollutant removal and (b) hydraulic conductivity. The results so far are inconclusive, showing great variability in response to wetting and drying.

Good progress continues in the PhD projects associated with this activity.

Preparation of bioretention experimental columns

Project 2: Policy and Risks

Project Aim

To develop a methodology and strategy to overcome institutional and social barriers to the widespread adoption of biofiltration technologies. In particular, Project 2 aims to:

- develop regulatory, policy and strategic guidance
- define risk perception, liability and opportunities

Project Leader

Dr Rebekah Brown, Monash University

Project Output

This research contributes to the broader aim of advancing the effective design and implementation of water biofiltration technologies by concentrating on the institutional dimension.

Biofilter technologies are advocated in key policy documents, such as *Melbourne 2030,* and are important to the range of actions needed to enable more sustainable futures. Yet wide-scale implementation of this technology remains limited to ad-hoc demonstration projects, reinforcing biofiltration as an afterthought in urban planning practices rather than integral to the design of more sustainable urban places.

In addition to a number of technical knowledge limitations to advancing widespread practice, there are significant institutional knowledge gaps. These relate to the design and administration of enabling policy and regulatory frameworks and addressing risk perception related to issues such as liability and developing new organisational capacities.

This research project will focus on these institutional knowledge gaps.

Project highlights 2005-2006

Break-through research on mapping Water Sensitive Urban Design (WSUD) development in Melbourne was undertaken by the project team.

Based on the theory of socio-technical transitions, key factors that have underpinned the WSUD transition across Melbourne were identified. The results provide a solid basis for framing a policy development pathway for completing the transition to the widespread practice of WSUD across Victoria, and therefore the widespread adoption of biofilters.

A report, *Transition to Water Sensitive Urban Design: The Story of Melbourne*, has been drafted and will be published in the very near future.

Activity 2.01 – Policy (Regulatory, policy and strategic guidance)

Aim
To undertake a comprehensive review of current Victorian legislative and policy drivers for improving urban stormwater quality, building on work already carried out by FAWB partner organisations.

Achievements 2005-2006
Preparation of a draft report: *Transition to Water Sensitive Urban Design: The Story of Melbourne.*

In the analysis to date, we have applied the theory of socio-technical transitions to understand the nature of the WSUD transition that has taken place, so far, in Melbourne. We have collected and synthesised multiple sources of evidence from the mid 1960s, including: 1) recording oral histories from 28 expert interviewees across multiple sectors, 2) facilitating one scientist-based focus group, and 3) facilitating two industry focus groups.

<u>Validation and finalisation of the WSUD transitions report.</u>
Key informants across Melbourne, representing government, consultants, land developers and academia are currently participating in a review and critique of the findings of the draft case study report (described above).

Activity 2.02 - Risk (Risk perception, liability and opportunities)

Aim
To identify and categorise current industry and community perceptions of potential risks connected with the incorporation of biofilter technologies into public and private infrastructure.

Achievements 2005-2006
Planning for the next research phase: Testing organisational receptivity/risk to WSUD.
An on-line survey has been designed as a data collection tool for the next research phase. This will be administered across the water sector to test organisational receptivity to, and risk perceptions of WSUD.

In tandem with this survey planning, a background report is being prepared on institutional impediments to more sustainable management experienced within the urban water sector, to provide context and inform the survey design.

Project 3: Adoption Tools

Project Aim

To develop biofilter design tools for practitioners, in particular, to develop:

- design methods and algorithms of stormwater biofilters for a variety of possible applications
- design guidelines (design manuals) for multi-functional biofilters

Project Leader

Dr Ana Deletic, Monash University

Project Output

A comprehensive set of design recommendations that outline key design considerations that are necessary to preserve the effective operational processes of biofilters as water quality improvement measures.

This document will include case studies derived from Project 2 to demonstrate how the fundamental technical specifications of biofilters can be adapted into urban design.

Project highlights 2005-2006

This project has been scheduled to start in 2006-2007. A research workshop (with all key FAWB researchers involved) has been planned for July 2006. A Stakeholders meeting, to be held in early 2006-2007, will be used to obtain the crucial input of our Collaborators for this project.

Activity 3.01 - Design Algorithm

Aim
To develop a simple, but robust, design methodology for biofilter design .
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Achievements 2005-2006
Project scheduled to commence in 2006-2007.

Activity 3.02 - Design guidelines for multi-functional biofilters

Aim
To develop a comprehensive set of design recommendations that outlines key design considerations that are necessary to preserve the effective operational processes of biofilters as water quality improvement measures.

Achievements 2005-2006
Project scheduled to commence in 2006-2007.

Project 4: Demonstration and Testing

Project Aim

To demonstrate and test the wide capability of novel multi-functional biofiltration designs, by:

- building a number of systems for different application and making them a showcase of the technology
- conducting preliminary tests of the systems to confirm developments from laboratory trials

Project Leader

Mr Justin Lewis, Monash University

Project Output

A key aim of FAWB's research is to develop biofiltration technologies that provide effective and sustainable treatment of stormwater.

We are using a combination of laboratory experiments and field trials of bioretention systems to test the influence of design configurations and operating conditions, and to demonstrate their full-scale applications.

The field trials are being documented to provide guidance on construction, operation and maintenance of biofiltration systems, for achieving long-term performance and sustainability.

Bioretention system in sodic soil environment (Sydney)
The application of bioretention systems in sodic soil environments requires particular attention to preventing any increases in discharge to groundwater and leaching of saline water into receiving waters. Field trials are undertaken to investigate if special construction techniques need to be adopted in constructing bioretention systems in sodic soil environments.

Bioretention for stormwater harvesting (Melbourne)
A bioretention system has been constructed to treat stormwater runoff from a car park, prior to its harvest for reuse. This system has been designed as three separate cells allowing field-scale trials of biofilter media (including additives) and hydraulic loadings.

Project highlights 2005-2006

Completion of detailed testing of the properties of the filter media of the Bioretention System in Western Sydney (Second Ponds Creek).

Completion of construction of the Monash Carpark biofilter.

Preparation of information on filter media including:

- Revised soils specifications for filter media in sodic soil environments.
- Report on the hydraulic conductivity for a range of existing biofiltration systems.
- Contaminant profile of filter media with depth for Victoria Park South Sydney

Activity 4.01 Bioretention System in Western Sydney

Aim
To provide insight into sodic soil interaction with the bioretention filter media and the significance of trench lining on the hydrologic performance of bioretention swales in Second Ponds Creek and to document design and construction procedures for bioretention systems in sodic soil environments.

Achievements 2005-2006
Detailed testing of the properties of the filter media of the Bioretention System in Western Sydney (Second Ponds Creek) was completed.

Based on the findings, and also our experience during the Monash biofilter construction, improved filter media specifications have been drafted.

A plan was made to test the new specified media before the filter media of the Second Ponds Creek biofilters are to be replaced for the second time.

Activity 4.02: Monash University Car Park Bioretention System

Aim
To provide knowledge about the operation and treatment efficiency of the bioretention system in removing typical urban stormwater pollutants and to complement laboratory experiments on different biofilter configurations and soil media.

Achievements 2005-2006
Construction of the Monash biofilter has been successfully completed.

Work to equip the site for continuous monitoring of inflows and outflows has been largely finalised. Monitoring of the hydraulic conductivity over time has also started; this will help us to understand the behaviour of soil/plant systems under wetting/drying cycles.

COMMERCIALISATION, PUBLIC RELATIONS AND COMMUNICATIONS

Commercialisation

Commercialisation opportunities have been identified in the FAWB Business Plan, updated during the year. These opportunities all relate either directly or indirectly to the costs and issues associated with achieving government mandated water management and water quality standards.

At this early stage in the project life cycle, specific products are difficult to identify but assuming the FAWB project work leads to widespread adoption of biofilter technologies, it is anticipated that commercial opportunities will arise in the following areas:

- Modular biofilter technologies
- Software modelling tools
- Consulting
- Landscape design and development
- Horticulture

In the FAWB Strategic Marketing and Stakeholders Management Plan, it has been noted (under part 5.3, Commercial Enterprises), that it is anticipated that the majority of the outputs of the research program of FAWB will not generate substantial profits for the participants. As stated in the Business Plan, the outputs will however result in significant cost savings and benefits to stakeholder groups that choose to apply biofilter technologies to meet their stormwater management obligations.

Ongoing review, in consultation with the Stakeholders Committee, will be undertaken to assess commercial opportunities FAWB research outputs. Consideration will need to balance these opportunities against 'public good' outcomes and associated commercial advantage for the Victorian urban development and land management industries as a whole.

The substantial involvement and commitment of FAWB and its key staff to the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, Melbourne, Australia, 2-7 April 2006, has been a pivotal step in awareness raising of biofiltration technologies. This is seen as a strategic initiative in building industry networks across government and commercial enterprises as part of FAWB's initial commercialisation planning.

FAWB session sponsorship and display at WSUD Conference
FAWB was the sponsor of the Poster Paper session of the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design. The FAWB Chairperson, Professor Russell Mein, welcomed delegates to the session and provided a brief overview of the Facility. There was specific mention of FAWB, as a sponsor, on the Conference Program.

A FAWB display booth was prepared and set up at the conference. The display featured project information and an experimental set-up of a biofilter column.

FAWB display and stand at UDM/WSUD Conference

A brochure on FAWB and its activities was also prepared with copies being handed out at the above conference.

Public Relations and Communications

FAWB website
A Facility website was established during the year. A first cut of the FAWB website came online on 31 March 2006 thanks to the cooperation and skills of the Monash IT group.

The FAWB website address is: www.monash.edu.au/fawb The overall design is the basic Monash website template. Further website entries will be made under: Staff, Publications, Products, Newsletters, and Events.

A total of 2731 successful website hits were recorded for 2005/2006.

Presentations or Briefings to Government, Industry, Research and other Organisations 2005-2006

Date	Speaker (s)	Topic	Organisation/Venue
15 September 2005	Dr Ana Deletic, Monash, FAWB Research Manager	FAWB and its activities	Sustainable Campus Group (SGC) (SGC membership includes facility and services managers for TAFEs and universities, and related environmental) /Monash University
9 November 2005	Dr Ana Deletic, Monash, FAWB Research Manager	FAWB and Biofiltration (Seminar on: Water - the LIQUID A$$ET)	Stormwater Industry Association of Victoria – 5th Annual SIAV Seminar/ Corporate Centre, Manningham City Council

Media References 2005-2006

Date (Page)	Medium	Title / Subject	FAWB Representative /Aspect
3 April 2006	Monash Newsline	Rain gardens to reduce pollution in Melbourne's waterways	Dr Tim Fletcher
April-May 2006 (page 15)	Ecos Issue 130 (Feature in the CSIRO magazine 'Ecos – Towards a Sustainable Future')	Rain gardens buffer Melbourne's waterways	Dr Tim Fletcher

EDUCATION AND TRAINING

FAWB Postgraduates 2005-2006
Five postgraduates worked on PhD studies associated with FAWB and its staff. Details of the postgraduates, including their topics and supervisors, are set out in the following table.

Name	University	Type of postgraduate enrolment (PhD, MEngSc etc)	Supervisor(s)	Funding source(s) ARC /Uni/etc	Topic
Dale Browne	Monash	PhD	Dr A. Deletic (Monash) Dr T. Fletcher (Monash) Dr G. Mudd (Monash)	MDS*	Predicting and modelling the clogging of stormwater infiltration systems
Belinda Hatt	Monash	PhD	Dr A. Deletic (Monash) Dr T. Fletcher (Monash)	MDS*/James McNeill scholarship	Developing novel stormwater treatment technologies for safe re-use
Sébastien Le Coustumer	Institut National des Sciences Appliquees (INSA) de Lyon.	PhD (enrolled at both INSA and Monash University)	Dr S Barraud (Lyon) Dr A. Deletic (Monash) Dr T. Fletcher (Monash)	Cotutelle Program, France	Measurement and modelling of hydraulic and environmental performance of urban stormwater infiltration systems
Nilmini Siriwardene	Monash	PhD	Dr A. Deletic (Monash) Dr T. Fletcher (Monash)	MDS*	Development of an experimentally-derived clogging prediction method for stormwater infiltration and filtration systems
Yaron Zinger	Monash	PhD	Dr A. Deletic (Monash) Dr T. Fletcher (Monash)	MDS*/MGS§	Advancing stormwater biofilter technologies

* Monash Departmental Scholarship
§ Monash Graduate Scholarship

Involvement of postgraduates in conferences
Postgraduates Belinda Hatt and David Browne participated actively in the 10th International Conference on Urban Drainage. Copenhagen, Denmark, 21-26 August 2005. Belinda Hatt and Nilmini Siriwardene were lead authors for conference papers. With Nilmini not able to attend the conference, her paper was presented by Dr Ana Deletic.

Belinda Hatt and Nilmini Siriwardene also presented papers at the 7th Urban Drainage Modelling and 4th Water Sensitive Urban Design International Conference held in Melbourne in early April 2006.

Training Courses
Two draft training course proposals were endorsed by the FAWB Board. These covered:

Title	Length	Target Audience
Design of bioretention and wetland systems	2 days	local government engineers engineering consultants catchment management engineers
Water sensitive urban design (WSUD) for landscape architects	1 day	landscape architects project manager environmental officers

It is proposed to run the courses in 2006-2007.

PUBLICATIONS 2005-2006

Technical Reports

Brown, R. and Clarke, J. (In press) Transition to Water Sensitive Urban Design: The Story of Melbourne. Facility for Advancing Water Biofiltration, Monash University, Australia

Refereed Journal Papers

Hatt, B. E., Deletic, A. and Fletcher, T. D. (In press). Stormwater reuse: designing biofiltration systems for reliable treatment. Water Science and Technology.

Hatt, B. E., Siriwardene, N., Deletic, A. and Fletcher, T. D. (In press). Novel bioretention systems for stormwater treatment and reuse - laboratory scale performance testing. Water Science and Technology.

Conference Papers

Allison, R. A., and Breen, P. F. (2006) Dirty clothes, green landscape: laundry wastewater harvesting to irrigate community housing estates. V2.481*

Blackham, D. M., Breen, P. F., and Barrett, R. (2006) Towards a general model of the impact of urban development on vegetation communities in wetlands. V1.261*

Brown, R. R. and Davies, P. (2006) Understanding community receptivity to water re-use: Ku-ring-gai Council case study. V1.119*

Burge, K. and Breen, P. F. (2006) Detention time design criteria to reduce the risk of excessive algal growth in constructed water bodies. V2.309*

Chandler, F. L.. and Eadie, M. (2006) Water by design: creating water sensitive developments in South-East Queensland. V1.159*

Clarke, J. M. and Brown, R. R. (2006) Understanding the factors that influence domestic water consumption within Melbourne. V1.143*

Coppock, M. H. and Brown, R. R. (2006) Advancing sustainable water futures for Melbourne: analysis of expert opinion on structural and non-structural approaches. V1.151*

Denman, L.., Breen, P. F., and May, P. (2006); An investigation of the potential to use street trees and their root zone soils to remove nitrogen from urban stormwater. V1.109*

Edwards, P., Holt, P., and Francey, R. (2006) WSUD in local government – implementation guidelines, institutional change and creating an enabling environment for WSUD adoption. V2.163*

Fletcher, T. D., Mitchell, G., Deletic, A. and Ladson, A. R. (2006) Is stormwater harvesting beneficial to urban waterway environmental flows?. V2.499*

Hatt, B. E., Deletic, A. and Fletcher, T. D. (2006) Stormwater reuse: designing biofiltration systems for reliable treatment. V1.85*

Haydon, S. R., and Deletic, A. (2006) Sensitivity of lumped conceptual pathogen models..V1.461*

Hoban, A. T., Breen, P. F., and Wong, T. H. F. (2006); Relating water level variation to vegetation design in constructed wetlands. V2.429*

Horn, D. A., Lamparski, H. L., Wong, T. H. F. (2006) Groundwater treatment curtains to improve water quality in open drains. V1.93*

Ladson, A. R., Lloyd, S., Walsh, C. J., Fletcher, T. D. and Horton, P. (2006) Scenarios for redesigning an urban drainage system to reduce runoff frequency and restore stream ecological condition. V2.233*

Le Coustumer, S., Barraud, S., and Chocat, B. (2006) Long-term hydraulic and pollution retention performance of infiltration systems. V1.203*

Leinster, S. (2006) Delivering the final product – establishing vegetated water sensitive urban design systems. V2.723.*

McCarthy, D. T., Mitchell, V. G., Deletic, A. and Diaper, C. (2006) Escherichia coli levels in urban stormwater. V1.347*

McManus, R., Knights, D. and Broady, J. (2006) University of Sydney integrated water cycle management strategy and implementation.. V2.473*

Mitchell, G., Deletic, A., Fletcher, T. D., Hatt, B E., and McCarthy, D. T. (2006) Achieving multiple benefits from stormwater harvesting. V2.387*

Siriwardene, N. R., Deletic, A. and Fletcher, T. D. (2006) Preliminary studies of development of clogging prediction method for stormwater infiltration systems. V1.211*

Taylor, A. C. and Fletcher, T. D. (2006) Triple-bottom-line assessment of water sensitive design options in a greefield residential area.. V2.113*

Taylor, G. D., Fletcher, T. D., Wong, T. H. F. and Duncan, H. (2006) Baseflow water quality behaviour: implications for wetland performance monitoring. V1.287*

Taylor, S. and Eadie, M. (2006) Application of new bioretention technologies to a regional scale bioretention basin in Brisbane. V1.101*

Walsh, G. M. and Wong, T. H. F. (2006) Water sensitive urban design for industrial sites and precincts. V2.593*

Wettenhall, G. and Wong, T. H. F. (2006) Hydrologic Regions for sizing stormwater treatment measures in Victoria. V1.295*

Wong, T. H. F., and Breen, P. F. (2006) Water sensitive urban design of catchments above natural wetlands – classifying wetlands and setting objectives. V2.241*

*Paper given by staff and/or postgraduates from FAWB Participants, Ecological Engineering and Monash University, at the 7th International Conference on Urban Drainage Modelling and 4th International Conference on Water Sensitive Urban Design held in Melbourne 2-7 April 2006. (Authors, title, and page listed, ie Volume 1- V1, and Volume 2 – V2.)

APPENDIX I - SUMMARY OF PERFORMANCE AGAINST PROGRAM MILESTONES, PROGRAM OBJECTIVES AND APPROVED BUSINESS PLAN

Index

Schedule 2

Part A - Summary
Completed details included as 'Attachment A'
(Includes supplementary information as requested via Catherine Alexander)

Part B – Performance Report
Completed details included as 'Attachment B'

Part C – Budget Report
Completed details included as 'Attachment C'

Schedule 3

Program Milestones for the Year
Completed details included as 'Attachment D'

Schedule 2 – Milestones (to 30 June 2006)
Part A – Summary
(Attachment A)
(Includes supplementary information as requested by DIIRD)

- *Ongoing recruitment details (i.e. wherever relevant expats returning, experts appointed, etc)*
  All staff recruitment completed.

- *Education and skills related activities*
  Postgraduates Belinda Hatt and David Browne participated actively in the 10th International Conference on Urban Drainage. Copenhagen, Denmark, 21-26 August 2005. Belinda Hatt and Nilmini Siriwardene were lead authors for conference papers. With Nilmini not able to attend the conference, her paper was presented by Dr Ana Deletic.

  Postgraduates Belinda Hatt and Nilmini Siriwardene also presented papers at the 7th International Conference on Urban Drainage Modelling and 4th International Conference on Water Sensitive Urban Design held in Melbourne in early April 2006.

  A FAWB display booth was prepared and set up at the above International Conference on Urban Drainage Modelling (UDM) and Water Sensitive Urban Design (WSUD), held on 3-7 April 2006. The display featured project information and an experimental set-up of a biofilter column.

  A brochure on FAWB and its activities was also prepared with copies being handed out at the Melbourne conference

  There was a strong involvement from FAWB Participants Ecological Engineering, and Monash University, in the 2006 conference. Staff and/or postgraduates from FAWB Participants, Ecological Engineering and Monash University, were authors of twenty-seven papers given at the conference. A list of the papers is included under 'Publications'.

  Postgraduate Yaron Zinger has transferred from Masters candidate to PhD following presentation of a successful transfer report to Monash University.

  Two draft training course proposals were endorsed by the FAWB Board at its May 2006 meeting. These cover:

Title	Length	Target Audience
Design of bioretention and wetland systems	2 days	• local government engineers • engineering consultants • catchment management engineers
Water Sensitive Urban Design (WSUD) for landscape architects	1 day	• landscape architects • project manager • environmental officers

It is proposed to run the courses in 2006-2007.

- *Description of infrastructure purchases as part of the Program for capital expenditure (eg new buildings, fit-outs, equipment etc);*
  A four-wheel drive vehicle for fieldwork was purchased.

- *Nature and value of "deals" finalised (eg grants, commercial contracts, financial commitments from Stakeholders);*
  Agreements with seven FAWB investors, its Collaborators, completed: Adelaide and Mount Lofty Ranges Natural Resources Management Board (formerly Patawalonga and Torrens Catchment Water Management Boards), Auckland Regional Council (for period to 30 June 2006), Brisbane City Council, Landcom NSW, Manningham City Council, Melbourne Water, and VicRoads. The agreements provide for a total of $411k in cash and $772k in in-kind contributions.

- *Links with prestigious national and international partners and Stakeholders;*
  FAWB linkages with its partners and stakeholders continue to be fostered. The major Australian urban water management agencies, Brisbane City Council and Melbourne Water are key participants.

  As advised with the May 2006 Business Plan update, Auckland Regional Council (New Zealand) have withdrawn funding from 30 June 2006, but wish to maintain research links on an active but informal basis.

  Significant linkages and interaction with Landcom –NSW have been established and continue, including a major demonstration site at Second Ponds Creek being provided by Landcom.

- *Short layman's descriptions of key developments, new technology applications and problems that have been solved through the project activities. This might include new discoveries, new treatments, environmental solutions etc.;*

Laboratory-based experiments aimed at the refinement of biofilter technologies continue to progress:

- The first phase of vegetation trials has been successfully completed.
- Biofilter column experiments continue with saturated hydraulic conductivity tests completed as part of filter media performance studies. Wetting and drying experiments, investigation of sediment transport in stormwater, and development of a two-dimensional model for clogging studies, continue.

Policy and risk work has progressed. A draft report on the historical development of Water Sensitive Urban Design entitled 'Transition to Water Sensitive Urban Design: The Story of Melbourne' is in the final review stages. Based on the theory of socio-technical transitions, key factors that have underpinned the WSUD transition across Melbourne, have been identified and analysed.

Demonstration and testing with biofiltration facilities at Monash University Carpark and Second Ponds Creek, Sydney are moving forward.

Construction of the Monash biofilter has been successfully completed. While plants are getting established, work to equip the site for continuous monitoring of inflows and outflows has been largely completed. (The majority of the work has been completed as at 15 July 2006, as shown in the attached photos, Figures S2.1-S2.3).

Detailed testing was completed on the properties of the filter media of the Bioretention System in Western Sydney (Second Ponds Creek).

Figure S2.1 Downstream v-notch weir housing.

Figure S2.2 & S2.3 Downstream v-notch weirs.

- *Media articles*
  3 April 2006, Monash Newsline, Article on 'Rain gardens to reduce pollution in Melbourne's waterways'. The article covered work on the Monash Carpark Biofilter.

  Feature in the CSIRO magazine 'Ecos – Towards a Sustainable Future'. The article, in Ecos Issue 130, April-May 2006, was published on the collaborative work between Monash University and Ecological Engineering on 'rain gardens'. The article drew in part on material available via the FAWB website.

- *Awards and acknowledgements for the Program and people involved.*
  FAWB was awarded $7000 from the joint Monash University /Lulea University of Technology Fund to establish links with Department of Civil and Environmental Engineering, Lulea University of Technology in Sweden.

- *Value ($) of deals done*
  As noted above, the agreements with Collaborators/Investors provide for a total of $411k in cash and $772k in in-kind contributions.

- *Links with prestigious overseas partners*
  Collaboration with Lulea University of Technology (Lulea, Sweden)
  Dr Ana Deletic visited Lulea in January 2006 (this was a condition of the grant awarded to FAWB).

  It is proposed that Postgraduate Yaron Zinger will spend time at Lulea in 2006-2007.

  Details of the joint laboratory work on the influence of temperature on biofilter activites that Lulea researcher Godecke Blecken and Monash's Yaron Zinger are to do while Yaron visits Lulea, were refined during the visit of Godecke Blecken and Prof Maria Viklander to Melbourne in April 2006.

  Collaboration with INSA de Lyon (Lyon France)
  FAWB collaboration continues this prestigious French research institution, the Institute National de Sciences Appliquées (INSA), on clogging of biofilters.

  In particular Mr Sébastien Le Coustumer, of INSA in Lyon, who is spending one year of his PhD at Monash, is undertaking hydraulic conductivity of all large columns. Sébastien's supervisor from INSA Lyon (France), Dr. Sylvie Barraud, visited FAWB in April as earlier noted, and his work program on the role of plants in maintaining hydraulic conductivity of the filter media, was agreed on.

  University of Belgrade, Serbia and Monte Negro
  Dr Ana Deletic gave a lecture on 12 January 2006 at the University of Belgrade on Biofilters and FAWB. The lecture was attended by a large number of people from Serbian industry and academia. Since Serbian towns and cities are under reconstruction, the lecture generated lots of interest.

- *Summary of new technologies*
  Draft specification for soil media prepared to assist planning, design, construction and operation of biofiltration systems. The specification was subsequently made available on the FAWB website.

- *People stories (expatriates returning, visiting experts in a field, local experts, etc)*
  A delegation from the House of Lords in the UK visited the Monash University Clayton campus and Ecological Engineering's office in late January 2006 as part of an Australian fact-finding trip to investigate the future management of water in the UK. In addition, members from FAWB accompanied the delegation to a number of field inspections of stormwater quality treatment facilities.

  In particular, the group wanted to learn how integrated urban water management has transformed the way in which the Australian water industry develops solutions for the future which are economically, socially and environmentally acceptable. Led by Lord Selborne, the delegation was conducted on its trip by Prof Richard Ashley, Professor of Urban Water, Sheffield University.

  Prof Ashley was also a participant in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006, in Melbourne.

- *Details of skill shortages or recruitment difficulties and details of any actions to overcome or success stories.*
  As set out in the initial business plan, it was proposed to appoint a Manager for Marketing Training and Commercialisation. With the endorsement of the FAWB Board, the appointment was deferred due to the limited tenure which could be offered for such a position and the limited cash resources available for any appointment other than part-time.

  The CEO, Dr Tony Wong, took up the formulation of the Strategic Marketing and Stakeholders Management Plan and overall direction of the Commercialisation Project. Contractors have been used for elements of the commercialisation activities, including graphic design.

- *Details of problems solved*
  In Activity 4.01: Second Ponds Creek Bioretention System, Sydney, the findings of laboratory and field tests indicated that clay and silt from the Western Sydney area was generally unsuitable for use as filter media in biofilters. A tighter specification for soil filter media was recommended, especially for sodic soil conditions. These recommendations were considered and an improved soil specification was developed and mounted on the FAWB website.

- *New treatments*
  As part of Project 1, a large laboratory set-up was established to optimise biofilter design. It consists of 140 standard and 18 advanced columns, representing different biofilter designs (with five replicates of each design). Regular dosing of the columns and monitoring of their treatment performance has commenced. Preliminary results are showing a high removal rate for all key stormwater pollutants, including 50% removal of total nitrogen.

- *Environment solutions*
  The laboratory testing of the pollutant removal performance of 20 different plant species has been completed as part of Activity 1.01. All laboratory data have been collected, and are currently being analyzed. Preliminary results indicate that some species are more efficient at removing nutrients than others;

  In Activity 1.02, a 10-month laboratory study of the performance of non-vegetated soil-based filter media has been completed. Non-vegetated soil media is highly efficient in terms of metals removal, but was shown to be a potential source, rather than sink, of nutrients. The importance of vegetation, as well as the influence of wetting and drying cycles on pollutant removal has been demonstrated.

- *New buildings or other new infrastructure*
  As noted above, construction of the Monash biofilter was successfully completed. This forms a pivotal part of the infrastructure for FAWB research.

- *Media attracted*
  A letter of invitation was sent to Minister John Brumby to launch the Facility. DIIRD responded, seeking information on the likely proceedings of the event in order for them to prepare a briefing document.

  Mr Matt Viney, MP, Parliamentary Secretary for Innovation and Industry has agreed to launch FAWB on 17 October 2006. With the assistance of the Monash Advancement Division, it is hoped to attract media to the launch.

Attachment B

Schedule 2

Part B – Performance Report

B. PERFORMANCE REPORT			
Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		**OUTLOOK** **List any issues impacting the progress of planned activities or changes in milestones and dates.**
	Program Milestones/ Performance Indicators/ Activities Planned **(2005- 2006 June Quarter)**	**For specified activities planned** **Result Achieved/Not achieved**	
Task 1 – Management			
M1.1 Establishment of UJV 1-Aug-05	A1.1 Establishment of the Board	Board established under Unincorporated Joint Venture Agreement.	
	A1.2 Appointments of CEO, BM, RM, MTCM,	Appointments of CEO, BM, RM confirmed at Board meeting of 16 Sept 2006. MTCM appointment deferred.	
	A1.3 Appointment of RAC	Research Advisory Committee established under joint venture agreement. To meet as Review Panel, Sept 2006.	
	A1.4 Signing the UJV contract and collaboration agreements	UJV Agreement signed 2 August 2005. Collaboration agreements signed over period December 2005 to May 2006.	
M1.2 Decisions on the main business matters (Quarterly)	A1.5 Regular Management Board meetings (Quarterly)	Board meetings held 16 Sept 05, 24 Nov 05, 21 Feb 06, 25 May 06.	
M1.3 Reports of SAC (Stakeholder Advisory Committee) **(**4 times in first year)	A1.6a Regular meetings of SAC	SAC meetings held 4 Aug 05, 10 Mar 06. 3rd meeting held 18 Aug 06.	
Reports of RAP (Research Advisory Panel)(Once each year)	A1.6b Annual meetings of RAP	Formal panel to meet on 25 and 26 September 2006.	
M1.4 Appointment of the staff (Oct 05)	A1.7 Appointment of other staff: RF in plant sci., PhD in soil sci., MSc in crashworthiness, RF in arts, RA for field tests, Lab technician, Programmer	Staff appointed as required in Revised Business Plan. MSc in crashworthiness no longer applicable. Programmer not required.	
M1.5 Submission of Progress Report	A1.8 Annual audit A1.9 Reporting to DIIRD (Quarterly)	Completed. Being submitted with October 2006 report Reports submitted for four quarters to 30 June 2006.	

Facility for Advancing Water Biofiltration	**Progress Achieved v Planned Program Milestones**		**OUTLOOK** **List any issues impacting the progress of planned activities or changes in milestones and dates.**
	Program Milestones/ Performance Indicators/ Activities Planned (2005- 2006 June Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
<u>Task 2 – Technology Development</u>			
M2.1 Detailed technology development plan (Oct 05)	A2.1 Refining the research plan	Project research plans submitted October 2005 to Management Board and approved November 2005.	
M2.2 Design for long term sustainability (30 June 07)	A2.1 Refining the vegetation A2.2 Refining filter types A2.3 Refining design for long term sustainability	On-going	
M2.3 Design for multi-functionality (30 Sept 07)	A2.5 Biofilters for urban developments A2.6 Biofilters for stormwater re-use A2.7 Biofilters for road safety	On-going	
<u>Task 3 – Adoption Facilitation (Policy and Risks)</u>			
M3.1 Detailed adoption facilitation work plan (30 Oct 05)	A3.1 Refining the adoption facilitation work plan	Outline included in updated Business Plan submitted October 2005. Policy and Risk Project Plan approved by Management Board, Nov 2005.	
M3.2 Regulatory, policy and strategic guidance (30 April 06)	A3.2 Regulatory and policy	Project 2 Report on mapping the institutional transition to adoption of WSUD in Melbourne at final review stage.	
M3.4 Assessed risk perception, liability and opportunities (30 Jan 07)	A3.3 Risk perception, liability and opportunities	On-going	
<u>Task 4 – Design Tool Development</u>			
M4.1 Detailed adoption facilitation work plan (15 Nov 06)	A4.1 Refining the design tools work plan	(Project 3 Research Plan discussed at 18 August 06 Stakeholders Meeting and approved at 7 Sept 06 Board.)	
M4.2 Software for design of biofilters for a wide range of applications (30 Dec 07)	A4.2 Development of software	On-going	
M4.3 Design recommendations (30 April 08)	A4.3 Development of design recommendations	On-going	

Facility for Advancing Water Biofiltration	**Progress Achieved v Planned Program Milestones**		**OUTLOOK**
	Program Milestones/ Performance Indicators/ Activities Planned (2005- 2006 June Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	**List any issues impacting the progress of planned activities or changes in milestones and dates.**
Task 5 – Demonstration and Testing			
M5.1 Detailed demonstration/testing plan (24 Dec 05)	A5.1 Refining the demonstration and testing plan	Demonstration and Testing Project Plan approved by Management Board, Nov 2005.	
M5.2 Novel systems installed (Jan 08)	A5.2 Building of novel systems according to the	On-going	
M5.3 Field data on filter performance (May 08)	A5.3 Field testing of existing and innovative biofilter designs	On-going	
Task 6 – Marketing			
M6.1 Strategic Marketing plan established (1Nov 05)	A6.1 Industry/focus group market research - establish market needs and environment (with collaborators)	Agreements with seven FAWB Collaborators, completed: Landcom NSW, Manningham City Council, Melbourne Water, VicRoads. Brisbane CC, Auckland Regional Council and Adelaide & Mount Lofty Ranges Natural Resources Management Board (see also A7.2)	
	A6.2 Establish strategic marketing plans and operational objectives	Strategic Marketing Plan submitted with DIIRD report (Jan 2006)	
M6.2 Strategic Marketing plan implementation commenced (1 Jan 06)	A.6.3 Internal marketing - establish consistent and robust messages and cultures within the Facility team and collaborators/partners	Board meetings, Stakeholder Advisory Committee meetings, and Research Workshop (Dec 2005) have been used to enhance internal marketing.	
	A6.4 Utilise email newsletter and promotional material (including static website) to establish Facility branding, profile and positioning	FAWB logo established with letterhead and business cards produced. FAWB website set up. FAWB was a sponsor of the International Conference on Urban Drainage Modelling (UDM) and Water Sensitive Urban Design (WSUD), 3-7 April 2006. A FAWB display booth was prepared and set up at the UDM/WSUD Conference. The display featured project information and an experimental set-up of a biofilter column.	

Facility for Advancing Water Biofiltration	**Progress Achieved v Planned Program Milestones**		**OUTLOOK** **List any issues impacting the progress of planned activities or changes in milestones and dates.**
	Program Milestones/ Performance Indicators/ Activities Planned (2005- 2006 June Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
M6.3 Marketing and promotion activities targeting broader stakeholders including industry practitioners and professional associations (1 Sep 06)	A6.5 Preparation of technical and industry targeted reports to establish understanding and confidence in technology as appropriate	A brochure on FAWB and its activities was also prepared with copies being handed out at the above conference Project 2 Report on mapping the institutional transition to adoption of WSUD in Melbourne at final review stage. Guideline Specification for soil media prepared to assist planning, design, construction and operation of biofiltration systems. Available on FAWB website July 2006. (See also A7.6)	
	A6.6 Establish regular series of presentations and/or technical workshops to create awareness and understanding/implications of research results	Two training workshop proposals endorsed by Board	
	A6.7 Annual planning/reporting w/shop	Planning workshop held December 2005. Workshop scheduled for (and held) 26 September 2006.	
	A6.8 Contribute articles/presenters to high profile events and publications within the target market	Article published in CSIRO Ecos magazine, April-May 2006	
	A6.9 External marketing - build industry conviction/confidence in the research outcomes through practical demonstration and monitoring	Launch of Monash Carpark Biofilter scheduled to 17 October 2006 with substantial invitation list to industry. Tour of demonstration biofilter and other facilities proposed.	
M6.4 Industry field days, training courses and site visits delivered and well attended (1Oct 07)	A6.10 Develop industry capacity and confidence to utilise software and other tools developed from research outputs	On-going	
Task 7-Commercialisation			
M7.1 Revised Strategic Marketing Plan (1 Jul 07)	7.1 Refine the Strategic Marketing Plan and alignment with Business Plan to support potential commercialisation	On-going	
M7.2 Commercialisation plan completed (1 Sept 07)	A7.2 Establish and recruit key industry stakeholders with interest in development and commercialisation	Agreements with seven FAWB Collaborators, completed: Landcom NSW, Manningham City Council, Melbourne Water, VicRoads. Brisbane CC, Auckland Regional Council and Adelaide & Mount Lofty Ranges Natural Resources Management Board (see also A6.1)	
	A7.3 Review in detail identified market needs and context for application.	On-going	
	A7.4 For each potential commercialisation product, establish detailed plans for management of legal, financial, marketing and production aspects	On-going	

Facility for Advancing Water Biofiltration	**Progress Achieved v Planned Program Milestones**		**OUTLOOK** **List any issues impacting the progress of planned activities or changes in milestones and dates.**
	Program Milestones/ Performance Indicators/ Activities Planned (2005- 2006 June Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
M7.3 Commercialised products introduced to market (1 Jun 08)	A7.5 Develop prototypes for demonstration & industry testing - work with industry collaborators to refine products to meet target market needs	To be identified, scoped and developed.	
	A7.6 Develop market ready products/knowledge in partnership with SMEs and other partners/co-investors	Guideline Specification for soil media prepared to assist planning, design, construction and operation of biofiltration systems. Available on FAWB website July 2006. (See also A6.5)	
	A7.7 Establish clear channels for launch, promotion and delivery of products to market	Links to industry via Collaborators/Stakeholders being pursued. Launch of Monash Biofilter will be combined with tour of facility. Soil spec on website and conference participation also used to build confidence in research outcomes.	
M7.4 Income stream established for Facility (1 Jun 08)	A7.8 Implement industry targeted integrated marketing communications strategy to establish and support product offer in market place.	To be assessed as appropriate for FAWB.	
	A7.9 Ongoing product support & develop. (new product launches or extensions)	To be assessed as appropriate for FAWB.	

Attachment C

Schedule 2

Part C – Monitoring and Reporting

QUARTERLY PERFORMANCE REPORT – AT 30 JUNE 2006

C: BUDGET REPORT The Budget Report is required to be completed in cash terms (compared to accrual terms)							
Budget' denotes planned expenditure as outlined in the Business Plan	Annual Budget ($)	Actual Year to Date Income ($)	Year to Date Expenditure ($)	Year to Date % Variance (provide explanation if >10%)	Total Funds Unexpended To Date ($)	Planned Income for Next Quarter ($)	Budget Next Quarter *Revise where appropriate* ($)
STI Allocated Funds	440,000	440,000	440,000	0	0	190,000	190,000
Consortium Contribution Funds	342,000	376,345**§**	155,584	59*	220,761	0	220,761
Total Program Funds	782,000	816,345	595,584	27	220,761	190,000	410,761

NOTES TO PART C

1. *Variance* =100* (Actual Year to Date Income - Year to Date Expenditure)/ (Actual Year to Date Income).

2. Notes on variances:
STI Allocated Funds Variance
Expenditure to 30 June 2006 allocated firstly to STI Allocated Funds, balance to Consortium Contribution Funds, giving a variance of 0% for STI Allocated Funds.

**Consortium Contribution Funds Variance*
Consortium funds includes $34,000 early payment by Monash, due in 2006/07. Carry-over of Consortium Funds required to support Projects in 2006/07.
§ Includes $11 other income, and $23,334 as one-third payment of Landcom contribution of $70,000, compared with rounded-up Business Plan contribution of $23,000 for 2005/06**.**

The contents of this report, including all attachments, are true and correct in every particular to the best of my knowledge after having made all due enquiries.

Signed:* *Tony Wong* *Date:21/7/2006*

Name (print): Dr Tony Wong *Witness (print):*John Molloy

*Position:*CEO *Qualification of Witness:*Business Manager

*The report must be signed by the Chief Executive Officer or Chairman of the Board, or other person approved by the Department

Attachment D

Schedule 3

Program Milestones for the Year – 2005-2006

Milestone	DIIRD Compliance Date
• Receipt of evidence and details of the commencement of the Facility including a relevant signed Consortium Agreement (UJV) agreement between Monash University and Ecological Engineering. • Receipt of Revised Governance Structure with positions provisionally identified, including: o the mechanism for engaging industry stakeholders for the duration of the Program; o the Research Advisory Panel; and o the Facility Board	Upon execution of the Grant Agreement by both parties.
• Receipt of revised business plan, approved by the Board and outlining how the Consortium plans to: ▪ raise the awareness of land developers, VicUrban and Vic Roads regarding biofilter capability and the activities of the Facility; and ▪ inform the Facility deliverables to regulatory bodies and their decision making processes such that the impact of the Facility's work is realised; • Evidence that the Facility has been established and is fully operational, including the establishment of all management committees • Evidence of:- o commencement of development of technology development plan o commencement of development of adoption facilitation plan o commencement development of strategic marketing plan (including access statement)	15 October 2005
• Receipt of the Strategic Marketing Plan, including a stakeholder management plan. • Evidence of :- o commencement of experiments directed at long term sustainability of bioretention systems, as outlined in the Business Plan o commencement of design and construction of demonstration sites	15 January 2006
• Evidence of completion of detailed demonstration and testing plan • Evidence that the identification of commercialisation opportunities and the preparation of commercialisation plan has commenced	15 April 2006
• Receipt of a revised and updated business plan for the Facility, approved by the Board	31 May 2006
• Evidence that of testing at demonstration sites has commenced.	15 July 2006

Compliance details for each Milestone

• Receipt of evidence and details of the commencement of the Facility including a relevant signed Consortium Agreement (UJV) agreement between Monash University and Ecological Engineering. • Receipt of Revised Governance Structure with positions provisionally identified, including: o the mechanism for engaging industry stakeholders for the duration of the Program; o the Research Advisory Panel; and o the Facility Board

A letter of 2 August 2005 was sent to DIIRD by Mr Sam Furnell, Monash University, enclosing signed copies of the Grant Agreement and the Joint Venture Agreement for the 'Facility for Advancing water Biofiltration'.

Governance Structure
The Revised Governance structure was included in the signed Joint Venture Agreement.

Industry Stakeholders
As part of the mechanism for engaging industry stakeholders, an initial meeting of industry stakeholders or collaborators as the 'Stakeholders Committee', was held on 4 August 2005. A further meeting was held on 10 March 2006. The first meeting for 2006-2007 was held on 18 August 2006.

Research Advisory Panel
As set out in Structure and Management, the Facility Governance Structure includes the Research Advisory Panel.

As noted in Schedule 3 of the Joint Venture Agreement, nominated members for 2005- 2006 were:

- Prof Simon Beecham (University of Technology, Sydney)(Now University of South Australia)
- Professor John Argue (University of South Australia)
- Mr Earl Shaver (Auckland Regional Council).

Prof John Argue has subsequently been succeeded by Prof Jenny Dixon, University of Auckland

Facility Board
Following the election of two Stakeholder/Collaborator representatives to the Facility Board of Management, the Board met in September 2005, November 2005, March 2006 and May 2006.

- Receipt of revised business plan, approved by the Board and outlining how the Consortium plans to:
  - raise the awareness of land developers, VicUrban and Vic Roads regarding biofilter capability and the activities of the Facility; and
  - inform the Facility deliverables to regulatory bodies and their decision making processes such that the impact of the Facility's work is realised;
- Evidence that the Facility has been established and is fully operational, including the establishment of all management committees
- Evidence of:-
  - commencement of development of technology development plan
  - commencement of development of adoption facilitation plan
  - commencement development of strategic marketing plan (including access statement)

Raising awareness with collaborators
As outlined in the revised Business Plan forwarded in October 2005:

'The Facility plans to raise awareness of its activities and to disseminate research findings and recommendations on water filtration technologies initially through the stakeholders consultation group established. Our project collaborators (investors) represent a diverse industrial group that cover land developers (Landcom), local governments (City of Manningham and Brisbane City Council), public utilities (VicRoads and Melbourne Water), regional catchment managers (Patawalonga and Torrens Catchment Management Board – Now the Adelaide and Mt Lofty Ranges Natural Resources Management Board, Melbourne Water, Auckland Regional Council).'

Links established with VicUrban
Further contact will be made with VicUrban in their role of providing representation of the land development industry in Victoria.

Deliverables to regulatory bodies
'Our deliverables to regulatory bodies will again initially be through our collaborator organisations, which include local governments and state authorities. Ongoing consultation with the Stakeholders Advisory Committee will be undertaken to identify methods for rapid dissemination of research outcomes.'

Election of Collaborator Representatives to FAWB Board of Management
Following the first meeting of the FAWB Stakeholders Committee on 4 August 2005, Ms Armineh Mardirossian, Landcom, NSW and Mr Claude Cullino, Manningham City Council were elected unopposed as Collaborator Representatives to the FAWB Board of Management.

Appointments by FAWB Board of Management
The first meeting of the FAWB Board of Management was held on 16 September 2005. The Board of Management confirmed the following appointments (as set out in the Business Plan):

- Prof Russell Mein as Chairperson (for the period to 30 June 2007)
- Dr Tony Wong as CEO and Project Leader
- Dr Ana Deletic as Research Manager and Project Leader
- Mr John Molloy as Business Manager
- Dr Tim Fletcher as Project Leader
- Dr Rebekah Brown as Project Leader

Establishment of FAWB financial reporting structure
A financial reporting structure for FAWB expenditure and income has been established at Monash University, the Lead Agency for the FAWB Consortium.

Establishment of Research Advisory Panel
The appointment of possible other members of the Research Advisory Panel including an overseas panel member, was discussed by the FAWB Board of Management at its 16 September 2005 meeting

As noted at the Board meeting, the composition of the Panel may need to change to match the particular aspects of research being conducted over the next three years.

Further membership proposals for the Panel are to be developed. The first meeting of the Panel was proposed for June 2006. Discussions were subsequently held between the CEO and panel members regarding planning for FAWB research and its review. A Research Review is planned for 25 and 26 September 2006.

Technology development plan
The technology development plan was completed and research projects were approved by the Board.

Adoption facilitation and strategic marketing plans
Activity on the development of the adoption facilitation and strategic marketing plans commenced with the appointment of a Marketing, Training and Commercialisation Manager being discussed by the FAWB Board of Management at its 16 September 2005 meeting.

In the interim and subsequently, the CEO has assumed the responsibility for preparing the adoption facilitation and strategic marketing plans.

- Receipt of the Strategic Marketing Plan, including a stakeholder management plan.
- Evidence of :-
    - o commencement of experiments directed at long term sustainability of bioretention systems, as outlined in the Business Plan
    - o commencement of design and construction of demonstration sites

Receipt of the Strategic Marketing Plan, including a stakeholder management plan.
A copy of Strategic Marketing Plan was forwarded with the January 2005 report to DIIRD.

Evidence of commencement of experiments directed at long term sustainability of bioretention systems, as outlined in the Business Plan

Vegetation experiments in progress at January 2006.

Construction of additional Columns for biofiltration experiments at advanced stage. Column experiments continuing with additional columns brought on line (as in Figure S3.1).

Figure S3.1 Laboratory Columns set up in greenhouse for column experiments

Commencement of design and construction of demonstration sites

Biofiltation facility substantially completed at Monash University Carpark site and experiments underway as at January 2006. (As in Figure S3.2)

Figure S3.2 Monash University Carpark Biofilter facility

Biofiltration facility at Victoria Park, Sydney site being completed. Experiments to commence shortly as at January 2006.

- Evidence of completion of detailed demonstration and testing plan
- Evidence that the identification of commercialisation opportunities and the preparation of commercialisation plan has commenced

Evidence of completion of detailed demonstration and testing plan

The Research Plan for Project 4: Field demonstration and testing was completed and submitted to the FAWB Board of Management and endorsed in October/November 2005.

A copy of the completed plan was enclosed with the report of April 2006. The plan is, however, a working document, and will be updated as the FAWB research program proceeds.

Evidence that the identification of commercialisation opportunities and the preparation of commercialisation plan has commenced

Commercialisation opportunities have been identified in the FAWB Business Plan, Section 1.6. These opportunities all relate either directly or indirectly to the costs and issues associated with achieving government mandated water management and water quality standards.

At this early stage in the project life cycle, specific products are difficult to identify but assuming the FAWB project work leads to widespread adoption of biofilter technologies, it is anticipated that commercial opportunities will arise in the following areas:

- Modular biofilter technologies
- Software modelling tools
- Consulting
- Landscape design and development
- Horticulture

As noted in the FAWB Strategic Marketing and Stakeholders Management Plan, under part 5.3, Commercial Enterprises, it is anticipated that the majority of the outputs of the research program of FAWB will not generate substantial profits for the participants. As stated in the Business Plan, the outputs will however result in significant cost savings and benefits to stakeholder groups that choose to apply biofilter technologies to meet their stormwater management obligations.

Ongoing review, in consultation with the Stakeholders Advisory Committee, will be undertaken to assess commercial opportunities FAWB research outputs. Consideration will need to balance these opportunities against 'public good' outcomes and associated commercial advantage for the Victorian urban development and land management industries as a whole.

The substantial involvement and commitment of FAWB and its key staff to the International UDM & WSUD Conference in Melbourne, 3-7 April 2006, was a pivotal step in awareness raising of biofiltration technologies. This

was seen as a strategic initiative in building industry networks across government and commercial enterprises as part of FAWB's initial commercialisation planning.

- Receipt of a revised and updated business plan for the Facility, approved by the Board

A revised and updated business plan was forwarded with the May 2006 report to DIIRD.

The plan was approved by the FAWB Board of Management at its meeting of 25 May 2006.

- Evidence that of testing at demonstration sites has commenced.

Demonstration and testing activities with biofiltration facilities at Monash University Carpark and Second Ponds Creek, Sydney, are moving forward as at July 2006.

Preparations for testing via continuous monitoring of inflows and outflows at the Monash Carpark have been made with installation of monitoring equipment (see Figure S3.3).

Figure S3.3 Downstream V-notch monitoring equipment, Monash Carpark Biofilter

Testing on the Bioretention System in Western Sydney (Second Ponds Creek) will follow completion of the installation. Work on expediting completion of the facility has been underway with assistance from Landcom and FAWB staff (see Figure S3.4)

Figure S3.4 Metal columns installed at Second Ponds Creek bioretention installation and used in testing the hydraulic conductivity of the filter media.

APPENDIX II - FINANCIAL INFORMATION, AUDIT

Signed Audit Opinions on Financial Reports and Information for
Year ended 30 June 2006
Including Participants Contributions

Copies of signed Audit Opinions provided by the Director, Audit and Risk Management, Monash University for the FAWB activities for the year ended 30 June 2006 are set out in this section.

Audit Opinions have been provided with respect to the:

- STI Grant Agreement, as addressed to the Minister for Innovation
- Joint Venture Agreement between the Participants Ecological Engineering and Monash University, as addressed to the Board of Management of FAWB.

MONASH University

Greg Connell
Director, Audit and Risk Management

Report No : 200638
Audit Ref : GRANTS14

31 August 2006

The Minister for Innovation
Department of Innovation, Industry and Regional Development
13th Floor
55 Collins Street
Melbourne 3000

Audit Opinion – The Facility For Advancing Water Biofiltration

This Audit Opinion is prepared for the purposes of the Grant Agreement entered into by the Parties and dated 20 August 2005.

Scope

We have conducted an independent audit in accordance with Australian Auditing Standards of the attached financial statement provided to us that specifies an amount of $1,060,248 ($595,583 Cash plus $464,665 In-Kind) of expenditure on the program and an amount of $840,999 ($376,334 Cash plus $464,665 In-Kind) as Matching Contributions towards the Program in order to express an opinion on it for the purposes of the Agreement.

Our audit involved an examination, on a test basis, of evidence supporting the amount of expenditure incurred, including all Grant funds and the amount of contributions (both cash and in kind) received. This included an examination of the financial records and receipts, and an evaluation of the policies and procedures used to calculate the expenditure of the Program and the Matching Contributions. These procedures have been undertaken to form an opinion as to whether the methodology used to calculate the expenditure and these contributions is in accordance with the Agreement, and that the figures stated are true and fair.

The Audit Opinion expressed in this report has been formed on the above basis.

Audit Opinion

I confirm that in my opinion:

- Expenditure of $1,060,248 has been incurred on the Program;
- The Matching Contributions to the Program totalling $840,999 ($376,334 Cash plus $464,665 In-Kind)

in accordance with the terms of the Agreement.

R G Connell

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MONASH University

FACILITY FOR ADVANCING WATER BIOFILTRATION

SUMMARY OF INCOME & EXPENDITURE

For The Year Ended 30 June 2006

	$	$
CASH INCOME		
State Government Grants	440,000	
Contributions - Participants (Monash, EE)	206,000	
Contributions - Collaborators	170,334	
Other Income	11	
Total Cash Income		**816,345**
CASH EXPENDITURE		
Salaries	225,037	
Salary Oncosts	39,137	
Infrastructure	85,336	
Scholarships	5,112	
Equipment	42,393	
Consultants	40,072	
Operating Supplies	146,380	
Travel-Australia	6,621	
Travel-Overseas	3,127	
Miscellaneous	2,368	
Total Cash Expenditure		**595,583**
Surplus - Cash		**$ 220,762**
IN-KIND INCOME		
Participant Contributions (Monash, EE)	378,501	
Collaborator Contributions	86,164	
Total Inkind Income		**464,665**
IN-KIND EXPENDITURE		
In-kind expenditure, salary and other	464,665	
Total Inkind Expenditure		**464,665**
Inkind Surplus/(Deficit)		**$ -**
Total Expenditure		
Cash	595,583	
InKind	464,665	
Total Cash plus Inkind Expenditure	**$ 1,060,248**	

MONASH University

Greg Connell
Director, Audit and Risk Management

Report No : 200638
Audit Ref : GRANTS14

31 August 2006

The Board of Management
The Facility For Advancing Water Biofiltration

Audit Opinion – The Facility For Advancing Water Biofiltration

This Audit Opinion is prepared for the purposes of the Grant Agreement entered into by the Parties and dated 20 August 2005.

Scope
We have conducted an independent audit of the attached financial statement provided to us that specifies an amount of $584,501 ($206,000 Cash plus $378,501 In-Kind) has been provided to the Program by the Participants, Ecological Engineering and Monash University.

Our audit involved an examination of supporting documentation for the receipt of cash contributions and the calculations of in-kind contributions provided by both Monash University and Ecological Engineering.

Audit Opinion
I confirm that in my opinion:

- Cash totalling $206,000 has been received by the Program; and summarised as follows - Monash University provided $196,000 and Ecological Engineering provided $10,000
- In-kind contributions totalling $378,501 have been provided to the Project and summarised as follows - Monash University contributed $289,549 and Ecological Engineering contributed $88,952

The figures stated are true, fair and in accordance with the terms of the Agreement.

R G Connell

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MONASH University

FACILITY FOR ADVANCING WATER BIOFILTRATION

MONASH UNIVERSITY and ECOLOGICAL ENGINEERING
Summary of Cash and Inkind Contributions

For The Year Ended 30 June 2006

	$	$
CASH INCOME		
Monash University	196,000	
Ecological Engineering	10,000	
Total Cash Income		**206,000**
INKIND CONTRIBUTIONS		
Monash University	289,549	
Ecological Engineering	88,952	
Total Inkind Contributions		**378,501**
Total Cash and Inkind Contributions		**$ 584,501**