NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 94 MAY 2001

A NOTE FROM THE DIRECTOR

Professor Russell Mein

Inside...

RETREAT TO COBRAM-BAROOGA

Given the day-to-day pressures of life in the working environment, many organisations see the benefit in having their staff meet together in some quieter place. Whether these gatherings are called workshops, retreats, or some other name, the intent is the same – organisations work better if their staff are informed about the totality of their operations, and appreciate the need for a 'team' approach to carry them out. These events often include an outline of corporate directions (or 'mission'), the chance to hear outside views from invited speakers, and the opportunity to meet and interact with others in the organisation (through structured 'team-building' exercises).

We have pretty good communication in our CRC – we can say that because we've just had an independent review that has told us so. Through our internal email newsletter (*CatchUp*), our more widely distributed newsletter (*Catchword*), our web-site, and other forms of contact (eg phone hook-ups, project meetings), it is easy to distribute information to CRC participants across the three eastern mainland States and ACT. Given the speed at which this information can be transmitted these days, one might be tempted to conclude that we could get by without bringing our staff and postgraduates together each year. (It would certainly save us a lot of time and logistical effort!).

It would be the wrong conclusion, judging by the response from participants at our CRC get-together last month!

We had our annual workshop this year at Cobram-Barooga, using the spacious meeting rooms of a golf club close to the Murray River. This one, our seventh for the CRC, was our biggest workshop yet, with over 90 participants attending during the (effectively) two days at the venue. The weather was brilliant – always a help to putting people in the right frame of mind – and the setting ideal.

The early workshop sessions were structured to provide information exchange on the six research programs. Brief presentations from program and project leaders helped give an overall picture of the totality of the research portfolio. (Most participants work on a single project, and appreciated to opportunity to see where their work fitted into the whole). This year we included presentations from postgraduate students as part of the relevant research program (rather than in a separate session); this highlighted the very large contribution made to the CRC's research by these talented young people.

CRC WINS AWARD FOR EXCELLENCE IN TECHNOLOGY TRANSFER

The CRC for Catchment Hydrology, in conjunction with Melbourne Water, The Urban Land Corporation, and Brisbane City Council has won an Award for Excellence in Technology Transfer at the CRC Association Conference in Perth earlier this month.

The awards are given to CRCs that can demonstrate that their research is innovative, has arisen from the CRC Program, has been applied or commercialised with significant benefits to Australia, and has strong end-user support.

Our application described the exciting application of the Urban Stormwater Quality Program's research on Water Sensitive Urban Design. Congratulations to Tony Wong and the team for the impressive work upon which this award is based.

For further information and to read the successful application turn to the Program 4 article on page 7.

It is the second time in three years that the CRC has been presented with this award. In 1999, the Tarago catchment research by the CRC and Melbourne Water on sediment sources featured in a successful application in the inaugural year.

CRC PUBLICATIONS LIST

Copies of the Publications List are available on request from the Centre Office on 03 9905 2704 or can be downloaded from the CRC website at

www.catchment.crc.org.au

All prices listed include GST, postage and handling.

The Centre's products can be ordered through the Centre Office.

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[The success of Rebecca Bartley, who had been in Canberra competing for the CRC Young Water Scientist of the Year Award at the AWA Conference, certainly brought this out. Her achievement in this competition is indicative of the generally high standard of the postgraduates in the CRC.]

The middle day of the workshop followed the theme 'integration', and sought to develop a shared view of our objective to integrate our research projects. The modelling tool-kit, involving the linking of a variety of models together for particular tasks, is one of the approaches we are following. A session to explain the concept and to consider the modelling outcomes of each research program, provided a valuable understanding of where we are at, and what we need to do to proceed.

The focus catchment approach, in which we concentrate project research on one or more of our five focus catchments (Fitzroy, Brisbane, Murrumbidgee, Goulburn-Broken, Yarra), was also featured in the integration session. Teams were formed to address realistic management scenarios prepared for each catchment, and to report back to a plenary group as to how CRC research could help.

The last morning was devoted to the Communication & Adoption, and Education & Training Programs, both vital to the effectiveness of the CRC. We heard presentations from two Board Members (Geoff Love and Geoff Earl) on the role of the Board, providing new information for most of those present.

At the workshop conclusion, Jim Miller (the CRC Visitor), made very positive remarks about the CRC as it now is, but reminded us of the challenge to achieve our prime goal – integrated prediction capability at catchment scale.

Jim remarked on the important role that key people play in this CRC, and how reliant we are on their contributions. Annual workshops help us all to appreciate these roles, and to foster the talents of the participants moving 'up the ladder'; among the many real benefits from getting together each year.

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PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Robert Argent

Project 1.1: Development of a catchment modelling toolkit

Research Shock: Predictions found to be accurate

Casting my thoughts back to the February edition of *Catchword*, I recall that I finished up by saying:
"I look forward to meeting many of you at this year's Annual Workshop, where you'll be thrilled, amused, (and confused?) with the latest news from Project 1.1."

The Cobram-Barooga meeting has come and gone, and, as predicted, there were elements of confusion (and thrill) surrounding the modelling toolkit. The feedback from that meeting has given us some good direction for our communication actions over the coming twelve months, and also for the activities that we need to further promote. Primary activities over the recent and coming months include finalising the first version of our communication and adoption strategy (thanks to those who contributed feedback), further testing of modelling toolkit frameworks, and development of an initial set of guidelines for good modelling practice.

Communication and Adoption

Considerable effort has gone into planning the communication activities for Project 1.1, as we have many stakeholders and a range of different messages for each. Rob Vertessy performed a considerable feat getting the strategy into draft shape in the early part of the year, and Dave Perry was kind enough to step back when we picked up the "C&A ball" and ran with it (and bounced it) during our major planning session in April. As a result, we have a well-focused and planned set of communication activities for the coming years (you are reading one now!), and many of you will have already been exposed to aspects of it. For those of you keen to know more about the communication and adoption of Project 1.1 messages and products, please contact Rob Vertessy.

The Modelling Toolkit (see box)

As reported in February, we have narrowed the world of modelling frameworks down to six candidates. These all have something to offer the toolkit, over a range of issues from good modelling practice, through data handling, wrapping of existing applications and construction of model components. Testing of these frameworks is ongoing, and development of the Environmental Management Support System (EMSS) in the Brisbane River

WHAT IS A MODELLING TOOLKIT?

A modelling toolkit is a bunch of useful tools; some of which are complete tools (eg stand-alone applications), and some of which are components that are put together to make tools.

HOW DO YOU MAKE A MODELLING TOOLKIT?

To make a toolkit, you need a modelling framework

WHAT IS A MODELLING FRAMEWORK?

A modelling framework is like an "environment" that does all the necessary management of the tools and components, such as testing if two components can be put together, keeping track of who made which components, and supporting construction of new components.

catchment is just one example of construction using an existing modelling framework.

By the end of 2001 we will have sorted through the available options and developed a mix of approaches that meets the diverse needs of our different user groups. These will be developed further over 2002 into our pilot toolkit. Given the nature of our investigation, it is probable that the pilot toolkit will not be a single mega-modelling application, but rather a mix of existing applications and tools (with some faithful friends such as a few Hydrological Recipes), a suite of model components (such as runoff, routing, pollution generation), and at least one framework for constructing new components, all wrapped up in a consistent package. Despite the range of possible futures, there are things that modellers can do today to improve the ease with which they will be able to build models and model components in the toolkit.

In the Mean Time - Good Modelling Practice

In developing a modelling toolkit, we are essentially aiming to influence modelling practice and engender a cultural shift amongst our stakeholders and ourselves. This modest revolution started with the release, this month, of an initial set of guidelines for good modelling practice. With these we are identifying actions that people can take today that will improve their modelling practice. Simple things such as consistent use of constants, a mature approach to documentation, and the idea of module-based software, all add to the movement.

Over the coming eighteen months we aim to gradually introduce further concepts and practices so that our users, particularly CRC for Catchment Hydrology modellers, will be ready to embrace the pilot toolkit in the round of projects starting in 2003.

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THE THIRD AUSTRALIAN STREAM MANAGEMENT CONFERENCE - THE VALUE OF HEALTHY STREAMS

27-29 August 2001

Hilton Hotel
Elizabeth Street
Brisbane

The Third Australian Stream Management Conference will be held during 27 - 29 August 2001 in conjunction with the 2001 River Symposium (29-31 August) and associated with the Third Australian Fishways Technical Workshop (30-31 August).

In support of the 'Value of Healthy Streams' theme, the Conference is centred on four key areas:

- Ecosystem services
- Hydrological connectivity
- Bio-physical integration
- Tools and techniques

DETAILS OF CONFERENCE ACCOMMODATION AND COSTS NOW ON-LINE at www.catchment.crc.org.au/streamconference

Book your accommodation early to ensure a room - please quote the conference name when booking.

See page 19 for update and registration details.

SALINITY DISPOSAL BASIN REPORTS NOW AVAILABLE ON-LINE

The CRC Project S2, 'On-Farm and Community Scale Salt Disposal Basins on the Riverine Plain, was a collaborative project between the CRC for Catchment Hydrology, CSIRO Land and Water and the Murray-Darling Basin Commission.

The outputs of the project include fifteen technical reports covering key issues in the siting, design and management of salt disposal basins.

Reports in this series can be downloaded (free) as pdf files from the CRC website at the address - www.catchment.crc.org.au/disposalbasins

The reports are also available in printed form for $27.50 (inc. GST) from the CRC Centre Office

PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Andrew Bradford and Lu Zhang

Project 2.3: Predicting the effects of land-use changes on catchment water yield and salinity

Goulburn Broken Catchment water yield issues

Background

The Goulburn Broken Catchment is one of the focus catchments of the CRC for Catchment Hydrology. It has a diverse range of land-use practices, from pasture through to forest. Agriculture is one of the main industries in the catchment, and this needs to be maintained. Past land-use changes including the change from deep-rooted woody vegetation to annual pasture have increased agricultural production, but have led to dryland salinity in the catchment. It is estimated that within the catchment there are about 4500 ha of salt discharge areas, which are expanding at around 5% per year. As a result, the catchment exports on average 180,000 tonnes/yr of salt to either the irrigation region or the River Murray.

Flows in the Goulburn and Broken Rivers are highly regulated to meet irrigation needs in the lower parts of the catchment. Water diversion from the catchment also services western Victoria via the Waranga Western Channel.

Project aim

To address the issues of dryland salinity, river management, and sustainable development of the catchment, a number of land-use operations have been proposed. This project in the CRC aims to estimate the change in water yield due to potential afforestation strategies in the upper part of the catchment.

Method

The water balance model used in this study was developed by Zhang et al. (1999, 2001). Mean annual evapotranspiration is calculated from mean annual rainfall and potential evapotranspiration with only one parameter. In estimating catchment average water yield, it is assumed that there is no net change in catchment water storage over a long period. As a result, catchment water yield can be calculated as the difference between long-term average rainfall and evapotranspiration.

The water balance model is used within a Geographic Information Systems (GIS) application. The GIS application uses the percentage of forest-cover per catchment and the mean annual rainfall to calculate evapotranspiration. Then the estimated evapotranspiration is subtracted from the long-term mean annual rainfall to provide the calculation of water yield. To investigate the change in water yield, each scenario requires a different forest-cover data as an input, while the catchment boundaries and rainfall surface data are kept constant.

Data inputs for the Goulburn Broken Catchment

The three key datasets that the GIS application requires are catchment boundaries, forested areas, and long-term mean annual rainfall. All the data used in the analysis are GIS raster datasets.

The catchment boundaries were determined from 25 m digital elevation model (DEM) data provided by the Department of Natural Resources and Environment Victoria (NRE). The current forest cover was determined from the Murray-Darling Basin Commission (MDBC) land information dataset at 25 m resolution. The rainfall data were obtained from the Bureau of Meteorology as long-term average values.

To investigate the impact of possible future landuse changes on catchment water yield, scenario landuse data were obtained from the Centre for Land Protection Research (2000). These datasets were generated from land capable of sustaining forest growth. The criteria used to generate these data included rainfall, temperature, slope and soil characteristics.

To date, we have modelled the impact of a southern blue gum (E. Globulus spp Globulus) plantation on catchment water yield. The other vegetation scenarios that will be modelled are sugar gum (E. cladocalyx), eurabbie (E. Globulus spp Bicostata), mugga (E. sideroxylon), broombush (M. uncinata), and red ironbark (E. tricarpa).

Initial validation

Initially the model was tested against nine first-order catchments defined by contributing areas upstream of gauging stations. Long-term mean annual stream flow values from gauging stations were compared against modelled runoff. Preliminary results under current vegetation conditions are encouraging. Eight catchments are within 10% of modeled results against gauging station flows. Further testing on finer resolution rainfall data is in progress to investigate the impact of rainfall variability on stream flow in small catchments.

Preliminary results and future analysis

The potential impact of a scenario involving the effects of southern blue gum plantation on inflow to the Lake Eildon was investigated. It was assumed that 100% of the area suitable for blue gums above Lake Eildon becomes plantation (90,000 ha). This represents an increase of 16% in forest cover. As a result of this scenario, the mean annual flow to the Lake Eildon will be reduced by 130 GL per year, which is about 7% of the current mean flow to the lake.

This estimate represents the upper limit of reafforestation above Lake Eildon. Future analysis will look at a number

of more realistic adoption scenarios in collaboration with NRE. It should be noted that the current analysis is based on long-term average rainfall and stream flow. While this is useful, it may be too coarse for river management [which may require seasonal or daily flow predictions under changed land-use conditions]. Predicting the impact of land-use change on seasonal water balance is one of the objectives of Project 2.3 and research is being undertaken to develop a simple model to address this issue.

CRC benefits

The collaboration between NRE and CSIRO Land & Water has resulted in sharing of catchment knowledge, data and modeling spatial techniques. NRE's knowledge of the catchment and assessments of likely adoption of landuse practices by farmers has assisted the analysis and simulation tasks. Spatial data has also been contributed by NRE and the MDBC for the project.

The final analysis of this catchment could result in the model being applied to other catchments at this scale with similar landuse and water yield issues. The primary benefit of this modeling approach will be to predict the change in water yields based on land-cover change and to indicate possible future impacts on other water users.

References:

Centre for Land Protection Research (2000). Goulburn Broken Dryland Regional Development Projects, Land and Climatic Suitability Criteria

Zhang L., Dawes W.R and Walker G.R (1999). Predicting the Effect of Vegetation Changes on Catchment Average Water Balance. CRC for Catchment Hydrology Technical Report 99/12

Zhang, L., Dawes, W.R., and Walker, G.R., (2001). Response of mean annual evapotranspiration to vegetation changes at catchment scale. Water Resources Research, 37, 701-708.

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PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader
JOHN TISDELL

Report by John Tisdell

Project 3.2: Enhancement of the water market reform process

Relative importance of the Council of Australian Governments (COAG) water reform objectives

Priorities for objectives

The Council of Australian Government (COAG) water reform framework included agreement that water be used to maximise its contribution to national income and welfare, within the social, physical and ecological constraints of catchments (National Competition Council, 1998). These objectives are likely to either be in conflict or not achievable simultaneously. The government may have to set priorities for these objectives.

Irrigator and community views

To gain insight to irrigator and community priority of these objectives, irrigators and community members in the Fitzroy and Goulburn Broken catchments were surveyed. They were asked to allocate 100 points between maximising farm income generated from available water supplies, ensuring an equitable and fair distribution of water, meeting environmental flow requirements and accounting for local economic and social impacts of trade[1].

- Goulburn Broken

Table 3.1 presents irrigator and community ranking of COAG reform objectives in the Goulburn-Broken catchment. Overall, respondents ranked (1) ensuring a fair and just distribution of water, (2) meeting environmental flow objectives, then (3) maximising farm income and finally (4) taking account of local town and community impacts. Irrigators consider ensuring a fair and just distribution of water as most important, maximising farm income and meeting natural flow objectives equally important and above concern for local towns and communities.

Fitzroy

Table 3.2 presents irrigator and community attitudes to key COAG reform objectives in the Fitzroy catchment. In contrast to respondents in the Goulburn Broken catchment, respondents in the Fitzroy catchment overall ranked meeting natural flow requirements and distributing water in a fair and just manner higher than maximising farm income or taking account of local town and community impacts. Consistent with their peers in the Goulburn Broken

NEW WATER ALLOCATION RESEARCH REPORTS

Two new reports from the Sustainable Water Allocation Program are now available.

IRRIGATOR AND COMMUNITY ATTITUDES TO WATER ALLOCATION AND TRADING IN THE GOULBURN BROKEN CATCHMENT

by
John Tisdell
John Ward
Tony Grudzinski
Geoff Earl

Report 01/3

IRRIGATOR AND COMMUNITY ATTITUDES TO WATER ALLOCATION AND TRADING IN THE FITZROY CATCHMENT

by
John Tisdell
John Ward
Tony Grudzinski

Report 01/2

These reports describe the results and findings of a survey of irrigator's and community members attitudes to COAG reforms in the Goulburn Broken and Fitzroy catchments respectively.

The cost of $27.50 includes postage and handling and GST in Australia.

For further information contact Virginia Verrelli on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

WATER ALLOCATION AND TRADING VIDEO

IRRIGATORS' ATTITUDES TO WATER ALLOCATION AND TRADING IN THE GOULBURN-MURRAY CATCHMENT

Dr John Tisdell
Program Leader - Water Allocation
CRC for Catchment Hydrology
Griffith University

November 2000

CRC Video 00/6

This presentation describes the results and findings of a survey of irrigators' attitudes to COAG reforms: temporary and permanent water trading; the role of the water authority in the market; and the environmental impact of trade. The survey also elicited irrigators' attitudes to breaking the nexus between land and water, points of blockage in current water markets and possible adjustments to trading rules and procedures.

COPIES ARE AVAILABLE FOR $27.50 (INC GST, POSTAGE AND HANDLING) THROUGH THE CENTRE OFFICE.

Contact Virginia Verrelli on 03 9905 2704 or by email virginia.verrelli@eng.monash.edu.au

Table 3.1. Analysis of key COAG reform objectives in the Goulburn Broken Catchment

	Mean Percentage		
Issue in Water Reform	Overall	Irrigator	Community
Maximise farm income	21.81	26.69z	15.82x
Distribute water in fair and just manner	31.62	34.19	28.47
Meet natural flow requirements	27.17	22.82z	32.50
Impact on local towns and communities	17.71	15.73	20.14x

Note: Percentages with the same symbol are not statistically different within that group (cohort).

Table 3.2. Analysis of key COAG reform objectives in the Fitzroy catchment

	Mean Percentage		
Issue in Water Reform	Overall	Irrigator	Community
Maximise farm income	22.29a	25.93y	19.02
Distribute water in fair and just manner	33.11b	36.08	30.51
Meet natural flow requirements	32.93b	27.30yz	37.58
Impact on local towns and communities	22.84a	22.70yz	22.95

Note: Percentages with the same symbol are not statistically different within that group (cohort).

Table 3.3. Combined analysis of key COAG reform objectives

Issue in Water Reform	Overall Mean Percentage
Maximise farm income	21.97
Distribute water in fair and just manner	32.20
Meet natural flow requirements	29.36
Impact on local towns and communities	19.59

Note: Percentages with the same symbol are not statistically different within that group (cohort).

catchment, Fitzroy irrigators consider ensuring a fair and just distribution of water as most important, followed by maximising farm income and meeting natural flow objectives. However, where irrigators in the Goulburn Broken catchment ranked concern for local town and community issues lower than the other objectives, Fitzroy irrigators ranked it equal to maximising farm income and meeting natural flow requirements.

The community in both catchments ranked meeting natural flow objectives highest, and interestingly above concern for local towns and communities issues. Ensuring a just and fair distribution of water was ranked second in both catchments. Where the community respondents in the Goulburn Broken ranked maximising farm income and taking account of local towns and community impacts of trade equal, Fitzroy community respondents ranked local town and community impacts statistically above maximising farm income.

- Combined Goulburn Broken/Fitzroy views

Table 3.3 presents combined irrigator and community ranking of COAG reform objectives. Across the two catchments respondents ranked the need to distribute water in a fair and just manner higher than all other issues listed. The issues, in statistical ranked order of importance are (1) ensuring a fair and just distribution of water, (2) maximising farm income, (3) meeting environmental flow objectives, and (4) taking account of local town and community impacts.

Preliminary conclusions

Maximising the return from water, measured in terms of aggregate farm income, is the most commonly used measure of COAG water reform success. Setting a priority for this objective appears to be at odds with the opinions of catchment communities. The results of this study suggest that the catchment communities consider social justice objectives more important than maximising aggregate farm income.

Reference

National Competition Council (NCC) (1998) Compendium of National Competition Policy Agreements, Second Edition, Melbourne, June. at <http://www.ncc.gov.au/nationalcompet/agreements/index.htm>.

[1] This was done as part of a comprehensive survey of irrigator and community attitudes to water reform in Project 3.2.

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PROGRAM 4

URBAN STORMWATER QUALITY

Program Leader
TONY WONG

TECHNOLOGY TRANSFER AWARDS APPLICATION

Our successful application for the 2001 CRC Association Technology Transfer Awards is reproduced below. The application was written by Diana Wolfe of Wolf Words and provides an excellent background and summary of the project's relevance and impact on stormwater management.

REVOLUTIONISING STORMWATER MANAGEMENT

KEY OUTCOMES

The CRC for Catchment Hydrology's research into innovative stormwater management techniques has:

- CONTRIBUTED to a significant change in thinking and approach among Australia's stormwater managers
- SHOWN that dramatic improvements in stormwater quality can be achieved with appropriately designed facilities and lead to:
  - savings in 'end-of-pipe' stormwater treatment costs for urban councils and water management agencies
  - cleaner waterways and bays
  - reduced risk of algal blooms
- ASSISTED with incorporating Water Sensitive Urban Design (WSUD) principles into a $15 million residential development in Melbourne – a first for Australia at this scale
- ENCOURAGED councils in Victoria and Queensland to incorporate WSUD principles into their planning policies for land developments
- RESULTED in the development of constructed wetland design guidelines being widely adopted throughout Australia
- CONTRIBUTED to Victorian stormwater management guidelines for urban catchment managers
- ENCOURAGED greater cooperation on stormwater management between professional and community groups, local councils and regional catchment management authorities, urban developers and consultant engineers.

OVERVIEW

Groundbreaking research by the CRC for Catchment Hydrology is helping to change the face of Australian urban developments – and protect waterways and bays from stormwater pollution.

Through its Urban Stormwater Quality research, the CRC has provided the technical basis for implementing Water Sensitive Urban Design (WSUD) principles that are being widely adopted as Best Practice and incorporated into urban planning policy and new housing developments Australia-wide.

Using an innovative combination of field tours, short courses, a national seminar series, an industry report, a video and postgraduate studies, the CRC has communicated WSUD principles and demonstrated the application of CRC research outcomes to more than 1200 urban designers, engineers and stormwater managers. WSUD is being embraced wholeheartedly by local councils, water and catchment managers and urban

WATER SENSITIVE URBAN DESIGN IS CHANGING THE FACE OF AUSTRALIAN URBAN DEVELOPMENT

WATER SENSITIVE URBAN DESIGN

WATER SENSITIVE ROAD DESIGN - DESIGN OPTIONS FOR IMPROVING STORMWATER QUALITY OF ROAD RUNOFF

by
Tony Wong
Peter Breen
Sara Lloyd

Report 00/1

This joint publication with the CRC for Freshwater Ecology investigates opportunities for incorporating stormwater quality improvement measures into road design practices for protecting aquatic ecosystems.

Copies of the report are available from the Centre Office for $27.50 (includes postage and GST).

Please phone Virginia Verrelli on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

THIRD INTERNATIONAL CONFERENCE ON WATER RESOURCES AND ENVIRONMENT RESEARCH (ICWRER)

Water Quality and Quantity Aspects in Modelling and Management of Ecosystems

22-26 July 2002
Dresden, Germany

CALL FOR PAPERS CLOSES 1 July 2001.

For further information please visit http://www.tu-dresden.de/fghhihm/hydrologie.html

or contact

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CRC RESEARCHERS INVESTIGATING THE EFFECTIVENESS OF A WATER SENSITIVE URBAN DESIGN (WSUD) SYSTEM

developers, who see a range of benefits flowing from the introduction of WSUD principles.

RESPONDING TO INDUSTRY NEEDS

In the past, water management agencies have designed drains to carry stormwater away from residential areas as quickly as possible, to minimise the threat of flooding and disease. Stormwater was discharged, untreated, directly into waterways and bays.

As water quality issues emerged in the 1990s, urban stormwater – carrying massive loads of nitrogen, phosphorus, suspended solids and gross pollutants – was identified as a significant contributor. Pollutants from stormwater runoff were recognised as a threat to the viability of productive Australian waterways and bays such as Port Phillip Bay, which contributes around $1.4 billion p.a. to Victoria's gross domestic product through tourism, farming, fishing and recreational activities, and Queensland's Moreton Bay, with its $300 million p.a. commercial and recreational fishing industry.

Urban water agencies were forced to consider treatment options, such as constructed wetlands, to remove the pollutants. However, treating stormwater at 'the end of the pipe' can be expensive. For example, urban stormwater contributes 40% of the nitrogen entering Port Phillip Bay; Melbourne Water would require about $1 billion in capital works to achieve its stormwater policy target of preventing 500 tonnes of nitrogen entering the bay each year via stormwater runoff.

In response to the need for reliable, cost-effective, environmentally-friendly, robust and aesthetically-pleasing treatment measures, the CRC undertook research to develop new and existing stormwater quality improvement practices. The integration of these practices into urban design is referred to as Water Sensitive Urban Design and its principles are applicable from individual houses and streetscapes to whole catchments.

To support a necessary change in thinking and approach by the industry, and facilitate the adoption of WSUD principles, the CRC embarked on a communication and adoption strategy. As a result, an increasing number of Australian councils and catchment managers are adopting WSUD as planning policy and a number of on-ground stormwater management systems are being designed and constructed in accordance with the CRC's research findings – activities supported by its effective research and communication links with industry.

ADOPTING CRC RESEARCH OUTCOMES – THE PRACTICAL APPLICATIONS

- The Urban Land Corporation's Lynbrook Estate at Lyndhurst, southeast of Melbourne, is the first large scale residential estate in Australia to incorporate WSUD. The first two stages of a three-stage, $15 million development are complete and the CRC and Melbourne Water are using Lynbrook as a major demonstration of WSUD principles. The project is providing an opportunity to evaluate costs and benefits and consumer responses to WSUD. Last year this project was presented with an Urban Development Institute of Australia Excellence Award for its innovation in land development.
- Brisbane City Council has introduced planning policy requiring all new developments to be designed according to WSUD principles. Its $2.3 million stormwater treatment wetland at Bridgewater Creek, designed according to

NEW HOMEBUYERS ARE EMBRACING THE BENEFITS OF WATER SENSITIVE URBAN DESIGN

design elements recommended by the CRC, recently won Queensland's Healthy Waterway Award for its use of innovative technology.

- Melbourne Water, the Victorian EPA and the Municipal Association of Victoria (MAV) have developed a stormwater management agreement that promotes a shared responsibility in the environmental management of urban stormwater between the agencies. In association, they published *Urban Stormwater – Best Practice Environmental Management Guidelines*, which draws extensively from the CRC's findings. The guidelines are being incorporated into policies including the Victorian Planning Provisions and State Environment Protection Policies, and Melbourne Water's Land Development Manual. The Victorian Government has allocated $22.5 million to implementing stormwater management plans, including WSUD, across Victoria.
- In Shepparton, a regional centre of 50,000 in northern Victoria, the viability of a new estate was threatened by an algal bloom in the estate's lake. Goulburn-Murray Water, Shepparton City Council, engineers and the developer undertook a CRC bus tour and seminar to witness the outcomes of the application of the CRC's research. The Council has now incorporated WSUD principles into urban policy and planning conditions to cover all new developments and a major public education campaign is underway to support the introduction of WSUD, including wetlands, in the city.
- The cities of Perth and Albany, WA, have designed five stormwater wetlands incorporating the principles from the CRC's research. In Adelaide, SA, the Patawalonga and Torrens Catchment Water Board have incorporated WSUD design procedures developed by the CRC into a wetlands project.

CONCLUSION

WSUD has been promoted since 1994 but industry was reluctant to apply the concept without a sound technical basis. The CRC for Catchment Hydrology Urban Stormwater Quality program has provided this foundation by addressing the key issues in incorporating WSUD principles into stormwater management practice.

Through a national strategy of raising awareness and interacting with industry practitioners, the widespread incorporation of WSUD principles in urban areas has started. Already several major Australian city councils have adopted WSUD as planning policy for new developments and others are following their example.

This research project has involved, and continues to involve, cooperation between the CRC and organisations including Melbourne Water, Brisbane City Council, Goulburn-Murray Water, the Urban Land Development Corporation (Melbourne), the Victorian Environmental Protection Authority (EPA) and the NSW EPA. Their close links and strong relationships have enabled WSUD to be developed with the needs and vision of local councils, water management agencies, industries, developers and communities in mind – ensuring rapid adoption of the technology.

In a relatively short time, WSUD is changing the face of urban design and, one day, may be part of every new Australian development.

Program Leader
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CANBERRA TECHNICAL SEMINAR

THE ROLE OF GLACIERS IN THE SPATIALLY DISTRIBUTED HYDROLOGICAL MODELLING OF ALPINE RIVER CATCHMENTS

by
Mark Verbunt
Visiting Postgraduate Student
Institute for Climate Research
Swiss Federal Institute of Technology

Wednesday 20 June 2001
10.45am for a 11.00am start

Tea/Coffee on arrival

at the Conference Room
C.S. Christian Laboratory
CSIRO Land and Water
Black Mountain Laboratory
Clunies Ross Street, Acton
Canberra

Contact Tanya Jacobson on 02 6264 5746 for further details

CLIMATE VARIABILITY PROGRAM TECHNICAL REPORT

STOCHASTIC GENERATION OF CLIMATE DATA: A REVIEW

by

Ratnasingham Srikanthan
Tom McMahon

Report 00/16

This report reviews the state of research and practice in the stochastic generation of annual, monthly and daily climate data.

Copies of the report are available from the Centre Office for $27.50 (includes postage and GST).

Please phone Virginia Verrelli on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Beth Ebert

Rainfall Forecast Skill in the Bureau of Meteorology's MesoLAPS Numerical Weather Prediction Model

Representations of land surfaces in models

A major aim of CRC Project 5.1 'Modelling and forecasting hydroclimate variables in space and time' is to improve the representation of land surface processes in numerical weather prediction (NWP) models, in particular the initialisation of soil moisture. Many recent studies have demonstrated the benefit of including a realistic treatment of soil moisture processes in producing more accurate forecasts of temperature, wind, and rainfall on scales ranging from hours to months.

Rainfall is intimately inter-related to soil moisture. Obviously, rain is the primary broad scale source of water available to the surface. Depending on the soil type, current water storage, and other factors, a portion of the rainfall will be taken up by the soil while the remainder will be lost as runoff and evaporation. Conversely, soil moisture is an important source of water for the atmosphere via evaporation. For example, surface heating on a sunny day causes moist air parcels to rise from near the surface and form clouds, which may develop further to produce rain showers and thunderstorms. A well known example of this water cycling is the afternoon convection in the Amazon Basin.

Rainfall processes in models

The processes leading to rainfall production are very complex, and operate on a wide range of space and time scales, many of which are unresolvable by existing NWP models. It is therefore necessary to parameterise the sub-grid scale rainfall processes. NWP models generally divide rainfall into two types: convective and non-convective. Convective rainfall will occur in a region if the atmosphere is unstable and there is sufficient moisture convergence and associated upward motion to lead to the growth of cumulus and cumulonimbus clouds. Convective rainfall is patchy and locally intense, and it is quite difficult for NWP models to predict the location and intensity of convective rainfall. Non-convective rain occurs when large-scale ascent and/or advection of moist air leads to supersaturation and stratiform cloudiness over a large area, and the excess moisture falls as rain. NWP models are generally much more skillful at predicting large-scale rain.

Improving rainfall forecasts quality

Improving the quality of rainfall forecasts is an important goal because rainfall has such strong socio-economic impacts. Besides that, rain is a sensitive function of atmospheric and surface conditions and therefore gives a powerful indication whether changes to a NWP model are producing improved forecasts. If rainfall forecasts are measurably improved, one could surmise that the associated forecasts of atmospheric and surface fields would also be improved. Fortunately, good rainfall validation data exist over large portions of Australia. The remainder of this report describes the forecast skill of the Bureau's operational mesoscale NWP model (mesoLAPS) for 24-hour precipitation. These can be viewed as baseline verification results for the unimproved model, to which future modified versions can be compared.

Evaluation of operational rainfall models

Five Australian river basins, corresponding to the CRC's focus catchments, were chosen for evaluation of mesoLAPS 0-24 h and 12-36 h forecasts (initialised at 23 and 11 UTC, respectively). These were the Yarra, Broken-Goulburn, and Murrumbidgee basins in southeastern Australia, and the Brisbane and Fitzroy basins in eastern Queensland. These represent distinctly different rainfall regimes, and each basin contains many rain gauges from which to derive the basin average rainfall. The validation data come from the Bureau's operational daily rain gauge analysis of observations made at 9 a.m. local time. The national-scale analysis uses a 3-pass inverse distance-weighted successive corrections scheme to map the 24 h gauge data onto a 0.25∞ latitude/longitude grid.

Time series results

Time series of forecast and analysed basin average daily rainfall are shown in Figure 5.1 for a three month period from early December 2000 through early March 2001. The time series show good correspondence between the 24 h forecast and the observed rainfall. There were occasional false alarms when the model predicted significant rainfall but little or no rain fell (for example, January 13 in the Yarra Basin, also February 11 in the Yarra and Broken-Goulburn Basins). Importantly, no major rain events were missed by the model.

Table 5.1 shows verification statistics for the 5 _ month period from 1 October 2000 through 14 April 2001. The first three statistics show model bias while the fourth statistic (correlation coefficient) measures the correspondence between the forecast and observed time series.

Overall findings for the catchments

On average the rain area (fraction of the basin that experienced rainfall) was overestimated in the Broken-Goulburn and Murrumbidgee basins and under-estimated in the Brisbane Basin. The mesoLAPS model had a tendency to over-estimate rainfall amounts, particularly rainfall maxima. An example is seen in the Brisbane River Basin in early February, where the observed rainfall was 80 mm d-1 but the model predicted over 200 mm d-1. Examination of national-scale verification results (not

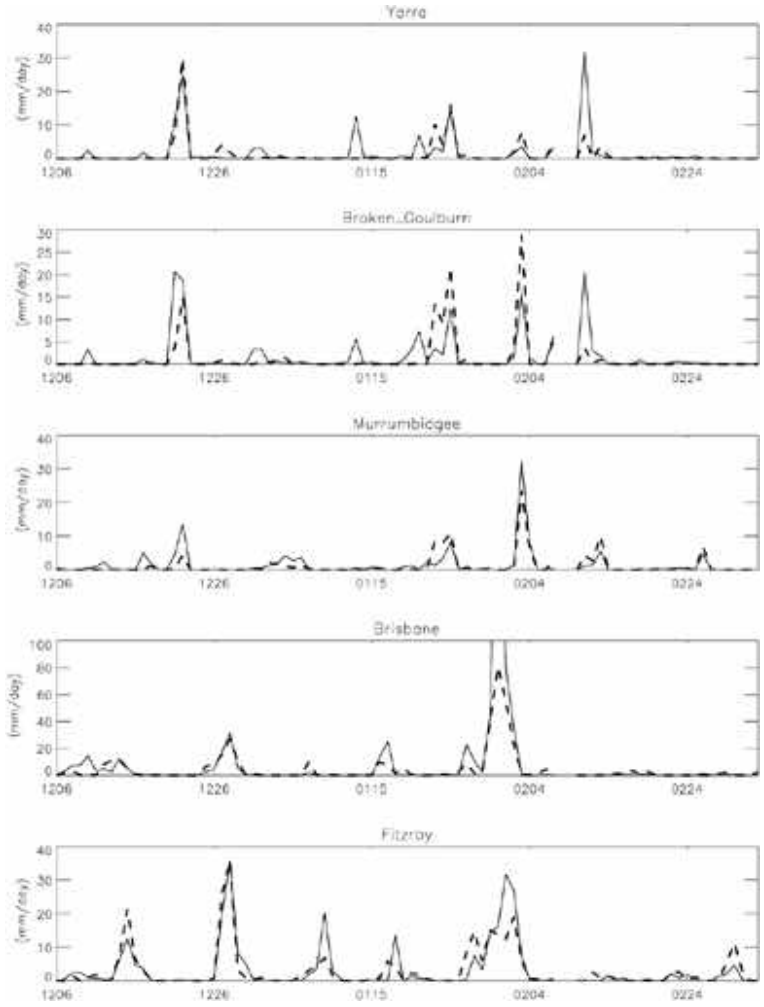

Table 5.1 Time series of forecasts and analysed basin average daily rain for a three month period - early December 2000 to early March 2001

BASIN	Yarra	Broken-Goulburn	Murrumbidgee	Brisbane	Fitzroy
24 h forecasts					
% error in rain area	-6	12	28	-19	-1
% error in average daily rainfall	6	24	50	49	18
% error in maximum daily rainfall	35	61	66	62	45
Correlation coeff. for daily rainfall	0.83	0.70	0.81	0.85	0.82
36 h forecasts					
% error in rain area	16	48	40	-19	-4
% error in average daily rainfall	32	42	47	63	11
% error in maximum daily rainfall	49	85	66	84	19
Correlation coeff. for daily rainfall	0.69	0.73	0.76	0.82	0.79

shown) indicate that the model's over enthusiastic rainfall production occurs mainly in the warm season and seems to be related to convective rainfall processes. In winter the predicted rainfall amounts have the correct magnitude on average.

For most basins the mean errors were somewhat greater for the 36 h forecasts than for the 24 h forecasts. The reason for the lower bias in the 24 h forecasts probably relates to model "spin-up", where rainfall amounts tend to be lower in the first few hours of the forecast when convection has not fully developed. The correlation of the time series was only slightly lower at 36 h than at 24 h, indicating that early in the forecast period the model shows good ability to predict the occurrence of rain.

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MELBOURNE TECHNICAL SEMINAR

REVISED EVAPOTRANSPIRATION MAPS FOR AUSTRALIA

by

Dr Francis Chiew
The University of Melbourne

Thursday 5 July 2001
5.00 for 5.30pm start

Tea/Coffee on arrival

Institution of Engineers
Australia
The Auditorium
21 Bedford Street
North Melbourne
Victoria

The Bureau of Meteorology and the CRC for Catchment Hydrology have collaborated to prepare and publish revised evapotranspiration maps for Australia. Francis Chiew will describe the methodology behind the new maps and their relevance.

For further information contact David Perry on 03 9905 9600

THE THIRD AUSTRALIAN STREAM MANAGEMENT CONFERENCE - THE VALUE OF HEALTHY STREAMS

27-29 August 2001

Hilton Hotel
Elizabeth Street
Brisbane

The Third Australian Stream Management Conference will be held during 27 - 29 August 2001 in conjunction with the 2001 River Symposium (29-31 August) and associated with the Third Australian Fishways Technical Workshop (30-31 August).

In support of the 'Value of Healthy Streams' theme, the Conference is centred on four key areas:

· Ecosystem services
· Hydrological connectivity
· Bio-physical integration
· Tools and techniques

DETAILS OF CONFERENCE ACCOMMODATION AND COSTS NOW ON-LINE at www.catchment.crc.org.au/streamconference

Book your accommodation early to ensure a room - please quote the conference name when booking.

See page 19 for update and registration details.

PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Nick Marsh

Project 6.4: Evaluation of riparian vegetation in a south-east Queensland catchment.

Stream rehabilitation and riparian vegetation

If you speak to a catchment coordinator, aquatic ecologist, fluvial geomorphologist, or landholder about stream rehabilitation strategies you will generally get a confusing mix of fact, fiction and fable (not necessarily in that order). The one area everyone seems to agree on is that revegetation should be an integral part of most stream rehabilitation projects. This is not because of any level of agreement between the stakeholders but because of the myriad of interconnected benefits provided by riparian vegetation. We are trying to quantify just a few of these in Project 6.4.

Target catchment

The target catchment, Echidna Creek is located on a fertile plateau about 5km west of Nambour in SE Qld. It is small (approx. 1.5km^2) and has been extensively cleared for grazing cattle (*Figure 6.1*).

Stream rehabilitation strategy

The strategy for Echidna Creek is a simple stock exclusion and revegetation project. The stream is fenced back approximately 5m from the bank. Quarried material is used to provide hard points for stock watering and for vehicle creek crossings. The revegetation is done using local native species which are spaced at 2m intervals. The project goal is to achieve 75% canopy cover in two years. This is a rather ambitious goal, however the channel is only 2-3m wide and the rainforest species used for the revegetation grow like weeds in this high rainfall, subtropical environment.

So far the rehabilitation has been going well, with most of the fencing complete and most of the seedlings planted with enough time for them to bed down before the cooler months

The experiment

The experiment follows a standard before-after-control-intervention (baci) type design. The treatment stream, Echidna Creek, is monitored before the establishment of the vegetation, and during/after the vegetation has been established, as well as simultaneously monitoring control sites. There are four control sites, two positive (riparian vegetation in good condition) and two negative (no riparian vegetation plus cattle grazing) control sites. The intention of the experiment is to focus on the relative difference between treatment and control sites as the vegetation becomes established. The attraction of the relative difference approach minimises the complicating influence of inter-annual climatic variation.

The project is focused mainly on the influence of vegetation on water temperature and suspended sediment load. Biological elements of the stream are being monitored by the Centre for Catchment and Instream Research (Griffith University), using the protocol developed in the recent Design and Implementation of Baseline Monitoring project conducted in SE Qld.

How long will it take to re-establish a natural temperature regime?

At the height of summer, the extreme high temperatures and daily range in water temperature of shallow unvegetated waterways can make them uninhabitable for temperature sensitive biota. Vegetation shades the stream, reducing the maximum temperature and daily temperature

Figure 6.1: Echidna Creek degraded reach with poor riparian vegetation.

range. Simultaneous temperature monitoring at treatment and control sites will show the relative change in the temperature in Echidna Creek over time. We are hoping to see the move of the temperature regime from that of a disturbed site to a high quality positive control site. The rate of this temperature recovery provides a timeframe to help plan future stream rehabilitation projects. This goes some way to answer questions such as "how long until the fish come back?", or "when should we start to restock with native fish".

Suspended sediment

A large proportion of a stream's nutrient load (particularly phosphorus) is attached to, or contained in suspended sediment. A key strategy for managing receiving waters in SE Qld is to reduce the sediment and nutrient load of streams. Riparian vegetation is often presented as a way of reducing the net sediment and consequently the nutrient load of streams.

Suspended sediment load is being continuously monitored using a turbidity logger at Echidna Creek and a negative control site. The relative difference in suspended sediment load over time may illustrate the role of riparian vegetation versus pasture grass for sediment control for this upland catchment. The literature would suggest that for small catchments, pasture results in narrower streams and the reverse applies further downstream. We are expecting an initial widening of the stream and release of sediment as the trees take root and shade the existing pasture grass, followed by continued channel stability with low net suspended sediment discharge.

The people

The rehabilitation work is funded under the SE Qld Regional Water Quality Management Strategy. The project steering group is headed by Cameron Traill of Maroochy Shire Council and one of the landholders, Mark Savage, has handled the day-to-day running and on-ground works.

The evaluation of the rehabilitation effort is funded by the CRC for Catchment Hydrology and the project is undertaken by part-time Research Fellow Nick Marsh, supervised by Professor Stuart Bunn (Griffith University), and Dr Ian Rutherfurd (Melbourne University).

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COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

The Flow on Effect – May 2001

This month: some details of new reports, updated software and manuals, and a sincere thank you to my colleagues.

New Research Reports – Sustainable Water Allocation

Two new reports from the Sustainable Water Allocation Research Program are now available from the Centre Office. They are

- 'Irrigator and Community Attitudes to Water Allocation and Trading in the Goulburn Broken Catchment' by John Tisdell, John Ward, Tony Grudzinski (Griffith University), and Geoff Earl (Goulburn-Murray Water) (CRC Report 01/3)
- 'Irrigator and Community Attitudes to Water Allocation and Trading in the Fitzroy Catchment' by John Tisdell, John Ward, Tony Grudzinski (Griffith University) (CRC Report 01/2)

CRC Project 3.2 'Enhancement of the Water market Reform Process' is exploring ways of enhancing the water market reform process by conducting a socioeconomic analysis of guidelines and procedures for trading in mature water markets. Existing trading rules and procedures and their impact on regional towns and communities will be evaluated and, in partnership with industry and other interest groups, scenarios and rules and procedures for trade in the year 2010 will be developed.

Phase 1 of the project involved gleaning irrigator and community current attitudes to water reform and their expectations of the future. These reports outline the findings of a survey of community and irrigators on the acceptance of water reform, the impact of water markets on regional communities and towns, and perceptions of the future direction of water markets as a result of trade in the Goulburn Broken and Fitzroy catchments.

The survey findings contribute to the overall project in providing vital information on irrigators, and their attitudes to breaking the nexus between land and water, points of blockage in current water markets, and possible adjustments to trading rules and procedures.

Copies of these reports can be ordered through the Centre Office. (The price of $27.50 each includes postage and handling and GST in Australia.)

CRC PROJECT SHEETS

Printed versions of the CRC project sheets (two page documents describing the key elements of research projects in CRC Programs except River Restoration and Communication and Adoption) are now available from the Centre Office.

There are 14 project sheets in total, and each gives details of research objectives, expected outcomes, target problems, key tasks, links, staff involved and contacts for that CRC project. They are an excellent way to quickly familiarise yourself with the nature and extent of our research program.

Copies are available by contacting Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au.

These sheets are also available for downloading from our website.

Look under Research 1999-2006 and follow the links for 'detailed information'

WHAT'S HAPPENING WHEN?

FIND OUT ABOUT CRC ACTIVITIES BY EMAIL

THE CRC WILL NOTIFY YOU OF AN UPCOMING CRC ACTIVITY IN YOUR AREA OF INTEREST

You can register to receive this information on line at www.catchment.crc.org.au/subscribe

or you can contact Virginia Verrelli at the Centre Office on 03 9905 2704.

For further information contact Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

Continuous Simulation for Design Flood Estimation Software Update

Dr Walter Boughton developed the Continuous Simulation for Design Flood Estimation software as part of a research project with the CRC. The software system consists of a suite of computer programs for:

- Calibrating models
- Generating 2000 year sequences of daily rainfalls
- Disaggregating the larger daily rainfalls into hourly values
- Calculating losses and rainfall excess values
- Calculating hourly hydrographs of runoff
- Selecting the design flood hydrographs for average recurrence intervals (ARIs) of 2, 5, 10, 20, 50, 100, 200, 500, 1000 and 2000 years. Annual maxima series of flood hydrographs or a partial flood series can also be produced if required.

Earlier this year Dr Boughton ran two successful workshops in Brisbane using updated versions of his Continuous Simulation for Design Flood Estimation software.

The updated version is now on the CRC website at: www.catchment.crc.org.au/models.

It is available for those wishing to further study and/or evaluate the methodology. Feedback to the CRC on experiences with the software is appreciated.

Updated AWBM Catchment Water Balance Model Manual

The AWBM is a catchment water balance model, also developed by Dr Walter Boughton. The model can relate runoff to rainfall with daily or hourly data, and calculate losses from rainfall for flood hydrograph modelling. Recently Dr Boughton and Professor Russell Mein have updated the AWBM manual to improve its readability and usefulness. For those who would like to update their manual or learn more about the use of AWBM, the updated versions are on the CRC website at www.catchment.crc.org.au/models

Excellence in Technology Transfer Awards - Acknowledgements

Many of our Catchword readers will have already learned about our recent success at the CRC Association Technology Transfer Awards in Perth – if not please read the Urban Stormwater Quality article on page 7. Congratulations to Program Leader Assoc. Prof. Tony Wong and the Urban Stormwater Quality team for their hard work over recent years. All of that effort has resulted in the widespread adoption of Water Sensitive Urban Design and of course recognition through the award.

There was also a considerable group of people involved in putting together the application - one that clearly described the project, its application and its benefits. Some key contributors to our success included: Diana Wolfe (Wolf Words) who wrote the application, Liz Butler (Monash University) who designed and arranged the printing of the application, Don McCarthy (Monash University) who took the photos, Sara Lloyd (CRC postgraduate) and Tony Wong (CRC Program Leader) who provided technical comment, John Molloy (CRC Business Manager) and Russell Mein (Director) who provided an editorial review and Chris Chesterfield (Melbourne Water), Andre Taylor (Brisbane City Council) and Bernie Porter (Urban Land Corporation) who arranged for supporting letters from their organisation's senior managers.

The Award organisers at the Conference also requested that a short video explaining the research and its impact be prepared for viewing at the award announcement dinner. Producing a professional three-minute video in less than six weeks is no mean feat. Consequently my sincere thanks to Amgad Louka (Monash University) for his role as editor and producer, Andrew Barcham (Monash University) for the graphic animation, Rob Pignolet (Monash University) for the camera work, and Brian Bayley (Melbourne Water) and Bryce Moore (Urban Land Corporation) for making time to provide testimonials.

Like many of the successes in our CRC, the outcome was achieved through the collaboration of a great many talented people.

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POSTGRADUATES AND THEIR PROJECTS

Our postgraduate for May is:

DD Kandel

Some personal background

I am a graduate in Agricultural engineering and hail from Nepal. After graduating in 1992 from the Tamilnadu Agricultural University, Coimbatore, India, I took up a teaching job as lecturer of Agricultural Engineering at the Institute of Agriculture and Animal Sciences (IAAS), Tribhuvan University, Nepal. My teaching covered engineering courses (Soil and water conservation, and irrigation) to undergraduate students of agricultural sciences.

In January 1995, I joined the Nepalese Government Department of Soil Conservation and Watershed Management (DSCWM), Kathmandu, Nepal and worked in various capacities until I joined the University of Melbourne in July 1999. DSCWM is a multidisciplinary department where civil/agricultural engineers, foresters, agriculturists, geologists, ecologists and socio-economists work as a team to address catchment management problems and related issues through an integrated and participatory approach. My initial work was as a District Soil Conservation Officer (Jan. 1995 to Dec. 1996) with both managerial and technical duties. I was responsible for executing catchment management programs and activities in the districts with the mobilisation and participation of local people. Later from Jan. 1997 to Jun. 1999, I worked as a research officer conducting field-based research on soil erosion/conservation and sedimentation.

I joined the Department of Civil and Environmental Engineering at the University of Melbourne in July 1999 as a research student for a degree of Master of Engineering Science. After a year, I converted from a Masters to a PhD candidate. Since then, I have been working on a PhD project and am expected to submit my thesis by July 2003. Currently, I am being supervised by Associate Professor Rodger Grayson along with other two Senior Research Fellows – Dr Andrew Western and Dr Hugh Turral.

Research Project

My research is related to soil erosion modelling and I intend to address the spatial and temporal scale issues related to soil erosion modelling in medium size catchments. This is a collaborative research project between the University of Melbourne and the People and Resource Dynamics Project (PARDYP) in Nepal. The project contributes to research in the CRC for Catchment Hydrology scaling project 1.2. PARDYP is a regional collaborative research-for-development project coordinated and implemented in five catchments in four countries (China, India, Nepal and Pakistan) within the Hindu-Kush Himalayan Region. It began in 1997 and is being coordinated by the International Centre for Integrated Mountain Development (ICIMOD) based in Kathmandu, Nepal.

My collaboration with PARDYP activities began with the project inception stage. I was involved through DSCWM in installing monitoring stations (erosion plots, gauging and meteorological stations) and in training the field staff in two catchments in Nepal and one catchment in Pakistan. Other development activities included to erosion control and rehabilitation of degraded lands within the Nepalese catchments of PARDYP. The second phase of PARDYP began in 2000 and will end in 2002. The PARDYP/ICIMOD has agreed to collaborate in my PhD project by providing data and by facilitating my field visit, which is scheduled from July to November 2001. My research is confined to the Jhikhu Khola catchment in Nepal.

Jhikhu Khola is an extensively monitored hilly catchment (111.41 km^2) situated within 27033'45'' to 27042'30" North and 85031'15'' to 85042'30" East, and located at 45 km east of Kathmandu valley in the mid-hills region of Nepal. It has five gauging stations, six erosion plots and more than ten meteorological stations distributed across the catchment. The hydro-meteorological data, particularly precipitation and discharge, have been collected at two-minute and daily time scales.

Statement of the problem

A number of empirically- and physically-based soil erosion models have been already developed and some of these models have been tested to evaluate their performances. However model testing has not encompassed a wide range of situations. Performance evaluation on steeper and terraced agriculture situations is rare. For example, the Unified Soil Loss Equation (USLE) technology is unsuitable for soil loss prediction on agricultural terraces in the mid-hills in Nepal. Nepal mid-hills are characterised by widely varied terrace systems, crop and land management practices and empirical models are not transferable to or within the region.

So far, no attempt has been made to apply and validate physically-based soil erosion models in the mid-hill situations in Nepal. This may have been due to the fact that these models are very demanding in terms of input data needs, often at fine temporal scales (i.e. minutes) and

UPDATED AWBM CATCHMENT WATER BALANCE MODEL MANUAL

The AWBM is a catchment water balance model developed by Dr Walter Boughton. The model can relate runoff to rainfall with daily or hourly data, and calculate losses from rainfall for flood hydrograph modelling.

Recently Dr Boughton and Professor Russell Mein have updated the AWBM manual to improve its readability and usefulness.

For those who would like to update their manual or learn more about the use of AWBM, the updated versions are on the CRC website at www.catchment.crc.org.au/models

the availability of such data is very rare in this region. The sparse data that is available is at the daily scale. Short duration rainfall and runoff rates are crucial for soil detachment and transport. At the daily time-scale, most of the information on rainfall and runoff rates is lost and models might be expected to perform poorly. However, the time-scale issues in process-based soil erosion modelling have not received adequate attention yet.

Assessment of the behaviour of these models at different temporal scales and the development of appropriate mechanisms to transform their applicability from sub-hourly to daily scales are still in their infancy. Ideally these models could be used reasonably accurately at the daily scale – the scale at which hydrologic and soil erosion data are more readily available around the world.

Approaches towards the solution

Studies have revealed that both rainfall excess and saturation excess processes may generate runoff in the mid-hills in Nepal. The current generation of soil erosion models consider only infiltration excess and do not explicitly consider saturation excess flow in generating surface runoff. Therefore, a runoff model is developed incorporating both infiltration excess and saturation excess components. The current generation erosion models, namely WEPP (Water Erosion Prediction Project), EUROSEM (European Soil Erosion Model) and GUEST (Griffith University Erosion System Template) are being tested for their applicability using plot-scale data at two-minute scales. A modified algorithm is being developed to allow the models to be applied at daily time-steps and will be tested against plot scale data. The new algorithm will be incorporated in a distributed catchment scale model and applied to the Jhikhu Khola catchment.

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CRC PROFILE

Report by Andrew Western

I am a Senior Research Fellow in Civil and Environmental Engineering at the University of Melbourne and I now work for the CRC on the scaling project (1.2) and on improving the land surface hydrology in the Bureau of Meteorology's numerical weather prediction (NWP) models (part of Project 5.1).

In my days as an undergraduate student I benefited from the involvement of Russell Mein and the crew at at Monash University while gaining degrees in Engineering and Economics. I then began a PhD at The University of Melbourne in the Centre for Environmental Applied Hydrology under Tom McMahon, Ian O'Neill and Roger Hughes. My PhD research was sponsored by the (then) Rural Water Corporation of Victoria and an Australian Postgraduate Research Award provided a scholarship.

The challenge was to understand and model salinity and stratified pools in the Wimmera River in order to provide a basis for predicting the impact of flow management on the river. I learnt about the trials and tribulations of field work and modelling and managed to develop a model of density stratification in individual river pools, as well as a hydraulic model of flow, salinity and stratification in a 200km reach of the Wimmera River. Both these models have seen subsequent applications in assessing the impacts of flow management on the Wimmera and other river systems. My PhD marked the start of a series of research projects that have had integration of field experimentation and numerical modelling as a common theme.

After my PhD, my key research focus changed from rivers to catchments. As a Research Fellow in Civil and Environmental Engineering at The University of Melbourne I undertook a three-year ARC funded project investigating the characteristics of spatial patterns of soil moisture and their importance in rainfall-runoff response in small catchments. This involved many hot and many cold hours in the Yarra Valley collecting data using the Green Machine and only one trip to a winery to put a radar reflector on top of a hill as part of PACRIM2, a NASA sponsored AirSAR remote sensing mission. I also spent some time working with Günter Blöschl at the Technical University of Vienna analysing the data and writing papers and worked closely with Rodger Grayson on this project. Two further ARC funded soil moisture projects grew our of this work and involved close collaboration in the MARVEX project coordinated by Ross Woods from

NIWA in New Zealand and numerous field expeditions to NZ. During this time I have also undertaken a range of other smaller research and consulting projects, some related to salinity and temperature stratification in rivers, some to catchment modelling and some to other river management issues.

My current work for the CRC for Catchment Hydrology is focused on the problem of representing sub-grid and sub-time-step variability in larger scale catchment models and improving the soil moisture representation in the BoM NWP models. Part of this work leads on from my soil moisture work, but the focus is on larger scales and generalisation. It also involves scaling issues more generally. I also supervise a number of PhD students working on these and other CRC projects, as well as having some involvement in other CRC projects where scaling issues are important.

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WHERE ARE THEY NOW?

Report by Fay Lewis

Where am I now? In the place that I've spent most of the last few years. At home in front of the computer, with jarrahs and grass trees shining in the sun outside the window.

I returned to work for Agriculture Western Australia at the beginning of 2000 when the luxury of three years of full-time dedication to a PhD ended. I continued working for the agency until August 2000, but missed my home office, so left to 'work for myself' – a euphemism for 'work for anyone who will pay me', but please don't tell my mother!

My first freelance jobs were with trees – irrigated sandalwood in the Ord River area of the Kimberley and blue gum plantations in the Great Southern region of Western Australia. The sandalwood work was an investigation of the shallow groundwater system below the plantation, and the blue gum research – which is on-going – is aiming to test the validity of several widely-held 'beliefs'.

The company that has engaged me for this work is Integrated Tree Cropping (ITC) and their research division happens to be dominated by graduates from the forestry course at Melbourne University. Two of the 'beliefs' I have been testing are:

- upper slope sites are 'water losing' sites and grow poor trees while lower slope sites are 'water gaining' sites and grow good trees;
- when plantations are established on agricultural land, the trees use up all of the stored soil water in their first few years, and thereafter growth rates decrease as they are reliant solely on rainfall.

I began by simply taking lots of field measurements. I recorded the diameters of thousands of trees, in conjunction with describing landscape features and surface soil characteristics in detail. It became clear that plantation production only rarely decreases along a transect from lower to upper slope sites. Not surprisingly, the results showed that changes in mean tree diameter occurred where there were changes in soil and geology.

To assess the role of initial stored soil water on the changes in tree growth rates over time, we compared the water content profiles to depths of 20 m below recently-established plantations with those below adjacent older plantations. We took undisturbed cores at either one- or two-metre intervals. The profiles below the older trees were drier, but only to about 5 m. Below this depth, there was

WANT TO KNOW WHAT'S GOING ON?

The CRC event calendar at www.catchment.crc.org.au allows you a 'sneak preview' of what is coming up month by month.

Details of CRC events (workshops, seminars, field tours etc.) are posted on the site as soon as they become available.

LOOK UNDER 'EVENTS' ON OUR WEBSITE.

no relationship between tree age and water content, even though we found fresh root material as deep as 16 m below the older trees. ITC has purposely avoided planting trees at sites with shallow bedrock or other impediments to growth, so we have not collected data from such sites for comparison. We will take more cores before the 'break-of-season' rains to see how the soil water stores changed over the dry summer.

I have also used water balance models and tree growth models to look at the variations that can be expected from year to year due solely to the rainfall variability. It turns out that the variability in rainfall is large compared to the available initial stored soil water. So, it seems reasonable to assume that differences in rainfall from year to year account for a large part of the variations in growth rates of plantations. The industry in Western Australia is still young, so we will have to wait for a few more years for enough tree growth data to test this.

Before getting too lost in the woods, I managed to submit my PhD on episodic recharge in early December. I was sorry to see it go as I enjoyed it even to the end.

For the last three months I have been very busy in another area – townsite salinity. Western Australia's Rural Towns Program employed me to review investigations of 23 towns, and then to complete the reports for them. Most of the investigations had included a drilling program, piezometer installation and monitoring, a pumping test, groundwater flow modelling and flood risk assessment. For most towns, four different people had drafted chapters and I have been editing these and then producing a list of recommendations for managing the salinity problems.

I have also spent a short time working with an Agriculture Western Australia project on low recharge farming systems – and we are still waiting anxiously for a plant breeder to produce perennial wheat. My next task is to complete a geology and hydrogeology field guide for land managers in Western Australia's wheatbelt. This was something I began when I returned to Agriculture Western Australia, but I was diverted from it for more 'urgent' projects.

Then, I imagine that sometime I will get the PhD back from the examiners and either have to start all over again or do some major revisions. Luckily, I still find episodic recharge interesting and have been getting withdrawal symptoms from lack of hydrograph analysis!

I am enjoying the variety of the topics I am working on, and the luxury of spending most of my time on 'real' work rather than getting embroiled in office and agency politics. I'll put up with the BAS for that!

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AWARD FOR DR NICK SOMES

Nick Somes, who completed his PhD thesis and graduated last year from Monash University, has just been awarded the Mollie Holman Doctoral Medal for the best thesis in the Engineering faculty in 2000. His thesis was titled ' An investigation of the hydrology and hydraulics of constructed stormwater wetlands'.

Nick, who was supervised by Associate Professor Tony Wong, Leader of the Urban Stormwater Quality Program, was given his medal at a Graduation Ceremony on 8 May 2001. Congratulations Nick.

Monday 27 - Wednesday 29 August 2001 **Hilton Hotel Brisbane, Queensland**

The biggest river event in Australia since the Cretaceous!

THE CONFERENCE THEME

The conference will explore the theme *'The Value of Healthy Streams'* through oral and poster presentations in four technical streams:

- Ecosystem services – **Keynote presenter is Dr. Steve Cork of CSIRO**;
- Hydrological connectivity – **Keynote presenter is Don Blackmore of the Murray Darling Basin Commission**;
- Integration – **Keynote presenter is Assoc. Prof Martin Toms of University of Canberra** ; and
- Tools and techniques – what are the latest developments in science that will assist us to better plan and manage our stream systems in a cost effective way?

REGISTRATION FEES

	Regular	*Discounted**
Full (3 days)	$480	$340
Daily (Monday or Tuesday)	$150	$115
Daily (Wednesday)	$220	$115

All registrations received **after Monday 6 th August** will attract a **$50 late fee**. Fees are payable at time of registration.

* Discounted registration fees apply to full-time students and members of volunteer-based organisations (such as Landcare and WaterWatch).

SOCIAL PROGRAM

Happy Hour – 6:30pm, Sunday 26th for delegates to pre-register and catch up with friends over a drink and finger food. The cost is included in the full registration fee – extra tickets $30 each.

Conference Dinner – 7:30pm, Monday 27th at the Hilton Hotel, including wine, food and entertainment. The dinner is not included in the registration fee. Cost is $85 per person.

River*prize* – 6:00pm, Wednesday 29th at the Brisbane City Hall to witness the awarding of prizes for outstanding international and national river management achievement. This function is free.

River*feast* - 7:30pm, Wednesday 29th, the famous "dinner on the bridge" with food, drinks and roving street theatre. The dinner is not included in the registration fee. Cost is $120 per person.

OPTIONAL TOURS

North Queensland Rivers Tour – 8:00am, Cairns Saturday 25th and returning to Brisbane on Sunday afternoon - $250.

Whitsunday Rivers Tour - 8:00am, Mackay Saturday 25th and returning to Brisbane on Sunday afternoon - $230.

Post-Conference Day Tours – 8:00am Brisbane CBD, Thursday 30th. Four tours are on offer, each costing $45 per person (including lunch and teas)

REGISTER NOW

Delegates are urged to register as soon as possible because the number of registrations available is limited due to venue constraints . Also there will be constraints on accommodation and air travel that week due to Brisbane hosting the 2001 Goodwill Games and the River*festival*.

Register either **on-line** (via www.catchment.crc.org.au) or by **fax or mail** (contact the Convenor for a registration form - see contact details below).

ASSOCIATED EVENTS

River*symposium* (29th – 31st August, Hilton Hotel) - visit www.riverfestival.com.au for details.

Third Australian Fishways Technical Workshop (30th - 31st August, Maroochydore) - visit www.monash.edu.au/oce/fishways for details.

ACCOMMODATION

A limited number of rooms have been tentatively reserved at several hotels in the Brisbane CBD for delegates. The price for these rooms ranges from $74 to $235 per night, which is significantly below the "at market" rates expected during that week.

FURTHER DETAILS

For further information on the conference program, travel, tours and accommodation –

Visit the conference web site at www.catchment.crc.org.au/streamconference or Contact the Conference Convenor, John Amprimo by –

Email: streamconference@dnr.qld.gov.au
Phone: (07) 3224 7668
Fax: (07) 3224 8359

For further information on how to register for the conference, tours and other events contact the Conference Organiser, River*festival* Brisbane Pty Ltd by –

email: conference@riverfestival.com.au
phone: (07) 3846 7444
fax: (07) 3846 7660
mail: PO Box 5696, **WEST END QLD 4101**

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PP338685/00026

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www.catchment.crc.org.au

If undelivered return to:

Department of Civil Engineering
PO Box 60
Monash University
Vic 3800

Surface Mail

Postage Paid Australia

OUR MISSION

To deliver to resource managers the capability to assess the hydrologic impact of land-use and water-management decisions at whole-of-catchment scale.

OUR RESEARCH

To achieve our mission the CRC has six multi-disciplinary research programs:

- Predicting catchment behaviour
- Land-use impacts on rivers
- Sustainable water allocation
- Urban stormwater quality
- Climate variability
- River restoration

CRC AUSTRALIA

The Cooperative Research Centre for Catchment Hydrology is a cooperative venture formed under the Commonwealth CRC Program between:

Brisbane City Council
Bureau of Meteorology
CSIRO Land and Water
Department of Land and Water Conservation, NSW
Department of Natural Resources and Environment, Vic
Goulburn-Murray Water
Griffith University
Melbourne Water
Monash University
Murray-Darling Basin Commission
Natural Resources and Mines, Qld
Southern Rural Water
The University of Melbourne
Wimmera Mallee Water

Associates: SA Water • State Forests of NSW