NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 84 JUNE 2000

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

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RESEARCH PROGRAM OVERVIEW

This month's *Catchword* continues the series begun in the March and April issues showing how the CRC's research programs fit together to form an integrated set. The purpose of the series is to show how each program contributes to the main goal - predictive capability for water, sediment, solute, and nutrient movement at catchment scale. (The integration of CRC activities extends to the Programs for Communication and Adoption, and Education and Training; they are just as important as the research programs in the overall goals of the CRC.)

Figure 1 shows the linkages between the Programs for Climate Variability and Predicting Catchment Behaviour discussed in previous *Catchwords*. It is reproduced here to show how the Program 2 - Land-use Impacts on Rivers - provides (in *Figure 2*) the major components for the box labelled 'Hydrologic Response'.

Overview Part Three – Land-use Impacts on Rivers

The mission of the CRC is:

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

Here, we interpret the words 'hydrologic impact' to include water and water-driven processes on catchments. Hence, as depicted in *Figure 1*, the CRC is looking to quantify the impact of changes in land-use and water management on water, sediment, salt and nutrients. (The toolkit we are aiming to develop will be general enough to add other processes, like pathogen transport, as and when they become available).

Effects of land-use on water yield and salinity (Project 2.3)
The impact of large-scale clearing of native forest for agriculture has changed the hydrologic balance in many areas. The consequences (eg dryland salinity) have been major indeed. This project has the objective of predicting the regional scale impacts of land-use changes (eg. establishment of forest plantations, conversion to perennial pastures) on seasonal water yield, groundwater recharge, and stream salinity. It will add significantly to studies begun in the 'old' CRC on the impact of afforestation on mean annual yield.

Sediment, salt, and nutrient runoff (Project 2.2)
This project aims to predict the delivery of sediment, nutrients and salt from hillslopes to streams. The intent is to develop process-based equations, or modules, based on catchment and land-use indicators. The inclusion of these modules in the tool-kit will account for the effects of spatial rainfall intensity and overland flow on sediment and nutrient movement.

Movement of nitrogen and carbon in riparian zones (Project 2.5)
Previous CRC work (the Tarago Project) was successful in showing how sediment and attached phosphorus could be trapped in buffer strips at the riverbank if certain design principles were followed. This project looks at nitrogen and carbon, two other contributors to water quality problems in rivers and estuaries. The linkages with Project 2.2 are clear; the combination of the two projects (together with previous project outcomes) provides the basis for estimating the delivery of sediment and nutrients to the stream itself.

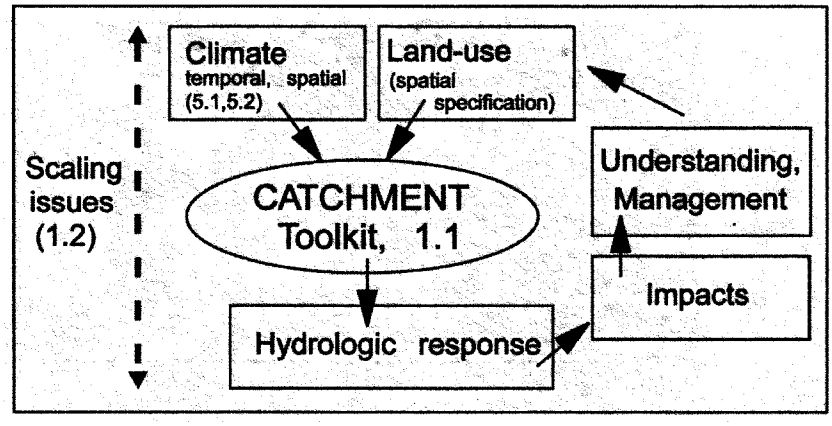

Figure 1 Modelling perspective of a catchment (Programs 1 and 5)

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Additional copies are available from the Centre Office or it can be downloaded from our website at www.catchment.crc.org.au

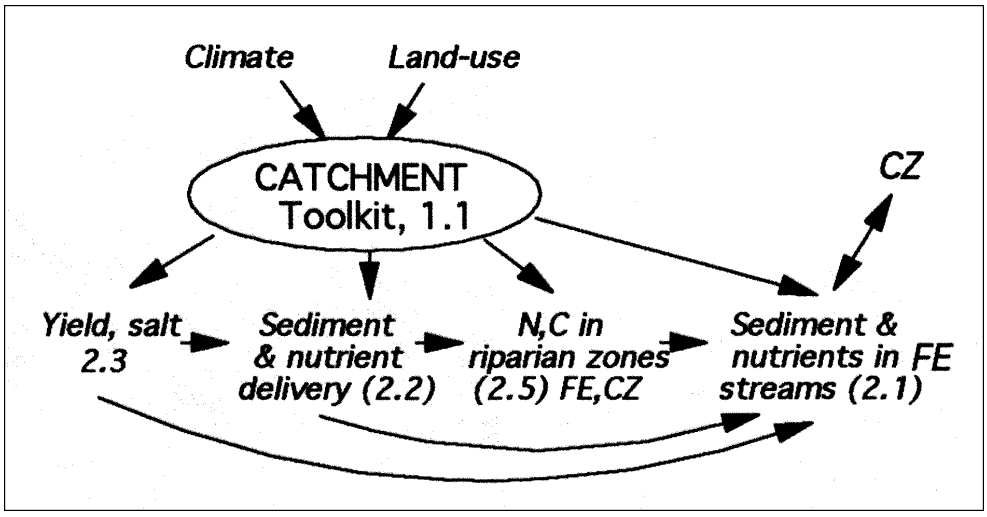

Figure 2 The components of hydrologic response being addressed by the Land-use Impacts on Rivers Program [FE = CRC for Freshwater Ecology; CZ = CRC for Coastal Zone, Estuary and Waterway Management]

Sediment movement and water quality in streams (Project 2.1)

This project aims to simulate the movement of sediment and nutrients in streams. Process-based equations will be developed to estimate this as a function of stream characteristics and flow. The combination of this capacity with the sediment and nutrient inputs from the catchment (and through the riparian zone), will provide, amongst other things, important predictions of recovery potential and stream habitat. Hence, as depicted in *Figure 2*, planned cooperative work with Freshwater Ecology CRC should prove fruitful. Another important output will be sediment predictions to be used in estuary models; here, we have established links with the Coastal Zone CRC to maximise the benefits of our work.

Overall

The Land-use Impacts on Rivers Program aims to deliver several key modules of our predictive catchment capability. The simulation of 'hydrologic response' (*Figure 1*) on rural catchments is the prime objective of this program, leading to quantification of impacts, and the knowledge base to evaluate alternative management options.

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PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Susan Cuddy

Integrated Catchment Management System (ICMS)

What is ICMS?

'The LWRRDC funded ICMS project is relevant to the CRC modelling toolkit project. ICMS is a PC-based product to aid rapid delivery of research results to catchment managers. It has four major components:

- ICMS Builder which is a model building environment that has a sophisticated graphical interface and data management facilities for designing, linking and running models. This component is aimed at people who want relatively simple catchment models; and people with some programming expertise. *Figure 1* is an example of a linked series of models to describe nutrient generation and instream transport. This screen shows the ICMS Builder interface.
- ICMS View which is a protocol for building DSS applications. This component interfaces to the 'engine' within ICMS Builder and allows a programmer to tailor applications to the user.
- ICMS Tools which provides data processing tools to assist with data management.
- ICMS Model Library which allows models to be packaged and easily distributed.

Thus ICMS encapsulates both a modelling environment and a delivery tool for catchment management applications. The separation of these components (into ICMS Builder and ICMS View) provides a very flexible way to build different views of a catchment and the models that have been chosen to best describe the processes in that catchment.

Why ICMS?

The need for tools such as ICMS grew out of a concern by LWRRDC and others that there are significant impediments to adoption of research within catchment management. While software is only one way of delivering research results to clients, it is an important and well-used one and is the focus of the ICMS project. Four impediments that it seeks to address are:

- the lag time between science and development of the applications which encapsulate the science
- inability of most catchment management applications to explore more than one management issue (eg both salinity and nutrient management) and link across domains (eg hydrology and ecology)
- the investment in current applications encourages an adherence to 'old' science
- complexities of data management and scale.

Where is ICMS at?

The project is 3/4 way through its four year life, due for completion in December 2000. While the ICMS Builder component is only necessary to provide the 'engine' for the ICMS Views, it is a stand-alone product and has been a significant software engineering task (by Michael Reed based on concepts developed by Andrea Rizzoli). This component is now quite mature and, while extra functionality can always be added, it is ready for beta release. The ICMS View protocols are in draft form and are currently being tested by building several applications. A case study in the Namoi has progressed to the stage where iCAM models of flow and sediment movement are available in ICMS. Another case study is in the upper

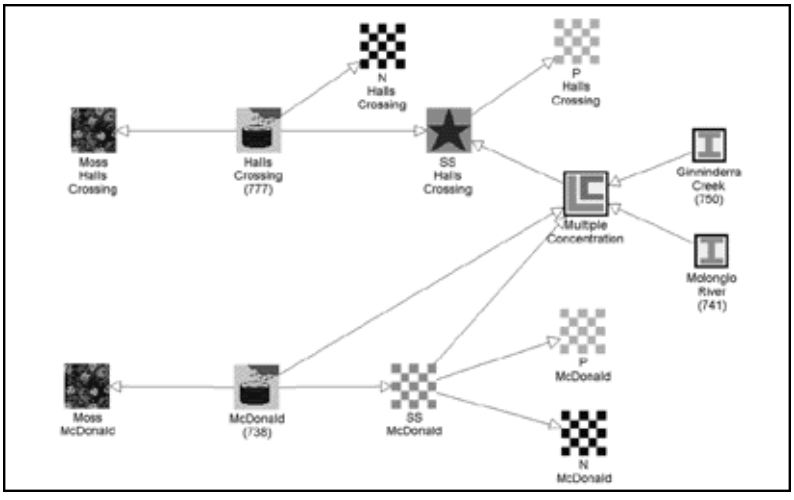

Figure 1: an example of a linked series of models to describe nutrient generation and instream transport.

HYDRAULICS/ HYDROLOGY FOR FLOODPLAIN MANAGERS

WORKSHOP 2: DESIGN FLOOD ESTIMATION

MONASH UNIVERSITY
13 Jul 2000 - 14 Jul 2000

Presenters include Erwin Weinmann, Russell Mein, Tony Wong and Roger Hadgraft from the CRC for Catchment Hydrology, and Peter Hill from Sinclair Knight Merz.

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

Details of this workshop are also on our website at www.catchment.crc.org.au - look under 'events'.

INDUSTRY SEMINAR VIDEO

MANAGING SEDIMENT SOURCES AND MOVEMENT IN FORESTS: THE FOREST INDUSTRY AND WATER QUALITY.

Presented by

Dr Jacky Croke
CSIRO Land and Water

Dr Peter Wallbrink
CSIRO Land and Water

Mr Peter Fogarty
Soil and Land Conservation Consulting

CRC VIDEO 00/1

This video was recorded in Melbourne last year; the first of the three seminars held in Victoria and NSW during November.

It will be of interest to anyone involved in forest and catchment management.

Murrumbidgee where ICMS has been used by iCAM PhD students to build a representation of nutrient generation and transport processes (ref system in *Figure 1*).

Workshops

A series of workshops have already been held, based around an on-line 6 lesson tutorial. More workshops are planned for later in the year for CSIRO and agency staff interested in trialling the software. Along with finalising the product and developing training material, the major emphasis now is on how best to market and transfer the concept and its implementation to the public. We are contracted to commercialise the software as a means of ensuring adoption and have recently commenced discussions with LWRRDC on how best to progress this.

The project team is Susan Cuddy and Michael Reed, CSIRO Land and Water, and Prof Tony Jakeman, Dr Barry Croke, Nick Ardlie and PhD students, Rebecca Letcher, Juliet Gilmore and Lachlan Newham, from CRES/iCAM at ANU.

Reference

Rizzoli, A.E. (1994) A software architecture for model management and integration: theoretical background. Technical Memorandum 94/10. CSIRO Division of Water Resources, Canberra

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PROGRAM 2
LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Ian Prosser

Riparian Research: Its past, present and future in Australia.

The contract research which the first CRC for Catchment Hydrology undertook on riparian lands has been completed. The final activity is a set of State workshops to communicate the major results. That is not the end of the topic though, as a second phase of research is in an advanced stage of planning. The CRC for Catchment Hydrology is one of the organisations shortlisted to undertake that work.

Initial CRC work

In its first round, the CRC helped lead the Land and Water Resources Research and Development Corporation's (LWRRDC's) program of research on riparian land management. Our role was to complete a sub-program on the erosion, sediments and nutrients work of the program jointly with CSIRO Land and Water. Ian Prosser led the research and other key contributors from the CRC were Ian Rutherfurd, Peter Hairsine, Cathy Wilson, Linda Karssies, Christoph Zierholz, Bruce Abernethy and Andrew Hughes. The PhD work of Lucy McKergow and Nick Marsh on the program continues.

At the start of that work five years ago there were great expectations of riparian management but little research to direct, encourage or modify those expectations. We are now in a much stronger position for some targeted areas such as the role of riparian lands in:

- preventing mass failure of river banks
- preventing erosion of smaller streams
- managing stock access
- trapping sediment eroded from agricultural land.

An international review committee recently complimented the Program on its achievements, particularly those of the students.

Communication and demonstration of findings

LWRRDC developed a coherent plan of communication and demonstration of the research results. This was exemplified in several popular products including the Rip Rap newsletter, riparian fact sheets, and the two volume set of Technical Guidelines for Riparian Management.

CRC researchers contributed to each of those products. This is now being complimented by a two-day workshop held in each State, for 25-30 riparian managers from across the State. Agencies such as DLWC in NSW, DNR in Queensland and DNRE in Victoria have organised the workshops in collaboration with LWRRDC. The workshops have been a rewarding opportunity for the researchers to give a personal touch to the results. A fieldtrip to a catchment with riparian restoration works and ongoing concerns over riparian management is included in the workshop. The fieldtrips and associated panel discussions have given us the privilege of seeing at first hand the issues that river managers are facing, how they deal with those issues and what help they need.

Vegetation versus "hard engineering"

I have had my eyes opened to the difficulties of rehabilitating coastal streams which now confine much higher power flows than they did naturally. This makes it harder to get any stability back in the channel, and leads to vigorous debate on the relative merits of vegetation versus "hard engineering" works. If you spend a day on one of these rivers, you can see the great demand for information which will come out of Ian Rutherfurd's river restoration program.

Other riparian issues

Other issues of wide concern are

- the design of large woody debris (LWD) restorations
- the impact of vegetation clearing on flooding
- how to evaluate whether riparian works have been successful
- the almost untouched issue of nitrate transport and processing in riparian lands.

Future work

Direct contact with the catchment managers will be invaluable in planning our future work on riparian lands. As a result of the success and strong agency support of LWRRDC's program it has been continued for another five years. The CRC for Catchment Hydrology put in a joint expression of interest in the program with CSIRO Land and Water. Our focus was on the physical aspects of hydrology, nitrogen, erosion, LWD and catchment planning.

Ecological aspects

Another shortlisted bid focussing on ecological issues was submitted by Stuart Bunn representing Griffith University and the CRC for Freshwater Ecology. Stuart is also a member of the CRC for Catchment Hydrology and of course we have developed a close working relationship with him as he led the ecological work of the riparian program over the last five years. We are thus confident of continuing the collaboration and cementing a further link between the two CRCs.

Interested in being involved?

The new program, like the first, will look for strong collaboration with State agencies, again a strength of the CRC's. As we start to explore the new opportunities in riparian research we would like to hear from anyone in the CRC for Catchment Hydrology who is interested in being involved. Please contact Ian Prosser or Ian Rutherfurd to discuss your interest. The products of the first riparian program are showcased on the web at www.rivers.gov.au which will be updated with the latest information soon.

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MURRUMBIDGEE MEETING

MURRUMBIDGEE 2000 CHARLES STURT UNIVERSITY WAGGA WAGGA

18 Jul 2000 - 19 Jul 2000

Several education and research institutions and government agencies are focusing research on the Murrumbidgee River.

Murrumbidgee 2000 is being organised for these researchers to exchange information and ideas about the broad range of recent, current, and proposed research occurring along the Murrumbidgee River.

A small registration fee will be charged to cover catering.

Please register with
Tanya Jacobson
CSIRO Land and Water
ph (02) 6246 5746.

Registrations close on 10 July.

RECENT INDUSTRY REPORT

THE REUSE POTENTIAL OF URBAN STORMWATER AND WASTEWATER

by

Grace Mitchell
Russell Mein
Tom McMahon

Report No. 99/14

This report deals with the feasibility of reusing storm-water and wastewater to reduce the demand on the potable water supplies in Australian cities. It also describe 'Aquacycle' - a model developed by the CRC to assist in this process.

Copies available for $25 from the Centre Office.

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

PROGRAM 3
SUSTAINABLE WATER ALLOCATION

Program Leader
JOHN TISDELL

Report by Gary Codner

Project 3.1 Integration of Water Balance, Climatic and Economic Models

Developments with Project 3.1

Mt Buffalo discussions

The Mt Buffalo workshop held in early June proved very useful for Project 3.1. It allowed two extended discussion sessions to take place between project researchers, CRC Parties, and other interested people. Topics covered were:

- the modelling requirements
- research priorities of the various users
- staffing of the project.

Integration of models

Part of project 3.1 involves the integration of economic models with the existing water allocation models. In Phase I of the project this will involve using very simple models which already exist. The socioeconomic drivers of water demand will be investigated ,including the question "what are the important factors affecting farmers' planning decisions on areas to be irrigated, crop types, total water usage and irrigation patterns?" The role of economic forecasts will also be considered, as well as stochastic modelling of socioeconomic factors.

Existing models

Such models already exist through ABARE. Discussions were held in early June with ABARE personnel to determine the range of models that exist, their capabilities and how they may be integrated with the existing water allocation models such as IQQM and REALM. ABARE have indicated a willingness to be associated with Project 3.1. Integration of economic modelling work from project 3.2 will occur at a later stage.

Industry staffing

It is planned to second two or three industry people as Research Fellows for a period of four to six weeks. The people involved would have a background in the practical application of the REALM and IQQM models respectively. Agreement has already been reached with Department of Land and Water Conservation NSW and negotiations continue with Department of Natural Resources and Environment Vic and Goulburn-Murray Water.

Research tasks

The Research Fellows will interact with industry to determine:

- modelling requirements of the different model users,
- capabilities and limitations of existing models (specifically REALM, IQQM),
- highest priority research/development gaps,
- most promising options for filling these gaps.

The work will cover areas related to basic system simulation model capabilities, climate and socioeconomic inputs and enhanced model outputs.

Stakeholder involvement

This approach has the advantage of involving the various industry stakeholders in the project so that the project has a very practical direction that will deal with the problems that industry faces. Using experienced industry personnel at the start of the project will also allow the work to proceed at a faster rate.

One expected outcome from the Research Fellows is that the latest versions of REALM and IQQM would be installed and fully operational at Monash and Melbourne Universities.

Proposed workshop

A one or two day workshop is planned for July to discuss industry needs and requirements. This will be a result of the output from the Research Fellows who will develop a series of issues and directions for discussion. The workshop will involve the various researchers and user organisations. The results will be written up and form the basis of various future research projects to start later in the year.

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PROGRAM 4
URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Tony Weber

Constructed Wetlands - So what do residents really think?

A report from the Brisbane Catchment

Background

Brisbane City Council has been undertaking a Stormwater Quality Improvement Device (SQID) design, construction, maintenance and evaluation program over the last few years. Currently, expenditure on the construction program is around $2M per year. With a capital program such as this, evaluation of the performance of these devices is critical to ensure their long term viability as stormwater quality management practices and to ensure that Council funds are allocated in the most cost-effective manner.

Monitoring Program

The current SQIDs monitoring program is evaluating proprietary units (CDS and Ecosol) and a constructed wetland on the northside of Brisbane at Cressey St, Wavell Heights. Some of the results of the program will be used in Urban Stormwater Quality Program of the CRC for Catchment Hydrology (Program 4). Assistance and funding of the wetland monitoring component was obtained through the Queensland Department of Natural Resources and the Natural Heritage Trust's Coast and Clean Seas Program. BCC's City Design Water and Environment Group was commissioned to undertake the monitoring program.

Initially, monitoring of the wetland focussed around water quality improvement. During the current year however, it was decided to evaluate some of the secondary 'benefits' of constructed wetlands, such as habitat creation, and the acceptance of wetlands by the local community. To measure this acceptance, it was decided to conduct a survey of residents in a 2 km radius of the wetland.

Survey Design

The objectives of the survey were relatively simple and included measurement of:

- The residents' attitude to the wetland.
- Their awareness of the wetland's function.
- The impact of the wetland on the local area (e.g. mosquitoes).
- Usage of the wetland by the local community.

Design of the survey was undertaken by Council's City Marketing Branch who developed a "multiple choice" type of mailout survey with questions developed to answer each objective.

An example of the type of question/answer design is shown below.

> Which of the following statements best describes how you feel about the wetland?
>
> | | |
> |---|---|
> | I really like the wetland | 1 |
> | I like most aspects of the wetland | 2 |
> | I like some aspects but not all | 3 |
> | I don't like the wetland at all | 4 |
> | Don't know | 5 |
>
> There was also space for general comments.

Results

A total of 880 survey sheets were mailed out to residents and 217 or 25% responded via the reply paid envelope. The response rate alone highlighted a significant interest in the wetland given that most other surveys of this nature rarely have a response rate greater than 10%.

Some of the general comments indicated that there was a high awareness of the wetland's existence, few negative opinions, no significant mosquito issues, and some negative aspects to be addressed such as weeds, rubbish, cane toads and limited seating. No previous awareness or education activities specific to the wetland had been conducted prior to this survey.

A selection of some of the more interesting results were:

Awareness — 84% of respondents were aware of the wetland

Attitude
- 37% really liked the wetland
- 32% liked most aspects of the wetland
- 2% didn't like the wetland at all

Main reasons for visiting - (NB Multiple choices were allowed)
- 60% To exercise
- 34% To relax or observe nature
- 27% Pass by or through (using a bikeway)
- 23% To feed the ducks

Understanding of wetland role - (NB Multiple choices were allowed)
- 74% As a habitat for birds/animals
- 58% To improve the natural area
- 40% For recreation/relaxation
- 24% To improve water quality

Livability — 53% Believe the wetland contributes a lot to livability

TECHNICAL REPORT FOR STORMWATER MANAGERS

EFFECTIVENESS OF STREET SWEEPING FOR STORMWATER POLLUTION CONTROL

by
Tracey Walker
Tony Wong

Report 99/8

This report investigates the effectiveness of street sweeping as a stormwater pollution source control measure. It describes a scoping study to assess the efficiency of Australian street sweeping practices in the removal of pollutants from street surfaces.

Copies of this report are available from the Centre Office for $25.

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Our new website at www.crc.catchment.org.au allows you to subscribe to our newsletter by post or email.

You can also register your interest online to receive notification of events relevant to your research interests.

Feature for home buyers

70% Consider it an attractive feature

Mosquitoes

Overall 42% Thought mosquito levels stayed the same

17% Thought mosquito levels had increased

General Comments

Typical responses centred around weeds and rubbish (total of 41 respondents). Numerous comments about the wetland being a nice place to feed the ducks were also obtained. One of the most interesting comments was "it silts up very quickly and bullrushes grow fast turning it into a swamp", so obviously the wetland must be performing!

Conclusions

The main points from this simple survey are that most of the respondents are aware of the wetland and consider it a valuable asset, though most are not aware of its true role (signage is on the way!). Mosquitoes are not a significant problem though cane toads were highlighted in several of the general comments (maybe they are eating all the mosquito larvae!). Maintenance of weeds and rubbish also needs to be enhanced and further opportunities to improve recreation amenities also need to be investigated.

Of particular interest is that only a small proportion of the respondents knew that the wetland's role was to improve water quality, suggesting that more needs to be done to raise awareness of the role of both natural and constructed wetlands in water quality improvement. Finally, given that a significant number of respondents feed the ducks at the wetland and want more facilities to enhance this, it may be necessary to manage this issue very early in the wetland establishment phase to minimise the impact.

The results of this survey will be included in the overall SQIDs Monitoring Report for 1999/2000 and a separate report on all aspects of the wetland monitoring will be prepared for the Natural Heritage Trust's Coast and Clean Seas Program. If you want to find out any more details on the monitoring program, please contact the author.

Acknowledgements

This project would not have been possible without the involvement of Council's City Design and City Marketing branches and the continued support and financial contribution from the Queensland Department of Natural Resources and the Natural Heritage Trust's Coast and Clean Seas Program. The residents surrounding the wetland must also be congratulated for their interest in the wetland and response to the survey.

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PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Francis Chiew

Use of seasonal streamflow forecasts in water resources management

El Nino/Southern Oscillation and streamflow

In last month's article, we discussed how streamflow can be forecast several months ahead from the serial correlation in streamflow, and the teleconnection between streamflow and El Nino/Southern Oscillation (ENSO). It is likely that the use of seasonal streamflow forecasts can help improve the management of water resources systems and allow decisions on irrigation water allocation, water restriction rules and environmental flows, to be more realistically based. Two studies are presented here to demonstrate the benefits of using streamflow so help manage water resources systems.

Restriction rules for Benalla water supply system

This study investigated the use of ENSO to help develop restriction rules for Benalla's water supply. Benalla is about 200 km north-east of Melbourne and has a population of about 10,000. This study has been completed with funding from LWRRDC and has been described in more detail in Chiew et al. (1999).

A REALM model was used to simulate the water supply system using monthly data from 1960 to 1992. A four stage restrictions approach was used, and restrictions were imposed at a particular stages when the reservoir storage fell below the volume set in *Figure 1*.

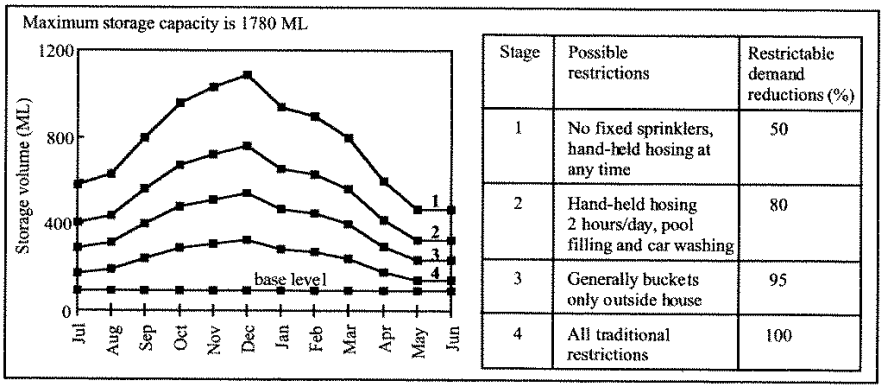
The impact of water restrictions on the community was evaluated using the loss function rating published by Weinmann and Erlanger (1996). The loss function rating was derived via a public participation workshop in the mid-Goulburn region in central Victoria, and considered three types of losses to the community (financial loss, personal inconvenience and loss of community amenities) as well as the length of water restrictions. A higher loss function value reflected a greater impact of water restrictions on the community.

In this study, the restriction rule was optimised using ENSO and flow persistence information. Different scaling factors were used to scale the restriction rules in Figure 1, for three discrete categories based on the previous three months total inflows, average southern oscillation index (SOI) value and average values of sea surface temperature (SST) off the east coast of Australia. Table 1 shows the optimum scaling factors, the loss function values, and the number of times the four restriction stages were implemented for the various simulations. For example, in the second simulation, the lowest impact value of 49 was obtained using scaling factors of 1.75, 0.98 and 0.98 when the previous three month average SOI value was less than −3, between −3 and +3, and greater than +3 respectively. As expected, a smaller scaling factor was used for the SOI>+3 category (i.e., less strict restrictions rule) compared to the SOI<-3 category because higher inflows were expected when SOI>+3 than when SOI<-3.

Although the study was simplistic, the results showed potential in using ENSO information to help develop rules for water restrictions. For example, the loss rating value for the "+3, -3" SOI category was about 30% smaller than the base case (same restriction rules regardless of ENSO, see Table 1).

Further refinements

It is likely that further refinements could improve the results. For example, the categories were arbitrarily chosen, and the use of discrete categories did not reflect the continuous relationship between streamflow and ENSO. The streamflow-ENSO correlations were not the same throughout the year, and it is likely that using different scaling factors for different seasons could improve the restriction rules. In addition, it may be useful



Stage	Possible restrictions	Restrictable demand reductions (%)
1	No fixed sprinklers, hand-held hosing at any time	50
2	Hand-held hosing 2 hours/day, pool filling and car washing	80
3	Generally buckets only outside house	95
4	All traditional restrictions	100

Figure 1 Restriction rules for the Benalla water supply system

INTERESTED IN MORE DETAILS OF OUR RESEARCH?

OUR WEBSITE HAS DETAILED INFORMATION ABOUT EACH OF OUR RESEARCH PROJECTS.

See 'Research 1999-2006' at www.catchment.crc.org.au

NEW WORKING DOCUMENT

SCALING ISSUES IN HYDROLOGY:

Report of a Workshop held at the Bureau of Meteorology 28-29 June 1999

Edited by Alan Seed

Working Document 00/3

There is a high level of interest in the topic of scaling in hydrology and this workshop provided a forum for various issues to be discussed and debated.

The final session of the workshop attempted to summarise the current state of knowledge of various aspects of scaling in hydrology and to identify what further research is needed.

The report is a valuable resource for researchers and others interested in the field.

To order your copy of this report ($20) please contact Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

		Scaling factor	Loss function value	No. of months with restriction stages			
				1	2	3	4
Single Factor		1.17	71	11	6	3	0
SOI	< -3	1.75					
	-3 to +3	0.98	49	12	5	1	0
	> +3	0.98					
SOI	< -5	1.62					
	-5 to +5	1.17	62	13	6	2	0
	> +5	1.17					
SST9	< -.5	1.78					
	-.5 to +.5	1.17	59	13	6	2	0
	> .5	0.98					
SST9	< -1	1.17					
	-1 to +1	1.17	67	10	6	3	0
	> +1	0.98					
Inflow	< 30%	1.17					
	30 to 70	1.16	71	10	6	3	0
	> 70%	1.16					

Table 1 Optimised scaling factors, loss function values and water restrictions for the various simulations

to also consider different demands in different years, and the potential relationship between water demand and ENSO.

Irrigation water allocation in the Lachlan River catchment

This study concerned the use of seasonal streamflow forecast to help determine irrigation water allocation in the Lachlan River catchment (see also Chiew et al., 1999 and Panta et al., 1999). The Lachlan River catchment is in central-west New South Wales and covers an area of approximately 84,600 km^2.

The plots in *Figure 2* show results from three simulations using the IQQM model developed by the NSW Department of Land and Water Conservation (DLWC). The model simulates the water distribution system on a daily time step (using data from 1894 to 1997) and takes into account climate and crop water requirements as well as environmental flow extractions.

Simulation options

The first simulation assumes no risk, with the cropping area based on the water allocation announced by DLWC in September (start of crop planting). The second simulation considers the farmer taking some risk and anticipating a higher final water allocation, therefore planting over a greater area compared to the first simulation. The third simulation considers the water authority taking some risks and determining the water allocation using a "90% probability of exceedance inflow" for the coming months instead of adopting the more conservative minimum historically observed inflow.

Results

As expected, *Figure 2(a)* shows that the cropping area increases with the risks. *Figure 2(b)* shows that with greater risks, there is a higher chance of the crops failing, with insufficient water to sustain all the planted crops in 30% of the years in the "water authority risk" simulation. There is no crop failure in the "water authority risk" simulation because the announced water allocation cannot be reduced, unless the reservoir is emptied. In the simulation here, the reservoir is never emptied because of the conservative carry-over storage used. However, there are potential risks involved (high security and environmental flow requirements may not be adequately met), as shown in *Figure 2(c)* where the reservoir is drawn

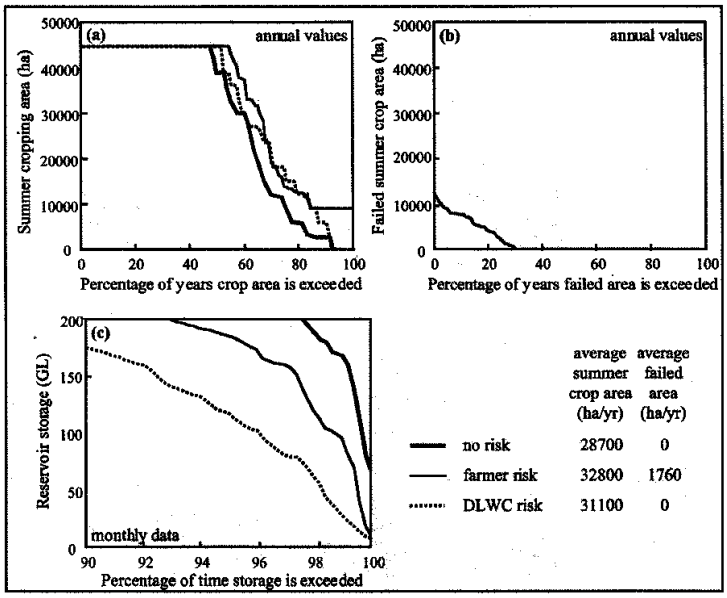


Figure 2 Results of IQQM simulations of alternative water

to much lower levels in the "water authority risk" simulation compared to the "farmer risk" and "no risk" simulations.

Although this study is limited by the rigidity of the IQQM model and considers only a simple representation of the system, the results suggest that there are benefits in using seasonal streamflow forecasts to help determine water allocation in the Lachlan River catchment.

What next?

These studies have shown that there is a net benefit in using seasonal streamflow forecast to help manage water resources systems. However, it is likely that more detailed studies would have to be carried out before water agencies can confidently adopt streamflow forecast in the actual management of water resources systems. We are hopeful that we can develop more detailed studies (jointly with the water agencies and with CRC for Catchment Hydrology Project 3.1) that consider the system in a more holistic manner as well as take into account the socioeconomic benefits and risks.

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PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Ian Rutherfurd

The CRC for Catchment Hydrology's River Restoration program is now (almost) fully operational after having been passed at the most recent Board meeting. There are now seven projects in the program, in two groups. Here is a brief description of each project, with some notes on the cooperation planned with the CRC for Freshwater Ecology (CRCFE) and other organisations. If you have any questions about the projects, either contact me, or email the Project Leaders identified with each project below. I would like to thank the many people who assisted in developing and finalising these projects.

Project Group A: Stream restoration procedures and evaluation (formerly listed as Project 6.1)

Project 6.1: Developing criteria and concepts for planning the evaluation of stream rehabilitation projects. Consistent problems plague the planning of most stream restoration projects. This project attempts to develop, together with CRCFE, some principles for evaluating restoration projects, and criteria for determining the recovery potential of stream reaches. (Project leader: Ian Rutherfurd (i.rutherfurd@geography.unimelb.edu.au) and Stuart Bunn (CRCFE) (s.bunn@mailbox.gu.edu.au))

Project 6.2: Stream restoration planning and execution in the Yarra catchment. A workshop is planned for the 20 June to finalise this project. The intention is to develop and evaluate some major stream restoration projects with Melbourne Water, together with the CRCFE. (Project leaders: Ian Rutherfurd with Dr Peter Breen from CRCFE (Peter.Breen@sci.monash.edu.au))

Project 6.3: Restoration ecology in the Granite Creeks catchment. The CRCFE, with some help from our CRC, has already completed a project looking at physical and ecological processes in the Granite Creek catchments in NE Victoria. With this understanding, it is now time to test some hypotheses about how such sand-slugged systems can be restored. Together with the Goulburn-Broken Catchment Management Authority, we will design and build artificial habitat structures in the creeks, and monitor their biological and physical effects. (Project leaders: Ian Rutherfurd with Prof. Sam Lake from CRCFE (Sam.Lake@sci.monash.edu.au))

Project 6.4: Evaluation of riparian revegetation projects in SE Queensland. This project is being developed in cooperation with the SE Qld Regional Water Quality

CRC SEMINARS AND WORKSHOPS - WHERE AND WHEN?

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RIVER MANAGEMENT MANUAL

A REHABILITATION MANUAL FOR AUSTRALIAN STREAMS VOLUMES 1 AND 2

by

Ian Rutherfurd
Kathryn Jerie
Nicholas Marsh

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or download the manual as a pdf free from www.lwrrdc.gov.au

Management Strategy. Part of this project is a major experiment to test the effectiveness of restoring large tracts of riparian vegetation. We will be employing a research fellow (half funded by us) at Griffith University, to assess the physical impact of the vegetation on streams. (Project leader: Stuart Bunn, Griffith University)

Project Group B: Improved design of tools for stream restoration (formerly listed as Project 6.2)

Project 6.5. Hydraulics and performance of fishways in Australian streams. In an earlier *Catchword* article we described the major research grant that our research program had won through AFFA to investigate vertical slot fishway designs.

Project 6.5 provides in-kind support for this AFFA project, as well as developing more research on rock ramp fishways. This work will be carried-out with Tim O'Brien from DNRE who is seconded to the CRCFE for half of his time. (Project leader: Bob Keller, Monash University (bob.keller@eng.monash.edu.au))

Project 6.6. Developing tools to predict scour of rehabilitation works in streams. Many stream restoration projects rely on an understanding of whether objects will survive in the bed of a stream, or whether they will be scoured out (typical objects are log sills, rock chutes, large woody debris, or live vegetation). This project will attempt to develop tools that will predict the probability of various objects surviving in a stream bed. (Project leader: Bob Keller, Monash University)

Project 6.7. Developing an environmental flow methodology: a trial on the Campaspe River. Building on the on-going work with CRCFE on the Campaspe River environmental flow experiment, we will be developing a generic environmental flow methodology that attempts to mesh hydrology, geomorphology and ecology. (Project leaders: Dr Mike Stewardson, Univ. of Melbourne (michaels@civag.unimelb.edu.au); Bob Keller, Monash University)

Hatches, matches and despatches

Just some quick notes on recent developments in the program, with a human dimension!

- Lindsay White (working in Project 6.5: Fishways) has just returned from a month or so in Canada working with some of the world's top fishway researchers.
- Dr Mandy Uys from South Africa is spending a few months in the Geography Department at The University of Melbourne as an Honorary Research Fellow. During her stay she is developing cooperative projects in stream restoration with LWRRDC, as well as doing some research as part of the stream restoration project with Melbourne Water (Project 6.2).
- Inge Van der Pool from the Netherlands is also working at Melbourne University (Civil and Env. Engineering) as part of her course work. She too is working on the Melbourne Water project, developing criteria for catchment scale restoration experiments.
- Finally, I would like to welcome a new PhD student. Dominic Blackham from the UK spent a few months working at Monash a few years ago, and has returned as a prospective PhD student in the River Restoration program based in Geography at The University of Melbourne.

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COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

Report by David Perry

The Flow on Effect – June 2000

Just collaborative research?

The CRC for Catchment Hydrology runs on collaboration. Our research programs and outcomes result from an intensive process of collaboration, discussion, and negotiation between land and water managers and land and water research groups. Goodwill and the desire to maximise synergies between the groups underpin this process. This results in research outcomes that meet the needs of land and water managers.

It makes sense then for the communication and adoption of our research to follow the same successful strategy; one which involves both industry and research organisations. In fact, it is essential since our CRC's research is an integrated program addressing catchment scale issues, and necessarily involves a huge diversity of end-users and stakeholders.

A framework for collaborative communication and adoption

Over the last few months, I have been working on the development of a simple framework and implementation process which enables CRC project teams and industry staff to plan an effective strategy for the ongoing communication and adoption of the CRC's research outcomes. Many people have contributed to its design including the Focus Catchment Coordinators, Program and Project Leaders and Kevin Balm of Integra Pty Ltd.

The intent of this framework is to ensure that the dialogue between industry and researchers is maintained throughout the life of our projects, and that the CRC achieves a smooth transition in getting research outcomes into practice.

Below I have outlined the framework - without the associated tasks and mechanisms associated with its implementation. The process commences with the initial scoping of the research and ends when the impact of the research is assessed. Throughout a project's life, the framework provides focal points (the ten objectives) for continued collaboration between researchers and industry groups.

Cyclic Process

Many people have commented that the framework is common sense - suggesting that the ten objectives have a logical sequence and address the key issues in achieving the adoption of our research outcomes. Whilst the framework appears to be a linear model, it is not – each step in the process informs the other objectives. It is a cyclic process during the entire project and is regularly revisited as the research progresses.

Next Steps

My key task over the next few months is to facilitate the continuing dialogue required between researchers and research users to address the ten objectives in the framework. Each project will approach the implementation of the framework differently, but the result will be an effective communication and adoption plan for each CRC project. Each plan will be a first draft and will continue to evolve during the project with regular input from research users.

In essence the framework provides a focus for planning what needs to be done to ensure that our research program delivers products and knowledge in a form that meet the expectations of land and water managers - and ensures that it is a collaborative process.

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PLANNING PHASE	OBJECTIVE
Scoping Plan	1. Research needs, process & roles *Identify the issues and research needs, define research process and roles* 2. Research deliverables *Define research program/project outputs, deliverables* 3. Geographic priorities *Identify where the research outputs, deliverables are best applied/most needed*
Implementation Plan	4. End-users *Identify the categories of end-users and their influencers* 5. Adoption environment *Develop understanding about the end-users adoption environment (ie. the circumstances under which the research outcomes will be applied) – relevance, benefits, product forms, intrinsic rewards* 6. Communication pathways *Determine and strategically sequence mechanisms to reach end-users identifying risk factors involved* 7. Roles and responsibilities Define communications and adoption roles, responsibilities of research team, industry parties 8. Sustaining adoption *Determine how the application of research outputs will be reinforced/institutionalised*
Evaluation Plan	9. Monitoring Adoption *Determine how the adoption of outputs will be measured and monitored.* 10. Evaluating Impact *Determine how the effectiveness (outcome and impact) of adoption will be assessed*

NEW WORKING DOCUMENT

DISAGGREGATION OF DAILY TO HOURLY RAINFALLS FOR FLOOD STUDIES

by
Walter Boughton

Working Document 00/2

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

FLOOD FORECASTING REPORT

DEVELOPMENT OF A REAL-TIME FLOOD FORECASTING MODEL

VOLUME 4: EVALUATION OF THE XINANJIANG-URBS MODEL

by

R. Srikanthan
M.H. Khan
P. Sooriyakumaran
J.F. Elliott

Working Document 00/1

This working document and the three others in this series are available from the Centre Office for $20 each.

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CRC PROFILE

Report by Robert Argent

As a relatively new member of the CRC, I am taking the opportunity to provide a little background on myself, so that other CRC people will know who I am, and where I'm coming from, when I start jumping up and down and waving my hands about at meetings.

I'm leading Project 1.1, the "Toolkit" project, in Program 1: "Predicting Catchment Behaviour". This project has members at Monash, Melbourne, and Griffith universities, as well as at CSIRO Land and Water, DNRE, DNR Qld, and DLWC (and Fred Watson, in sunny Monterey Bay, California)

My interest in land and water resources management, and the application of research to solve "real-world" problems, comes from a farm upbringing in rural Gippsland, in Victoria, followed by an Agricultural Engineering degree at The University of Melbourne, in the early 1980s. This was in the early days of Tom McMahon's reign at the head of the Agricultural (now Environmental) Engineering section, when a graduating class of only five people was still acceptable. The legacy of that class still haunts environmental management in Victoria, with three of us (myself, Rodger Grayson, and Tony Ladson) still at the University, and Rowan Barling and Paul Saunders embedded in the rural water scene.

I followed up my undergraduate stint with a couple of years in New Zealand, working for the then New Zealand Agricultural Engineering Institute (NZAEI). At that stage New Zealand was entering the heady world of economic rationalism, and our group, being small, somewhat powerless, and pliable, were selected as guinea pigs for the great "earning outside income" experiment. That we succeeded was due to a mixture of good management, good skills, and a buoyant kiwifruit industry. The majority of my time, while not skiing and hiking through New Zealand's glorious National Parks, was spent designing artificial (ie constructed) windbreaks to protect fruit crops that included kiwifruit, grapes, nashi and persimmon. Having well and truly caught the travel bug during my time in New Zealand,

I returned briefly to Australia (for a short project on global hydrology at The University of Melbourne) before heading to Canada (via China and Russia - ok, so geography has never been one of my strong points) to undertake a Masters degree. In the choice between career (with a Masters at the Boundary Layer Wind Tunnel Laboratory, in Ontario) and outdoor adventure (with a Masters at the University of Alberta) I opted for "career". Whoops! London (Ontario) is a nice place to visit (but you wouldn't want to stay) and two years there was quite long enough. Luckily, the BLWTL hosts many overseas students and had an active and interesting student and staff group. Highlights of my Canadian time included skiing at Lake Placid (Lake Plastered?) and sailing in the Grand Bend 100 (an overnight race on Lake Huron), as well is getting a Masters of Engineering Science (for a thesis entitled "Wind Shelter and Crop Protection"). I also took the opportunity for some State-bagging in the US, ending up with about 23 of the contiguous states.

Returning to Australia in the lows of the "recession-we-had-to-have", I opted to return to The University of Melbourne to undertake a few months work as a research assistant before starting on a PhD. Tom McMahon and Francis Chiew had just received a grant under the National Greenhouse Advisory Committee's Greenhouse Research Grant Scheme (yes, NGAC's GRGS) which had, attached to it, money to support a PhD student. Tom and Francis were able to meet the requirements of the grant without extra input from a PhD student, so I (being lucky enough to land the PhD scholarship) had a bit of a free rein. After kicking around some ideas about palaeoclimatic reconstruction for a few months, I was faced one day, in a supervisors meeting, with a piece of fossilised red gum from a small quarry near Albury. The question - which became my research question - was that of creating hydrologic reconstructions for the River Murray based upon analysis of tree rings. Shouldn't be hard, I thought. Four years later I emerged with a PhD entitled "Dendroclimatological Investigation of River Red Gum (Eucalyptus Camaldulensis) Dehnhardt"; possibly not much closer to answering the question, but knowing what not to do to answer it!

During the latter part of my PhD I worked, with Rodger Grayson, on application of the AEAM (Adaptive Environmental Assessment and Management) methodology to nutrient management in the Goulburn River in Victoria, and also on a riparian research planning exercise in the North Johnstone River catchment, in Queensland.

These adventures exposed me to some new approaches and ideas in the area of research synthesis and transfer, and resulted, in 1996, by my involvement in the 5-year, LWWRDC funded "Research Integration" project (known officially as Integration of Research and Development in Catchment Management, and acronymically as the I&A of R&D in ICM). Through this project I have been involved in a range of research, social process investigations, case study

applications, and software development, and have developed a strong interest (maybe even a passion) for the delivery of appropriate software tools (when the use of software is appropriate!) for catchment management. Highlights have included involvement in the development of the AgET water balance program for the Western Australian wheatbelt, and the FILTER nutrient load assessment tool for the Port Phillip catchment. Consequently, when the opportunity to be involved in the "toolkit project" came up, I grabbed it with both hands, and that's where I am today.

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WHERE ARE THEY NOW?

Report by Mike Stewardson

Late last year, Michael Stewardson, a former CRC PhD student, completed his thesis titled "Characterising and Modelling the Hydraulic Environment of Streams". Since receiving his PhD, he has accepted a job with a progressive organisation, undertaking hydrological research within a multi-disciplinary framework, at the catchment scale. This may sound like the CRC for Catchment Hydrology, ... well it is! He is now a Research Fellow in the River Restoration Program (Program 6). Over the next three years, Mike will test the effectiveness of stream rehabilitation and continue research on hydraulic aspects of stream habitats. For the moment, he is located in the Department of Civil and Environmental Engineering at The University of Melbourne.

It is interesting to note that Mike is one of the few PhD graduates from the CRC that have gone on to work with an Australian research institution. It is not surprising that, despite excellent research training, most CRC for Catchment Hydrology PhDs move to government agencies or consulting companies rather than continuing with a research career. For some, it was their intention to leave research once they graduated. However, for others it is the temporary nature of post-doc research jobs that discourages them from continuing with research. As a large group, with secure funding, the CRC is in a strong position to provide longer-term post-doc research positions (eg. 3 years). Such positions are necessary if more senior level researchers are to be trained and retained in Australia. Supporting the employment of Mike Stewardson and other recent PhD graduates is a sign that the CRC is continuing to take on this responsibility.

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WORKING DOCUMENT

An Integrated Dataset of Climate, Geomorphological and Flood Characteristics for 104 Catchments in South-East Australia

by
Ataur Rahman
Russell Mein
Bryson Bates
Erwin Weinmann

Working Document 99/2

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