NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 78 NOVEMBER 1999

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

Integrating research – the challenge for the CRC

The concept of 'Integrated Catchment Management' (ICM) has been around now for some time, although there is still confusion as to what exactly is meant by the term. Generally, there is acceptance of the notion of taking a holistic (whole-of-catchment) approach, in which the interactions between important components (eg. water, land, vegetation, socio-economics) are properly considered. In catchments in which water and land resources are developed close to, or beyond, their sustainable level, the concept of ICM is an especially vital one.

It is easy for researchers to applaud the concept of ICM, but leave it to others to do the integrating. A typical approach is for specialist research in a number of catchment-related areas (eg. flood estimation, yield, erosion and sediment transport, aquatic biology, irrigation, wastewater treatment), with findings reported in scientific and technical literature. Catchment land and water managers are then expected to seek out and assimilate the findings of relevance to their own problems, and manage accordingly.

Not surprisingly, the links between land cover, climate variability, runoff, and river health are poorly understood by those charged with catchment management. When political and socio-economic aspects are included, the picture becomes rather more obscure.

What managers want

Managers want tools (Decision Support Systems) that enable them to manage their catchments. They want these tools to integrate hydrologic, meteorologic, geomorphic, ecologic, and socio-economic knowledge to allow them to simulate land-use and water management decisions in a holistic way.

Clearly, such tools will need to be able to handle a range of problems, and therefore a range of spatial and time scales. With them, they could look at the effects of a seasonal climate aberration over a few months, or the change in stream water quantity and quality due to land clearing (or afforestation) over decades.

Is it realistic to contemplate the development of Decision Support Systems with this capability?

What is proposed in the CRC

The premise of the CRC for Catchment Hydrology is that such integration is possible, and it is putting together a suite of research projects to help achieve it. The challenge is to bring together research and knowledge from a number of disciplines, and to combine that knowledge into an integrated package.

(This is new ground for us. Long-term readers of *Catchword* will remember our former discipline-based programs like Forest Hydrology and Flood Hydrology; these were relatively much easier to conduct because researchers were able to stay within their areas of expertise, or 'comfort zones'.)

The projects we are working up will achieve integration in a number of ways.

First, scientists from different disciplines are working together on individual projects. For instance, in the Climate Variability Program, meteorologists and hydrologists are developing forecasting capability; in Sustainable Water Allocation, economists are combining with water-resource specialists.

Second, we are developing a modelling platform to provide for the combination of tools from different disciplines. These will include many of the existing models already in use, but combined to provide multi-disciplinary capability.

Third, we will ensure compatibility with GIS database systems, which are now becoming the industry standard for storing spatial information of all kinds. Such systems are a key ingredient in making integration possible.

The resulting CRC research projects will thus be inter-linked, with each feeding information to, and being dependent on, others. We are using risk-management approaches to ensure that the set of projects is 'robust', ie. that the 'failure' of one project to meet objectives will not jeopardise others. We'll have checks and contingency plans to cope with the sort of unknowns that are typical in research.

Integration of research is essential for the CRC to meet its mission to provide 'resource managers the capability to assess the hydrologic impact of land-use and water management decisions at whole-of-catchment scale'. It is a challenge we aim to meet.

Russell Mein
Tel: (03) 9905 2704
Email: russell.mein@eng.monash.edu.au

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VIRGINIA VERRELLI ON
TEL (03) 9905 2704 or
FAX (03) 9905 5033
EMAIL virginia.verrelli@eng.monash.edu.au

PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rob Argent

Following on from Program and Project updates in recent editions of *Catchword*, the following article covers the objectives and methodologies proposed for Project 1.1 and 1.2, together with a brief description of the ephemeral Project 1.3.

A Catchment Modelling Toolkit (Project 1.1)

This is a fine and interesting project (as you read last month – but then, I'm biased) that will be investigating options for development of a toolkit of computer programs to assist in predicting catchment behaviour. We will be looking into the design and eventual selection or development of a framework that allows us to integrate different computer programs into one "toolkit". The toolkit will include testing of existing frameworks, examining programs in use to see where they could be made more accessible and simpler to run, and development of new and existing models (including those embodied in other CRC for Catchment Hydrology Programs).

A significant component of the first year of Project 1.1 will be the development of documentation, validation, and review standards for the models that are included in the toolkit. Few programmers would dare claim that they write completely bug-free code, although it is likely that most bugs do not significantly alter the program outputs (or outcomes?!). As recent experience (Catchword, August 1999) has shown, this is not always the case. In Project 1.1 we will develop a sensible approach whereby the details of program operation and the underlying models (algorithms) are described in a way (maybe using a standard visual modelling language) that enhances comparison between the theory of the model operation and the program code.

Early activities of Project 1.1 will include three separate workshops, with aims: 1) to identify which models are being used by our CRC Parties and why; 2) to classify the key catchment management questions being asked of models, and 3) to find out from all CRC for Catchment Hydrology modellers their current design and deployment paradigms, and model development plans. Other activities over the initial three year project period include a review of model linkage protocols and software engineering practice (relevant to programs used in catchment management), a review of existing modelling frameworks under development, specification of draft protocols for model documentation, review and validation, the integration of existing models into candidate frameworks, and the selection and development of a pilot framework for the modelling toolkit.

Scaling procedures to support process-based modelling at large scales (Project 1.2)

Another fine project, and one which refers to scale twice in one title! In Project 1.2 the aims include the development of representations of spatial variability in soil moisture and landscape characteristics that allow relaxation of various assumptions about uniformity in both the Bureau of Meteorology weather model (Project 5.1) and the CRC for Catchment Hydrology large-scale catchment yield model (Project 2.3).

Further to this, Project 1.2 will develop representations of the temporal variability in precipitation intensity that occur at the sub-daily scale. These representations can then be used to simulate the effects of short period intense precipitation without the need to run models at very short time scales – something which we should obviously try to avoid if we can.

Beyond these various representations of spatial and temporal variability, the Project will then go on to generalise the methods previously developed for application to other models, particularly those that will form part of the modelling toolkit (Project 1.1 – see the Project description above, just in case you missed it the first time). On top of this, a meta-methodology will be developed that will allow ready determination of the circumstances where these methods and representations need to be applied, and when they can be ignored without affecting simulated behaviour.

Quantification of uncertainties in hydrological modelling and model predictions (Project 1.3)

This project has not been prepared as a project agreement, but has been mooted for further consideration due to its place close to the heart of all hydrologists. "Uncertainty", I hear you say, "well, I'm not sure about that". In Project 1.3 (if it is supported now or in the future as a CRC for Catchment Hydrology project) the overall goals are to develop and apply unified approaches for uncertainty analyses that are applicable to a wide range of hydrological models. The method used will involve working closely with a number of CRC for Catchment Hydrology projects on the application of largely Bayesian approaches to new and existing models. This approach is aimed at enhancing the utility of the outputs from those projects whilst learning where and how to include uncertainty analyses in model design.

Robert Argent
Tel: (03) 9344 7115
R.Argent@civag.unimelb.edu.au

PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Report by Peter Hairsine

External links

In this month's *Catchword* I want to emphasise links to external groups where the outputs of this program can be combined with the research outcomes from elsewhere.

Workshop on water supply protection

Recently Fiona Dyer and I gave a talk to the CRC for Water Quality and Treatment workshop on catchment management for protection of water supplies. The aim of the workshop was to identify the issues of concern to the water supply industry, especially management options that have the potential for improving water quality. The focus was on catchments rather than reservoir management. Other presentations on current research were made by representatives of the CRC for Water Quality and Treatment, the CRC for Freshwater Ecology, the University of New South Wales and the Australian Water Quality Centre.

The workshop emphasised diffuse pollutants including organic matter, phosphorus and sediment. Water engineers have a growing interest in the functioning of stream networks and the connection between diffuse pollutant sources and reservoirs. The workshop is another milestone in the movement to "treating the catchment to minimise treating the water".

The contribution of our research was based around the Tarago work. In that project we found sediment tracing had benefits in targeting land management measures to hot spots. We also showed the benefits in riparian management for lessening the impacts of land use on the delivery of sediment and nutrients to water supply streams.

Roads in forestry environments

Another linkage of this program to the research and communication of other groups concerns unsealed roads in forestry environments. I recently presented a seminar on the topic of 'Does runoff from roads and tracks reach streams?' This work concerned an important objective in minimising the impact of roads and tracks upon instream water quality: reducing sediment movement in non-channelised overland flow.

Work in our CRC's Forest Hydrology Program by Jacky Croke and her team has focussed upon two other objectives in the environmentally sensitive design and maintenance of unsealed roads. They are: minimising the erosion of the road and tracks themselves, and the prevention of extensions to the stream network through gullying at road drainage outlets.

Jacky and I now propose to provide a design approach that combines these three objectives. This approach will be discussed in the upcoming IUFRO workshop, 'The State of Knowledge in Forest Hydrology', and will be formalised in a book chapter in preparation by Jacky and myself.

Peter Hairsine
Tel.: (02) 6246 5924
email: peter.hairsine@cbr.clw.csiro.au

NEW INDUSTRY REPORT

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

by

Jacky Croke
Peter Wallbrink
Peter Fogarty
Peter Hairsine
Simon Mockler
Bob McCormack
Jim Brophy

Report 99/11

This report presents an overview of CRC research findings on the management of sediment sources and delivery pathways and the effectiveness of best management practices.

This report is relevant anyone involved in the forest industry, shire councils, road planning and catchment water quality management.

Copies available from the Centre Office for $25.

NEW TECHNICAL VIDEO

CATCHMENT WATER BALANCE
A SIMPLE APPROACH

Presented by

Dr Lu Zhang
CRC for Catchment Hydrology
CSIRO Land and Water

CRC VIDEO 99/4

Results from over 240 catchments in many parts of the world, including Australia, show that for a given forest cover, there is a good relationship between long-term average evapotranspiration and rainfall.

This seminar describes the development of a simple two-parameter model that relates mean annual evapotranspiration to rainfall, potential evapotranspiration, and plant available water capacity.

PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader: John Tisdell

Report by Gary Codner

Project 3.1 Integration of Water Balance, Climatic and Economic Models

Bulk Entitlements – hydrology and economics

Over recent years, overall allocations of water resources for various uses (e.g. irrigation, town supply, hydro) - bulk entitlements for water - have been determined for a number of catchments in several states. This has essentially been done on a hydrologic basis alone by converting previously existing water demands into bulk entitlements. Water authorities are now attempting to optimise the use of the resources allocated to them within the constraints imposed by the regulatory frameworks. The economic aspects of the water resources have largely been ignored, yet the interconnection of hydrologic and economic aspects to achieve an economic and technological efficiency is clear.

The Council of Australian Governments (COAG), based on traditional market theory, introduced water trading as a mechanism for achieving an optimal distribution of water entitlements. The market, however, will be constrained by hydrological capacity to supply, and by regulatory constraints, including environmental flow requirements.

Long term modelling for water resources planning

Detailed system simulation models such as IQQM and REALM are currently the basic tools to assess a water resource system's response to different combinations of climatic inputs, water demands and water management scenarios. These models are typically run over long historical or stochastically generated climate sequences to assess the long-term system performance (security of supply). However, to produce realistic outputs for planning purposes, the models need to closely reflect the seasonal allocation and system operation decisions made by the water authority for a shorter operating horizon (typically the remainder of the current season). The changed allocation and water use frameworks created by COAG initiatives and other reforms, e.g. water trading markets, on-farm adaptation strategies, and changed regulatory frameworks, have brought a new dimension to these modelling tasks.

Decision-making for seasonal water allocation

There is currently increasing pressure on water authorities to make fuller use of the resources available in a season, by allowing temporary or permanent transfers of water to areas of high demand and by reducing inefficiencies in water use. However, such seasonal allocation decisions require new decision support tools and need to be checked for consistency with long-term performance targets and regulatory constraints.

Current models

The two main models used by CRC for Catchment Hydrology Parties, IQQM (used in NSW and QLD) and REALM (used in Vic), have evolved over some time to deal with the recognised modelling issues within their domains of application. A very large effort has been invested into applying these models in the major water resource systems of these states to produce results for a range of planning decisions. Both models are highly developed, but they differ in many of their basic features and capabilities.

Improvements to models

A range of enhancements to existing models is desirable to address the emerging modelling needs and to allow integration with improved climate and economic models developed in other CRC for Catchment Hydrology projects.

To provide water authorities with more powerful tools to ensure efficient and sustainable water management, the project proposes to address the following key areas for model improvements:

- Greater ability to incorporate the key factors that drive seasonal allocation decisions in the model operating rules. The currently-used rules and constraints reflect operating practice that is based on experience with historic allocation frameworks, farm practices and economic environments, rather than being responsive to present or future conditions.
- Improved capacity to undertake assessments of dynamic system behaviour. This will allow for the variations and interactions of climate, demand, water management and economic environment factors over a the full range of conditions that might occur in future years.
- Enhanced scope to use the models to support medium term operational decisions. That is, to run the models in a mode that uses inputs conditioned on the current state of the system, e.g. forecasts of seasonal climate conditions and economic outlook information.
- Modelling capabilities to translate the hydrologic and water quality performance measures produced by

simulation models into socioeconomic and environmental performance measures that are more meaningful to the stakeholders and more conducive to effective public participation in the decision making processes.

Other potential developments

Enhanced real-time modelling capabilities to support the day-to day operation of water resource systems are also seen as important for water authorities and users. Many of the features of the enhanced planning and seasonal allocation models would be readily applicable to real-time modelling systems, but these would require a number of additional modelling capabilities.

Gary Codner
Tel.: (03) 9905 4969
Email: gary.codner@eng.monash.edu.au

NEW TECHNICAL REPORT

FOREST MANAGEMENT FOR WATER QUALITY AND QUANTITY PROCEEDINGS OF THE SECOND FOREST EROSION WORKSHOP - MAY 1999

by
J.Croke
P.Lane

Report 99/6

This report contains the Proceedings of the Second Erosion in Forests Workshop held in Warburton in May 1999. This volume of short papers and abstracts reflects the wide range of research approaches and tools currently used to measure and model the impacts of timber harvesting activities, including road construction and vegetation changes, on water quality and quantity.

Copies available for $20 from the Centre Office.

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

NEW TECHNICAL REPORT

BLACKBURN LAKE DISCHARGE AND WATER QUALITY MONITORING PROGRAM: DATA SUMMARY AND INTERPRETATION

by

Sharyn Rossrakesh
Chris Gippel
Francis Chiew
Peter Breen

Report 99/13

The 100 page report documents work undertaken by the CRC for Catchment Hydrology and the CRC for Freshwater Ecology on the performance of an urban pollution control pond in Melbourne.

Copies of the report will be available from the Centre Office at the end of November 1999 for $25. Advanced orders can be placed.

PROGRAM 4
URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Tony Wong

Water Sensitive Road Design

The Urban Hydrology Program of the initial CRC completed a review of available options for incorporating stormwater quality improvement measures into road design. This work was for the Australian Road Research Board in a project funded by AusRoads. The report, which was prepared by the study team consisting of Peter Breen (CRC for Freshwater Ecology), Sara Lloyd (PhD Student) and myself, is entitled "Water Sensitive Road Design: Design Options for Improving Stormwater Quality of Road Runoff". It will be published separately by the CRC.

Limiting environmental degradation

There is increasing public concern that stormwater generated from urban catchments can lead to significant degradation of environmental values of urban aquatic ecosystems. Water Sensitive Urban Design practices are being promoted in urban development to address issues of physical and biochemical impacts of catchment urbanisation on the aquatic ecosystem. Many factors influence aquatic ecosystem health but often changes in catchment hydrology and the stormwater quality are the main driving factors in ecosystem health deterioration. Design options for improving the quality of road runoff form an important element in an integrated approach to Water Sensitive Urban Design. The above report explored a range of stormwater quality improvement measures that could be incorporated into road design practices.

Impact of road surfaces

Roads and other transport-related impervious surfaces can constitute up to 70% of the total impervious area in an urban catchment. The report examined the nature and significance of pollutants conveyed in stormwater runoff from road surfaces. It was found that road surfaces, including car parks and driveways, contribute a higher proportion of stormwater pollutants than other impervious surfaces (eg. roof areas, pedestrian, pathways etc.). Monitoring of stormwater quality from these surfaces consistently shows higher concentrations of TSS and associated contaminants such as lead, zinc and copper as shown in the table below. Many of the pollutants are associated with inorganic particulates washed off road surfaces by stormwater.

Traffic volumes

Limited field studies have also indicated that stormwater pollutant concentrations are related to traffic volumes in roads. Concentrations of key pollutants in highways with traffic volumes greater than 30,000 vehicles per day were found to be as much as four times higher than roads of lower traffic volumes. (Please see table next page).

Rural areas versus urban roads

Comparison of hydrocarbons generated from rural catchments with that from urban roads indicated that road runoff hydrocarbon concentrations are at least an order of magnitude higher.

Removing suspended solids

The options examined in this report placed particular emphasis on the removal of suspended solids. Effective removal of suspended solids can often reduce a significant proportion of other contaminants conveyed by stormwater. Many of the options examined involved the use of

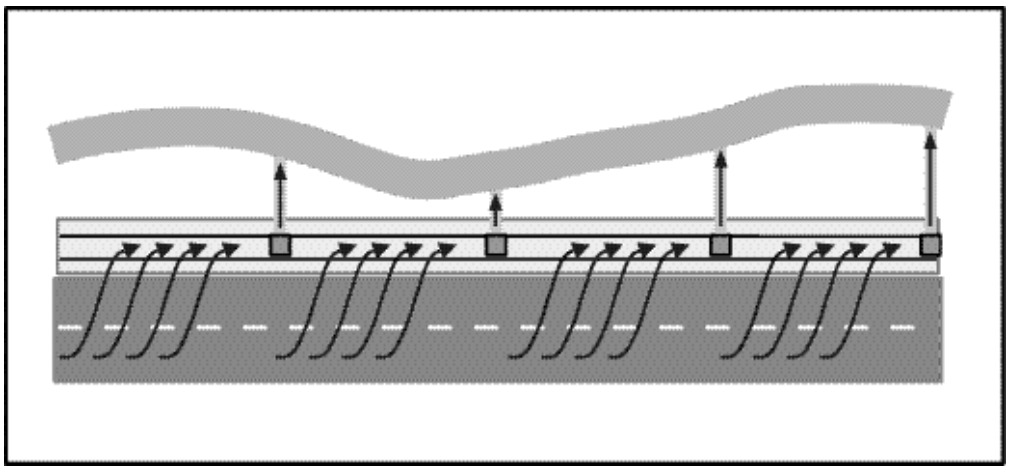
URBAN LANDUSE AND TYPICAL POLLUTANT LOADS (KG/HA/YR)

Land use	TSS	Pb	Zn	Cu	TP	TKN	NH4-N	NOx-N	BOD	COD
Freeway	986	5	2.4	0.41	1	8.8	1.7	4.7	N/A	N/A
Parking lot	448	0.9	0.9	0.04	0.8	5.7	2.24	3.24	53	302
High density residential	470	0.9	0.8	0.03	1.1	4.7	0.9	2.2	30	190
Med. density residential	213	0.2	0.2	0.15	0.5	2.8	0.5	1.6	14	80
Low density residential	11	0.01	0.04	0.01	0.04	0.03	0.02	0.11	N/A	N/A
Commercial	1120	3.0	2.4	0.45	1.7	7.5	2.1	3.5	69	470
Industrial	963	2.6	8.1	0.56	1.4	4.2	0.22	1.45	N/A	N/A
Park	3.3	0.005	N/A	N/A	0.03	1.6	N/A	0.33	N/A	2.2
Construction	67,200	N/A	N/A	N/A	90	N/A	N/A	N/A	N/A	N/A

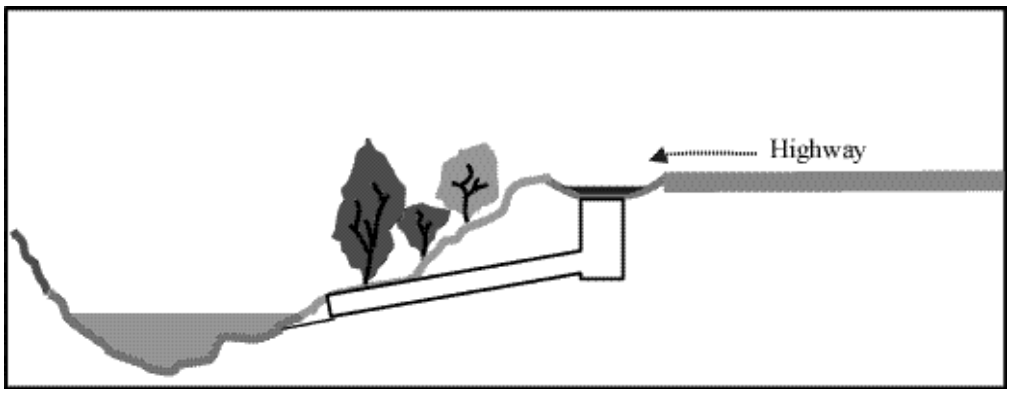
US HIGHWAY RUNOFF CONCENTRATIONS FOR VARIOUS STORMWATER POLLUTANTS

Pollutant	EMC for highways with < 30,000 vehicles/day (mg/l)	EMC for highways with > 30,000 vehicles/day (mg/l)
Total Suspended Solids	41	142
Copper	0.022	0.054
Zinc	0.08	0.329
Lead	0.08	0.4
Nitrite & Nitrate	0.46	0.76
TKN	0.87	1.83
Phosphate	0.16	0.4
Volatile Suspended Solids	12	39
Total Organic Carbon	8	25
Chemical Oxygen Demand	49	114

EMC : Event Mean Concentration



Plan Illustration of Swale Drain Road Runoff Management Option.



Longitudinal Section Illustration of Swale Drain Road Runoff Management Option.

SECOND EDITION OF INDUSTRY REPORT PUBLISHED

MANAGING URBAN STORMWATER USING CONSTRUCTED WETLANDS

by

Tony Wong
Peter Breen
Nicholas Somes
Sara Lloyd

Report 98/7

Over 900 copies of this successful Industry Report have been sold resulting in a Second Edition. This new edition includes a new section, Appendix A, which answers a number of common questions on the use of constructed wetlands in stormwater management.

Copies available from the Centre Office.

NEW TECHNICAL REPORT

PREDICTING THE EFFECT OF VEGETATION CHANGES ON CATCHMENT AVERAGE WATER BALANCE

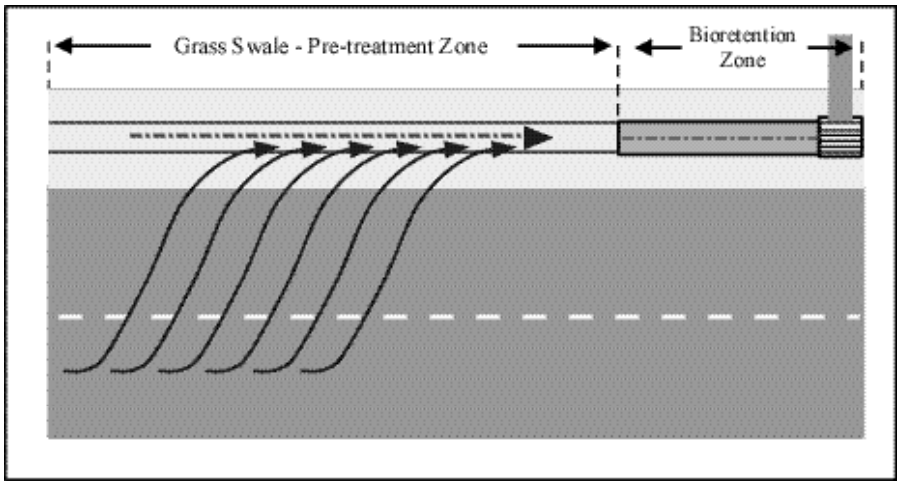
by

Lu Zhang
Warwick Dawes
Glen Walker

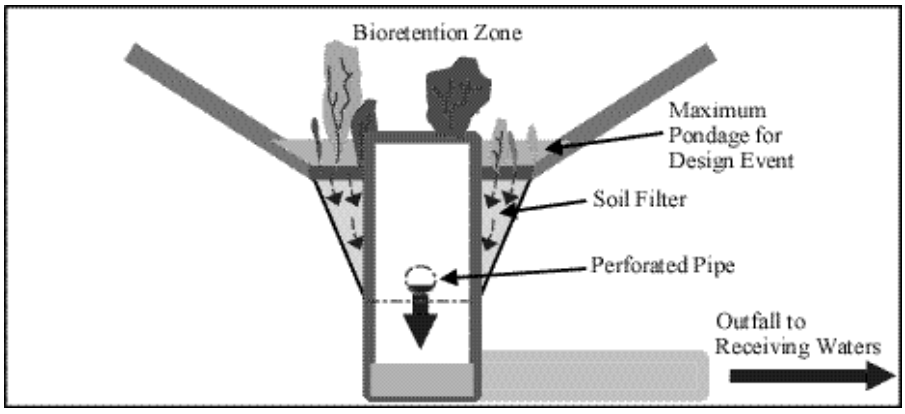
Report 99/12

This project's aim was to estimate the effects of afforestation or deforestation on run-off that leads to recharge to some of the alluvial catchments in the upland areas of the Murray-Darling Basin. The method proved to be very successful and can be more widely used by providing a basis for making estimates of the water yield impacts of wide-scale afforestation in Murray-Darling Basin

Copies of the report will be available from the Centre Office at the end of November 1999 for $25. Advanced orders can be placed.



Plan Illustration of Swale Drain and Bioretention System for Managing Road Runoff.



Cross Section Illustration of Bioretention Media.

vegetation in grassed swales, buffer strips or constructed wetlands to facilitate removal of suspended solids. The principal pollutant removal mechanisms are those of filtration, enhanced sedimentation and particle adhesion. These vegetated systems represent current best practice and are the subject of extensive on-going research in Australia and overseas, directed at further refinement of their design specifications. An example of one of these options is illustrated in *Figure 1*.

Infiltration approach

Other options that are considered to be effective in improving stormwater quality of road runoff include the promotion of infiltration through a "bioretention" media. In this approach, the principal pollutant removal mechanisms are filtration and biological uptake of soluble pollutants by biofilms in the infiltration media. Pre-treatment of stormwater to remove coarse and medium-sized particulates is necessary to ensure continued effective operation of the infiltration system and this can be provided by conveying stormwater to the system via a grassed swale. This is illustrated in *Figure 2.*

Summary

This report has demonstrated, through hypothetical case studies and worked examples, how many of the stormwater quality improvement measures can be sized and incorporated into road design. Variations in the design of the same treatment measures are applied to suit different site conditions and other road design objectives. A marginal incremental cost for road construction could be expected from many of these measures. Their implementation essentially requires the road designer to consider design objectives beyond the traditional objectives of road engineering.

Tony Wong
Tel: (03) 9905 2940
Email: tony.wong@eng.monash.edu.au

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM MCMAHON

Report by Alan Seed and Francis Chiew

Introduction

We have proposed two projects in the Climate Variability Program to the CRC Board; (Project 5.1) Modelling and forecasting hydroclimate variables in space and time, and (Project 5.2) National data bank of stochastic climate and streamflow model. Project 5.1 is discussed here.

Background and objectives of Project 5.1

Rainfall and runoff can vary considerably from year to year. The management of land and water resources involves designing and operating to cope with the variability in the climate system. In Australia, the management problem is compounded by the higher inter-annual variability of river flows compared to elsewhere in the world. The ability to forecast climate and streamflow days or months ahead is thus invaluable to the management of land and water resources systems. This project will develop space-time models of rainstorms and models for forecasting rainfall and streamflow from several hours to several months ahead.

Main research areas of Project 5.1

This project will develop models for characterising the spatial and temporal properties of rainstorms for various climate regions of Australia. The models will be based on the multiplicative cascade method described in the October *Catchword*. The same method will be used for forecasting rainfall for the very short-term (up to three hours ahead) by tracking and advecting the spatial characteristic of the rainstorm forward in time.

Numerical weather prediction models

Research will also be carried out to improve the representation of surface hydrology in Numerical Weather Prediction (NWP) models. NWP models are run operationally by many national weather agencies, and they provide the basis for medium-term forecasts of climate variables (12 hours to one week ahead) (see September *Catchword*). The accurate modelling of the land surface processes and the interaction of these processes with the atmosphere, are vitally important to the accuracy of the NWP forecast.

Forecasting aspects

The NWP models have reasonable skill in forecasting rainfall up to one or two days ahead, but the skill reduces quickly as the forecast lead-time increases. Two methods that can use outputs from the NWP models to forecast rainfall up to one week ahead will be explored. The first is a stochastic downscaling technique that relates atmospheric variables forecasted by the NWP models to point or catchment rainfall. Downscaling techniques are used because - although NWP models have little capacity to forecast rainfall over the longer term - the forecasting of large-scale atmospheric variables is still reasonably reliable. The second method uses the space-time rainfall model, which is initiated with the shorter-term NWP forecasted rainfall.

Seasonal rainfall and streamflow

The project will also develop methods for forecasting seasonal rainfall and streamflow. Statistical methods that relate rainfall and streamflow to El Nino/Southern Oscillation (ENSO) and the serial correlation in streamflow will be developed. The use of the space-time rainfall model to forecast seasonal rainfal, and the use of stochastic downscaling techniques to forecast rainfall from large-scale atmospheric variables forecast by climate models, will also be explored.

This project will also investigate the benefits and risks of using the seasonal forecasts in the management of water resources systems.

Outcomes

The outcomes from the project will be models for characterising the spatial and temporal characteristics of rainstorms and methods for forecasting rainfall and streamflow several hours to several months ahead.

The project involves some fundamental research exploring new techniques as well as the refinement and further development of existing methods. The methods developed in the project should be applicable anywhere, but will be tested using data mainly from the focus catchments.

The research will further our understanding of hydrological processes and hydroclimate teleconnections. The scientific results will be published in journals and presented in expert seminars and conferences. The research results will also be used directly in the Bureau of Meteorology operational NWP models. The project will also produce other technology transfer products, such as PC-based computer models - models that are likely to have many users in the water industry (e.g., a statistical model for forecasting seasonal streamflow, a space-time rainfall model, and a design storm model).

NEW VIDEO

EROSION IN FORESTS FIELD TOUR WARBURTON, VICTORIA MAY 1999

CRC VIDEO 99/3

This new CRC video presents the field tour in the Noojee State Forest undertaken as part of the recent 'Second Erosion in Forests Workshop'.

The video includes presentations by forest managers and researchers as well as questions from participants and group discussion.

Copies are available for $20 from the Centre Office.

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

STREAM CONFERENCE PROCEEDINGS

The Proceedings of the Second Australian Stream Management Conference held in Adelaide earlier this year are available through the CRC Centre Office for $95.

The two volumes (750+pp) consist of over 150 papers covering all aspects of stream management.

Please contact Virginia Verrelli on 03 9905 2704 to order your copy.

Links

The Bureau of Meteorology, University of Melbourne and CSIRO Land & Water are the main CRC research parties, with the water agencies involved in the testing and application of the methods on the focus catchments. Existing linkages between researchers in this project and other leading researchers in Australia and overseas will ensure the development of state-of-the-art approaches. This project also has numerous links to other CRC for Catchment Hydrology projects through collaborative research, model development to provide input data to other projects, and computer software development of catchment modelling toolkit.

Timing

This project should start in January 2000. The project is initially planned for three years, but depending on the resources available, the project may be extended beyond the three years.

Francis Chiew
Tel: (03) 9344 6644
email: f.chiew@civag.unimelb.edu.au

PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Nick Marsh

Program update

After a series of pretty specific articles from the River Restoration stable (regarding large woody debris and environmental flow modelling), it is time for a more general update on the program. This article will remind readers of the purpose of the River Restoration Program, where the planning is up to, and how we are planning to mesh the program with the research planned by the CRC for Freshwater Ecology.

What is river restoration?

River restoration is the return of natural, environmental values to streams. There is tremendous enthusiasm to rehabilitate Australian streams, with at least $50 million being spent on this activity in Australia each year. This research program aims to provide stream managers with tools that they can be confident in using, and with an understanding of stream processes. Both of these will lead to more effective expenditure on restoration, and ultimately, healthier streams. Stream health is usually measured in terms of the organisms that live in streams, but the health of these organisms is often the result of physical processes. Thus, the strength that the CRC for Catchment Hydrology brings to stream restoration is in the disciplines of hydrology, hydraulics and geomorphology.

Background to program

As a result of the Woodend Workshop in 1998, and the Technical Advisory Group (TAG) process, three interrelated projects were proposed in this program. They cover planning and evaluation of stream restoration (Project 6.1), tools for restoration (Project 6.2), and understanding the physical processes of restoration (now incorporated into Project 2.1, and jointly managed with Peter Hairsine under the "Land-use impacts on rivers" program). The TAG proposed that the three projects should get about 35%, 25% and 40% respectively of the proposed budget.

Project 6.1 Planning procedures and evaluation for stream restoration projects

Two of the most pressing gaps in the area of river restoration are the lack of examples of restoration projects that are firstly well planned, and secondly well evaluated.

The purpose of Project 6.1 is:

- To trial stream rehabilitation procedures (as described in the Stream Rehabilitation Manual) in a reasonably large catchment (ie. to use the procedure to prioritise and plan works in a large catchment)
- To build and rigorously evaluate some large scale stream rehabilitation projects in partnership with the management agencies.

Note that such projects are major undertakings and require unprecedented cooperation between agencies, researchers and the community. In part, this is because the projects need to continue for at least 5 – 6 years. Organisations like the CRCs are well placed to do this type of project in the present research and government environment.

Before we embark on this type of project it is wise to include three other tasks. These are to:

- Develop targets for physical and ecological systems (to be done in association with Program 4);
- Develop models to assess whether these targets are achievable in the planned projects; and
- Learn what we can from existing stream rehabilitation projects. For this we need to review and assess a cross-section of existing stream rehabilitation projects around Australia.

The existing Stream Rehabilitation Manual provides a good place to start with the planning procedure. It also provides a medium for transferring results quickly. One of the key goals of this project is to maintain and update the manual, and develop training material from it.

Project 6.2 Improved design of tools for stream restoration

The aim of this project is to improve the confidence with which people can design and apply tools for stream restoration in Australian streams. There is huge demand for 'hybrid' stream management structures that perform their function, but have reduced environmental impact. Examples are: structures that provide fish passage but still perform as rock chutes, gauges, or culverts; or bank protection that incorporates vegetation (bio-engineering). Unfortunately, managers are often not willing to risk altering standard engineering designs with untested modifications. For example, how can fish passage be ensured over a gauging structure without compromising its use as a gauge? The aim of this project is to predict the behaviour of rehabilitation activities in streams in order to reduce the risk associated with construction.

Activities in this area include: fishways (vertical slot and rock-ramp), incorporating vegetation into engineering structures (bio-engineering), and returning large woody debris to streams. It is also intended that we develop a decision support system to assist managers in deciding which of the numerous techniques available would be the best for a particular situation.

Project 2.1 Sediment movements, water quality and physical habitat in large river systems

Many river restoration problems relate to the instability of streams, and the movement of sediment through streams. This project examines these issues at an unprecedented catchment scale.

More details of each of these projects will be given in future articles in *Catchword*.

Interaction with the CRC for Freshwater Ecology and other CRCs

There should be close cooperation between the four water related CRCs. This has been emphasised to us many times, particularly in our Fifth Year review, and as a condition of our successful second round bid. In particular there should be close cooperation in the River Restoration Program with the CRC for Freshwater Ecology (CRCFE). In fact the CRCFE also has a stream restoration program. How will the two Restoration programs cooperate?

To ensure that there is the fullest cooperation at the project level, it is proposed that the two CRCs develop joint project contracts for specific activities. Such contracts will be required where the success of the project is dependent upon cooperation of both parties.

Joint contracts will be developed where there is considerable overlap between projects in the two Centres. In the Restoration Programs we have identified four specific activities for which joint contracts are proposed.

Agreement 1: Criteria for evaluating stream rehabilitation projects
Evaluating stream rehabilitation projects is a central activity in the two CRCs. It is appropriate that the CRCs jointly develop criteria for selecting and designing projects for evaluation.

Agreement 2: Restoration of the Granite Creeks, Vic.
This will be a major exercise in understanding physical and biological processes in a moderately sized catchment, and then attempting to restore sections of the stream. The project will require intense work from both CRCs.

Agreement 3: Planning and restoration in the Yarra Catchment
Again, this project involves intense evaluation of rehabilitation work by both CRCs, in cooperation with

NEW TECHNICAL REPORT

GUIDELINES FOR STABILISING STREAMBANKS WITH RIPARIAN VEGETATION

by

Bruce Abernethy and Ian Rutherfurd

Report 99/10

The Queensland Department of Natural Resources contracted the CRC for Catchment Hydrology to write technical guidelines to help specify the width and composition of vegetated riparian zones, for bank erosion control.

This report will guide and focus the practitioner's approach to planning riverbank stability works using vegetation.

The report is available from the Centre Office for $25.

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

ANNUAL REPORT

The CRC for Catchment Hydrology 1998/99 Annual Report is available.

Free copies can be obtained from the Centre Office.

Melbourne Water. In contrast with the Granite Creeks projects, here we will be trialing a rehabilitation planning procedure, and possibly selecting an entire sub-catchment to rehabilitate.

Agreement 4: Evaluation of riparian revegetation in a SE Queensland catchment

This project is still being negotiated, but there is potential to develop a long-term evaluation site in SE Qld.

Details of proposed Projects with joint CRC activity will be further refined as the two CRCs move through their planning stages.

Nick Marsh
Tel: (07) 3875 7101
Email: nick.marsh@mailbox.gu.edu.au

COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

The Flow on Effect – November 1999

Introduction

Since July this year much of the CRC's focus has been on planning the research for the new CRC. At the same time, research results from the old CRC are being published as Industry Reports, Technical Reports and CRC videos. Accordingly, this month I will briefly describe some of the recent and 'soon to be available' publications – you never know, they may make the ideal Christmas gift!

New Industry Report

As part of the recent Industry Seminar on 'Managing Sediment Sources and Movement in Forests', a CRC Industry Report has been prepared and is now available for $25 from the Centre Office. The 38 page report summarises the CRC research findings under three major categories: Sediment and Runoff Sources; Sediment-Delivery Pathways and Best Management Practices.

Each section presents the key research findings and describes the fundamental aspects of controlling sediment delivery to streams in forested catchments. The report includes the identification of key sources of sediment and delivery 'hotspots' in a forested catchment and how best to plan and locate roads for water protection. The report will assist those involved in the forest industry, shire councils, road planning and catchment water quality management.

Erosion in Forests Workshop – Field day Video

The successful 'Second Erosion in Forests Workshop' held at Warburton in May this year attracted over 100 forest researchers and managers. The second day of the workshop included a field day in the Noojee State Forest in Victoria. A CRC video crew was on site for the day to record the presentations by researchers and forest managers, as well as questions from participants and group discussions. The video includes footage of the examples referred to by the speakers. This video is also available from the CRC Centre Office and complements the new Industry Report.

Research Reports Relevant to River Managers

Two technical reports recently released will be of value to many river managers. Both are available from the Centre Office.

The CRC Report 99/7 entitled 'Physical Evaluation of Rehabilitation Works in Broken River and Ryans Creek, North East Victoria' by Michael Stewardson is a unique study in Australia. The research project set out, not only to design and build structures that would contribute to stream rehabilitation, but also to evaluate whether they improved the ecological condition of the stream. The report explores some methods that could have wide application in future evaluation of stream rehabilitation.

'Guidelines for Stabilising Streambanks with Riparian Vegetation' by Bruce Abernethy and Ian Rutherfurd (CRC Report 99/10) meets the practical needs of a river manager. The guidelines provide assistance in planning and implementing riparian revegetation works specifically designed to retard bank erosion rates to more natural levels. The authors' intention is to provide some general rules for deciding on the structure and width of vegetated riparian zones for bank erosion control. A companion report 'Guidelines for Riparian Filter Strips for Queensland Irrigators' by researchers Linda Karssies and Ian Prosser and published by CSIRO Land and Water provides detail on the design of riparian zones to filter sediment and nutrients from overland flow entering streams. Copies of this report are available from:

Leanne Dempsey, Senior Communication Officer
CSIRO Land and Water
GPO Box 1666 Canberra ACT 2601
Tel: 02 6246 5717
Fax: 02 6246 5800
E-mail: Leanne.Dempsey@cbr.clw.csiro.au

Blackburn Lake Report

'Blackburn Lake Discharge and Water Quality Monitoring Program: Data Summary and Interpretation' by Sharyn Rossrakesh, Chris Gippel, Francis Chiew and Peter Breen will be published later this month (around the time you receive this *Catchword*). The 100 page report documents work undertaken by the CRC for Catchment Hydrology and the CRC for Freshwater Ecology on the performance of an urban pollution control pond in Melbourne. To achieve this, two years of intensive flow and water quality data were collected and analysed. The technical report will be available from the Centre Office for $25.

Catchment Water Balance Report

Another report (CRC Report 99/12) available later this month is entitled 'Predicting the Effect of Vegetation Changes on Catchment Average Water Balance' by Lu Zhang, Warwick Dawes and Glen Walker. This research was conducted under the old CRC project S3 – 'Salt exports from Dryland Catchments'. The aim was to estimate the effects of afforestation or deforestation on runoff that provides recharge to some of the alluvial catchments in the upland areas of the Murray-Darling Basin. The approach adopted in this study proved to be very successful. It can be more widely used as a basis for making estimates of the water yield impacts of wide-scale afforestation in Murray-Darling Basin.

Coming soon

There are many other CRC reports nearing publication particularly from the old CRC's Urban Hydrology and Salinity Programs and all will be available through our Centre Office. These will be advertised in this section and the green margins of *Catchword*.

For CRC Publications contact
Virginia Verrelli
CRC for Catchment Hydrology
Tel: 03 9905 2704
Facs 03 9905 5033
Email: virginia.verrelli@eng.monash.edu.au

David Perry
Communication and Adoption
Tel: 03 9905 9600
Fax: 03 9905 5033
Email: david.perry@eng.monash.edu.au

WATER VICTORIA EMAIL (WAVE) LIST

The WaVE list (formerly known as VicWater) has been set up to facilitate the discussion of water related issues.

The list is free and can be used to advertise seminars, workshops, job vacancies, to solicit information on any range of water related topics or any other appropriate use. Posters should keep matters relevant to the state of Victoria, Australia. The list is closed, which means that only those on the list can post a message, but it is open for anyone to subscribe or unsubscribe as desired.

To subscribe, send subscribe to: wave-request@eng.monash.edu.au

To send a messages, send an email to:
wave@eng.monash.edu.au

The list is maintained by Peter Hill at Sinclair Knight Merz. Any queries should be directed to: phill@skm.com.au.

WaVE is supported by the Victorian Water Engineering Branch of the Institution of Engineers and the CRC for Catchment Hydrology.

CRC PROFILE

Our profile for October is Bill Eastgate.

Bill Eastgate

Bill Eastgate is the Representative for the Department of Natural Resources, Qld on the CRC for Catchment Hydrology Governing Board

Bill graduated as a Civil Engineer with first class honours in 1965. He continued his studies and obtained a Master of Engineer Science, a Diploma in Computer Science and studied several miscellaneous subjects; Economics, Accounting, Research and Communications.

His career has focused on engineering, scientific and information management activities related to the sustainable use of natural resources, the emphasis being on water resources and soil conservation.

The first five years of his career placed him in a relatively unique position of being responsible for all the engineering functions related to the Queensland Government's soil conservation program. This gave him the opportunity to undertake work in small catchment hydrology and hydraulics, and to work in multidisciplinary teams comprising agriculturalists, soil scientists, economists and land use specialists.

Bill moved to the Queensland Water Resources Commission in the early seventies. He worked in or managed many of the Commission's functional areas; high level state, regional and catchment water resource assessment and planning; project planning for dams and weirs; groundwater resource assessment and management. Other work involved policy and economic planning for special water resource projects; environmental impact assessments, surface water hydrology; stream gauging throughout the State (hydrography); urban water services related to water supply, sewerage and flood mitigation; and on-farm water supply advisory services.

Bill also played a significant role in introducing and encouraging within the Commission the use of evolving computer based and information management technologies.

In the early nineties he was appointed to manage the Information Systems Division, Department of Primary Industries, with the primary task rationalising the numerous computer systems and establishing a single statewide networked system to enable communications and access to information that is now taken for granted.

In 1995 his role was to establish the Resource Sciences Centre within the Department of Primary Industries. The Centre had some 350 staff comprising professionals from many disciplines. The Centre's task was to provide research and applied technology support to the Departmental core businesses related to land, water and vegetation.

Since 1997 Bill has managed the Department of Natural Resources' Regional Infrastructure Development program. The program is responsible for planning the release of water allocations for consumptive use, potential infrastructure developments and also for direction to the water industry through development and implementation of water industry policy, legislation, guidelines and strategies.

In 1997 he was appointed Adjunct Professor, Civil Engineering, University of Queensland.

Bill reflected that during his thirty plus years of experience enormous advances in community awareness and technology have occurred; from slide rule to super computers, satellite imagery, an information management revolution and so on. Greater and more complex advances will be made within the next decade putting even greater demands on the community and professionals. The Co-operative Research Centres and their participants are well positioned to make a significant contribution to society and he looks forward to contributing to the success of the CRC for Catchment Hydrology.

Bill Eastgate
Tel.: (07) 3224 8145
Bill.eastgate@dnr.qld.gov.au

REPORT ON COMPLETED THESIS

Report by Sam Green

Drawdown and river bank stability

What is drawdown?

Drawdown is the lowering of a water level, and can refer to the level of a storage, the level of groundwater, or the level of a river. In this thesis it will generally refer to a river going from a high flow condition to a lower flow condition. The rate of drawdown is expressed as either the change in flow per unit time, or the change in stage per unit time. The latter is of most importance in terms of bank stability.

Impacts of drawdown

It is commonly thought that 'rapid' drawdown of river levels adversely affects river bank stability. This concern over river banks stems largely from work done following the failures of some earth dams once the storage had been drawn down. Little further work has been done in looking at whether the same approach can be used for assessing the likely impact of drawdown on river banks. Given this apparent lack of information and knowledge on drawdown failures, this work investigated the effect of drawdown rates on river bank stability, and in so doing a better understanding of the key parameters was gained.

Research approach

The task was approached from three angles.

- **Historical analysis**

The first was an analysis of the historical records to see what the rates of fall prior to regulation were, and whether they had changed since regulation. The results indicated that it can not be shown conclusively that the rate of drawdown has increased since regulation. They also showed that there has been a marked change in the frequency at which drawdown events of a given size occur, particularly the high incidence of lower drawdown rates.

- **Fieldwork**

The second approach to the investigation was the fieldwork component. The focus of the field work was the response of the near bank watertable to changes in river level. Other data collected were soil particle size distribution, bank profile monitoring (through the use of photogrammetry) and permeability testing. The results of this work show that the near bank watertable was easily able to match the rate of drawdown seen in the river channel. The particle size analysis and permeability data confirmed this observation.

- **Modelling**

The third prong was the smallest and consisted of some very simple modelling which further showed that drawdown rate is not so critical for river banks.

Overall findings

The findings of this thesis are that drawdown at the current rates is not a factor in the failures observed on northern Victorian rivers. The rate of drawdown has not significantly changed since regulation, although the frequency at which specific rates of drawdown occur, has changed. Observational data shows that elevated and sustained nearbank watertable levels cause seepage failures that look like drawdown failures. Permeability is the key factor in the response of the near bank watertable and should be used as a guide to the maximum drawdown rate.

Sam Green
Tel: (03) 5833 5559
samjg@g-mwater.com.au

If undelivered return to:

Monash University
Department of Civil Engineering
Clayton Victoria 3800

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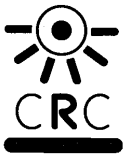
COOPERATIVE RESEARCH CENTRE FOR **CATCHMENT HYDROLOGY**



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, Qld
Department of Natural Resources and Environment, Vic
Goulburn-Murray Water
Griffith University
Melbourne Water
Monash University
Murray-Darling Basin Commission
Southern Rural Water
The University of Melbourne
Wimmera Mallee Water

Associates: Hydro-Electric Corporation, Tas • SA Water • State Forests of NSW •

CENTRE OFFICE:
Department of Civil Engineering
Monash University, Clayton
Victoria 3800 Australia
Telephone: +61 3 9905 2704
Facsimile +61 3 9905 5033

http://www.catchment.crc.org.au