NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 86 AUGUST 2000

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

RESEARCH PROGRAM OVERVIEW

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

Figure 1 shows the some linkages between the Climate Variability, Predicting Catchment Behaviour, and Land-use Impacts on Rivers Programs, discussed earlier in the series. By achieving the objectives for the projects in these programs, the CRC will be able to simulate the behaviour of rural catchments for different land-use scenarios and climate sequences. This capability to simulate catchment behaviour leads naturally to the program to be featured this month – Sustainable Water Allocation.

Overview Part Four – Sustainable Water Allocation

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.

The question may be asked "How does sustainable water allocation fit into catchment hydrology'? Given that in catchments like the Murray-Darling, upwards of 80% of flow is diverted from the rivers (mostly for irrigation), the links to hydrology become apparent. Land-use change in the catchments may impact on river yield (and water quality), and hence on the volumes available for allocation. Climate affects both yield and demand.

The Sustainable Water Allocation Program is particularly relevant for the many Australian catchments in which the economic, practical, and environmentally sustainable limits to water harvesting have been reached. In the Murray-Darling, for example, there is a 'cap' on further water diversions, meaning that further development (while protecting environmental values) will have to come from more efficient use of water. One of the important mechanisms for this is the introduction of water trading, a practice that involves many hydrologic questions, among others.

Since water trading is driven by economic and social factors, it is somewhat meaningless to look at the hydrologic aspects in isolation. Consequently, this CRC Program pays a good deal of attention to socio-economic aspects of water allocation.

Integration of Water Balance, Economic, and Climate Models (Project 3.1)

The introduction of water trading to improve system efficiency has brought the need to add the economic dimension to the water balance models now used to simulate water supply systems. Typical of the latter are models like REALM (used in Victoria) and IQQM (NSW,

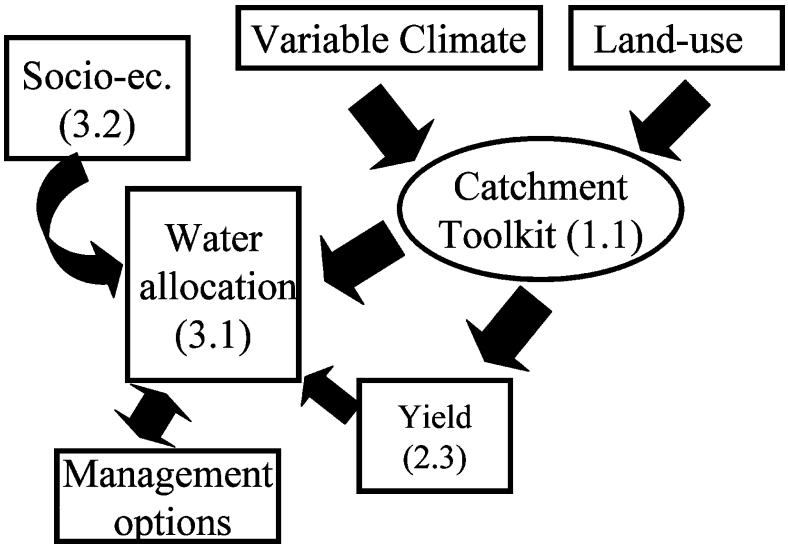

Figure A Linkages between the Sustainable Water Allocation and other CRC Programs (rural catchments)

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

CRC PUBLICATIONS LIST

Reports, videos and software, available from the CRC, are listed in our Publications List.

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

www.catchment.crc.org.au

All prices listed include GST, postage and handling.

Queensland); these models are typically run using periods of historic data to help optimise system performance.

The project has a number of objectives, including evaluation of the hydrologic aspects of trading. Another priority for the project is the addition of appropriate algorithms to simulate the economic drivers of water demand. The addition of such a module to the modelling 'toolkit' (Figure 1) will integrate water allocation into the catchment response model, thus allowing climate variability and land-use effects to be included in scenarios of water management. There is an opportunity with this work to improve water management decisions by linking them to climate forecasts – we see this as quite important.

Enhancement of the Market Reform Process: a Socio-Economic Analysis of Guidelines and Procedures for Trading in Mature Water Markets (Project 3.2)

As indicated above, water trading is becoming a significant component of water management. With trading comes the potential for major impacts on communities; water traded out of a region may mean economic and social decline, and vice versa. This project aims to provide knowledge to make possible a more holistic assessment of the impact of water trading.

A major outcome from this CRC research is that the linking of socio-economic modules with catchment yield and water distribution system models will provide the tools needed to evaluate alternative policy/management scenarios - and the capability to evaluate hydrological, economic, and environmental outcomes.

Overall

To date, water allocation models have largely concentrated on physical aspects such as supply and demand for irrigation centres, and the transfer capacities of the channels that supply and link them. The Sustainable Water Allocation Program adds the socio-economic dimension, and enhancement through direct coupling with catchment hydrology. Given the demand pressures for water, it is clear that this work has major national significance.

Russell Mein
Tel: (03) 9905 4980
Email: russell.mein@eng.monash.edu.au

PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rodger Grayson and Andrew Western

Project 1.2: Scaling procedures to support process based modelling at large scales

A major focus of the work in Project 1.2 relates to developing ways of representing variability in the various factors that affect hydrological response and the interaction between the surface and atmosphere. These factors include things like precipitation, vegetation, soils, and hydrologic variables such as soil moisture and soil water storage.

There is a wide interest in the measurement of soil moisture by remote methods eg from aeroplanes or satellites. Groups as disparate as meteorologists and Wall Street traders want better information on soil moisture – Why? Because not only is soil moisture a key control on runoff processes, it is also a key control on plant growth and evapotranspiration. It is worth a lot of money to traders in commodities to have improved predictions of things such as the likely wheat production of India this year - soil moisture at particular times of the cropping cycle affects these predictions. Meteorological models rely on accurate estimation of evaporation from the land surface so that precipitation can be modelled accurately. In turn, such models need good measurement and modelling of soil moisture.

Despite the range of new instruments available in recent years, soil moisture can be measured on the ground, only at a point or points – i.e. we do not have ground-based methods for getting areal measurements of soil moisture. Some of the work in Project 1.2 is related to interpreting point measurements in an areal context, but we are also looking at alternative methods for measuring and characterising spatially variable soil moisture.

Remote sensing of soil moisture

The approach being investigated by several groups from around the world is some form of remote sensing. Soil moisture is known to affect the dielectric constant of the soil, which in turn affects the nature of emitted and backscattered electromagnetic radiation, particularly in the microwave range. Several passive microwave instruments have been built (passive means that they measure emitted radiation and do not "bounce" a signal off the surface). These have been tested using aeroplanes over large

catchments. They seem to give reasonable estimates of moisture content of the top 2-10 cm of soil under bare conditions. However some technical issues related to the instruments mean that if they were deployed in space, the "footprint" on the ground would be around 10x10 – 50x50 km – too large to see important scales of variability. Active sensors (ones which actually bounce a signal off the surface) are able to overcome this problem of spatial resolution and can resolve to the order of 10x10 m from space (these are known as SAR instruments – synthetic aperture radar). SAR microwave instruments also "see" only the top few cm of soil.

NASA testing at Tarrawarra, Victoria

In an effort to better understand the various influences affecting the accuracy of SAR instruments, NASA has mounted one on an aeroplane and has been testing and developing it for the past few years. In 1996 it came to Australia during the PACRIM mission and flew over the Tarrawarra catchment, while we busied ourselves on the ground taking large numbers of measurements for comparison (see Western et al., 2000). This work provided promising results (see *Figure B*), so when NASA returns later in August this year for the PACRIM 2 mission, Andrew Western and Hugh Turral are planning a more comprehensive field program for ground-truthing in collaboration with DNRE Victoria's Institute of Sustainable Irrigated Agriculture (ISIA) at Tatura.

Improving soil moisture and salinity estimates

Our work at Tarrawarra suggests that we can use SAR to measure average soil moisture in 0.25-1 ha areas. Other work has shown that vegetation can have an important impact on the signal interpretation and that there is potential for measuring soil salinity with SAR. Given these results, Andrew and Hugh are planning to collect detailed ground-truth data for about 40-50 homogenous 1ha patches in the Rochester area. The aim of the project is to develop improved algorithms for estimating soil moisture and soil salinity in the presence of a vegetation canopy (current techniques assume bare soil or minimal vegetation). The ground measurements will target soil moisture (dielectric constant), soil salinity (electrical conductivity), surface roughness and vegetation, as these characteristics of the surface control the SAR response. This data should thus allow us to develop more comprehensive image interpretation techniques and soil moisture and salinity maps with known reliability for the target areas.

Other NASA data

In addition to the SAR data, NASA will be collecting MASTER data and ISIA will be doing ground truth measurements for surface temperature estimation. MASTER is the test instrument for MODIS and ASTER, two of the key instruments on the recently launched Terra satellite. Terra is one of the flagship satellites for NASA's Earth Observing System. This data has the potential to provide information on vegetation and the surface energy balance and to understand the scale effects associated with the larger footprints of the space-borne instruments. Given that MODIS has daily coverage at pixel sizes ranging from 250m (visible bands) to 1000m (thermal infrared bands), it is a potentially valuable source of information on the dynamics of the Earth's surface.

Review of other data and instruments

The data from the NASA instrument will take them some time to process and we do not expect results until later in 2001. In the meantime we will be looking at data from previous missions of this and other instruments to assess whether they can be used to assist in modelling. We will investigate how best to characterise variability in a way that can improve our modelling of surface hydrology and land-surface atmosphere interaction. If you would like more information on this work and the potential of remote sensing of soil moisture, please contact us.

Rodger Grayson
Tel.: (03) 8344 6623
Email:
rodger@civag.unimelb.edu.au
Andrew Western
Tel.: (03) 8344 7305
Email:
a.western@civag.unimelb.edu.au

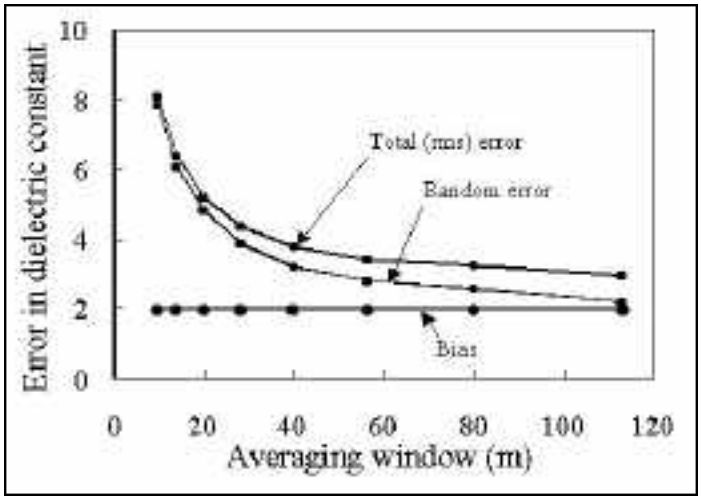

Figure B: Errors in dielectric constant (effectively soil moisture) estimation using L band AirSAR images at Tarrawarra on 11 November 1996.

PROJECT DETAILS ON OUR WEBSITE

The CRC has recently published 'project description sheets' for each research project on the CRC website.

The pages (also available as pdf files) give details of research objectives, expected outcomes, target problems, key tasks, links, staff involved and contacts for each project.

Click on 'Projects 1999-2002' on our website at www.catchment.crc.org.au

NEW CRC SOFTWARE

AQUACYCLE

Aquacycle is a daily urban water balance model which can be used to investigate the use of locally generated stormwater and wastewater as a substitute for imported water. Dr. Grace Mitchell developed Aquacycle during her postgraduate studies.

The Aquacycle includes the CD-ROM and a complimentary copy of the CRC Industry report 'The Reuse Potential of Urban Stormwater and Wastewater'.

A copy of Aquacycle can be ordered through the Centre Office. Users are requested to sign a User Agreement and a manufacturing and distribution cost of $27.50 applies to orders.

For further information visit www.catchment.crc.org.au/products

PLEASE NOTE: The Aquacycle software is currently only available for IBM compatible computers.

PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER HAIRSINE

Springvale – a catchment study in the western Fitzroy

Mark Silburn's light-hearted story of the Springvale study follows. It is a catchment typical of much of Australia's often-degraded, semi-arid landscape. In piecing together our understanding of how the Fitzroy and similar catchments work, the knowledge Mark and his colleagues have accumulated is vital. Please follow up with Mark if you want to get more details.

Peter Hairsine

Report by Mark Silburn

"Fredworld – adventure playground"

I should have known something was up when the Cyril Ciesiolka of the Bogantungan Polytechnic Institute of Advanced Geomorphic Studies sucked Chris Carroll and I into the vortex of the "Springvale" study (aka Fredworld), in the semiarid tropics of the Fitzroy, Central Queensland. Not so much the 11 hrs drive from my office, but that the nearest town is called Anarchy (locally misspelt Anakie). A flume was installed on a 9.6 ha catchment, and it was good, as the brown snakes could lie in it and drink from the plunge pool below it, and leave us alone in our work in the catchment. 9.6 ha might not sound like a much, but in this landscape it included spatial variability aplenty, what with 2.5 geologies, eight soil types, a badlands gully-alluvial system, overlayed with areas of grass or no grass at all, and trees or no trees at all. So some 20 sub-areas were instruments for runoff and erosion measurement, which was good, as the redbacks could live in the logger boxes, land crabs could live in the Gerlach troughs (I kid you not) and the 20L tipping buckets going off at night could scare the police searching for prison escapees.

After eight years of driving a day to get there, digging in 40° heat, soil coring, restarting loggers hit by lightning, weighing eroded sediment, cutting grass and staring at cover quadrats, tree canopy mirrors and upraised pencils pointed at trees till you spoke in tongues, a startling insight overcame us. It would be much easier to work out how much runoff and erosion happened, and heck, the whole damn water balance, using computers in an air-conditioned office. In a blinding flash (and Robin Connolly's Masters Thesis and four Journal papers) it transpired that we could accurately simulate runoff hydrographs flushing the brown snakes from the flume and land crabs from the troughs, come thunderstorm or cyclonic depression, come the eating (or not eating) of all grass living and dead (and some trees) by cattle. All one needed was the data from one simple week of fieldwork (with only 2 rainfall simulators, 2500 soil samples, 4 4WD's, 8 people and a 10t truck).

Much taken with air-conditioned comforts, and the innocence of student Jo Yee Yet, who saw no difficulty in coding our daily runoff model into the notorious spaghetti-coded (©greg.mckeon.com) GRASP pasture production model, we determine fabled runoff Curve Numbers and erodibilities, and the holy-grail "whole water balance" for Rudosols, Sodosols, Chromosols, Kandosol etc. To wit (one undergrad Thesis and 2 "in prep" papers later), soils are soil! The pedologist's fine distinction of pH trend, bolas and chroma came to nothing – the model fitted all our sweat-soaked data with a single set of runoff and erosion parameters based on ground cover, be it from grasses or trees, so long as one has the right pork (measured PAWC) and inclination (slope).

And so, with Springvale encapsulated in a silicon chip, the young seek new insights into effects of erosion on pasture production (Chris Chilcott) and the spatial distribution of erosion and deposition (Banti Fente). While by the flickering light of the nightly TV episode of 'Tree Clearing Qld', I check and recheck Springvale's pillar of salt, but alas in this case it's still there in the soil and has not yet yielded to the clearing of trees.

Mark Silburn
Qld Department of Natural Resources, Toowoomba
Tel: (07) 4688 1281
Email: mark.silburn@dnr.qld.gov.au

PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader

JOHN TISDELL

Report by Rob O'Neill and Erwin Weinmann

Project 3.1: Integration of Water Balance, Climatic and Economic Models

The challenge:

As the title of the project implies, the challenge of Project 3.1 is mainly one of integrating different aspects of modelling to assist with development of water management policies for sustainable water allocation. The complex aspects of the project work are reflected in the interaction of many different areas of expertise, including:

- hydrologic and climate modelling
- economic modelling
- farm management
- environmental management
- water resource management policy

In each of these areas, key knowledge gaps need to be identified and linkages with other work must be made. While this project will use outputs from other projects, these outputs will need to be adapted to satisfy the specific modelling requirements.

Project Definition Process

The approach indicated in the June Catchword has now been followed up, with substantial inputs from the following industry representatives seconded to the Project during July / August:

Barry James	*Department of Natural Resources and Environment, Victoria*
Seker Mariyapillai	Goulburn-Murray Water
Rob O'Neill	Department of Land and Water Conservation, NSW

This team worked in conjunction with representatives from Monash and Melbourne Universities to identify a preliminary list of knowledge gaps in current modelling capabilities.

These issues and knowledge gaps were discussed at a workshop on 27 July at The University of Melbourne. The workshop group comprised representatives from the following industry organisations:

Department of Land and Water Conservation - NSW, Department of Natural Resources and Environment - Vic, Goulburn-Murray Water, Department of Natural Resources - Qld, Murray-Darling Basin Commission

Also present were representatives from other related CRC Programs and experts with backgrounds in socio-economic and environmental modelling.

Overview of Water Resource System Simulation Process

As part of the briefing documents for this workshop, the project team developed a diagram of the system simulation process with emphasis on demand modelling (see Figure C). The diagram identifies the linkage between the discussed knowledge gaps and their driving mechanisms, and how these fit in with modelling the processes that occur within a river basin.

One of the key knowledge gaps relates to modelling irrigator behaviour in relation to decisions about crop planting, area to be irrigated and water trading. These decisions are influenced by many factors including:

- resources allocated for the season by the resource manager
- regulatory constraints on water trading
- market conditions for agricultural produce and water trading
- preceding and current climatic conditions
- farm infrastructure
- any farmer specific behaviour

Current modelling of these decisions and factors ranges from relatively crude regression based approaches (which are strongly dependent on the availability of historical data) to more predictive approaches based on attempts to replicate the underlying processes and decision mechanisms.

Typical outputs from existing simulation models are in the form of volumes supplied to specified demands, streamflow regimes and selected water quality indicators. It is desirable to convert these outputs into more meaningful indicators of socio-economic and environmental performance.

The workshop and its outcomes

At the workshop, the key knowledge gaps and model deficiencies were discussed, quantified in terms of work required and priorities set to reflect industry needs and expectations.

The workshop helped to identify the model deficiencies where substantial research work has been done or is ongoing elsewhere. An important aspect of Project 3.1 is to develop effective linkages with these other areas.

The knowledge gaps and model deficiencies not adequately covered by other projects are now being processed and summarised into a number of briefs for

DOWNLOAD SOFTWARE FROM OUR WEBSITE!

Continuous Simulation System for Design Flood Estimation

by

Dr Walter Boughton

The Design Flood Simulation Package is available as a FREE DOWNLOAD from the CRC website at http: / / www.catchment.crc.org.au / products / models /

The software is a simulation package, which generates rainfalls to route through a catchment model to estimate design floods. Dr Walter Boughton, Honorary Research Fellow (Griffith University and CRC for Catchment Hydrology) developed the package as part of his work in the (former) CRC project 'Holistic Flood Estimation'.

The aim in making the package available directly from our website is to encourage feedback and further applications of the novel technique.

Further information about the software is available on the CRC website.

RECENTLY PUBLISHED

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 ($22 - includes postage and GST), please contact Virginia Verrelli at the Centre Office on 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

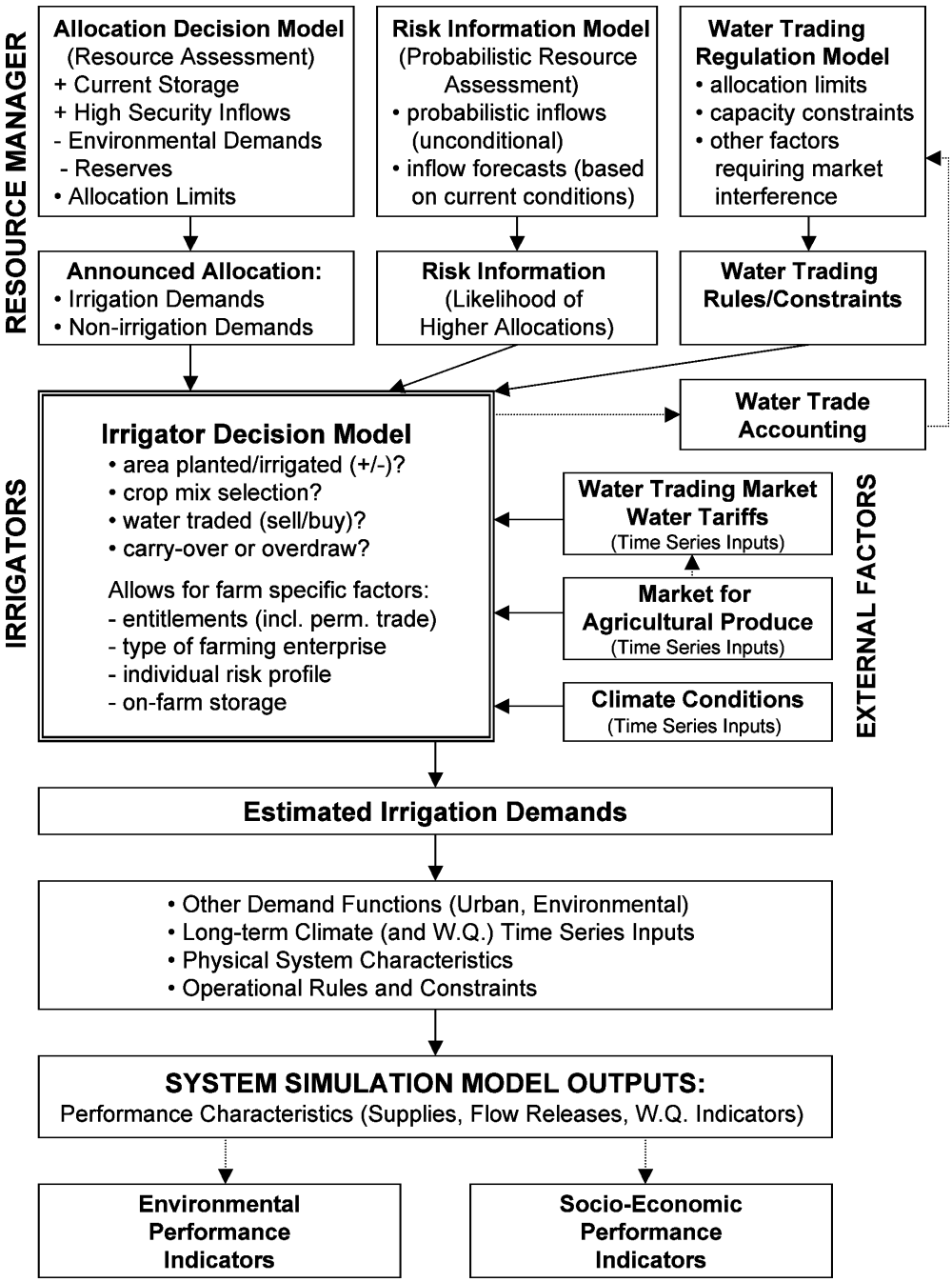

Figure C: Overview of water resource system simulation process, with emphasis on modelling irrigation demands

sub-projects within Project 3.1. The sub-projects envisaged range from relatively small scale investigation tasks to assess the current state-of-the-art in relation to specific modelling issues, to large scale research based tasks to provide a sound technical basis for model development and enhancement.

Next Stage

The project briefs will be disseminated for comment by mid August.

Once these project briefs have been finalised, more detailed project planning and detailed investigation and research work will commence.

Robert O'Neill
Tel: (02) 9895 7438
Email: roneill@dlwc.nsw.gov.au

Erwin Weinmann
Tel: (03) 9905 4979
Email: erwin.weinmann@eng.monash.edu.au

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

PROGRAM 4

URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Margaret Greenway, Project Leader

Brisbane-based activities

The Brisbane Node of the Urban Stormwater Quality program comprises Brisbane City Council and Griffith University.

Staff

Major team members of the Brisbane Node include Tony Weber - Senior Waterways Program Officer (Water Quality) and André Taylor - Principal Waterways Program Officer (Water Quality), from the Urban Management Division, Brisbane City Council (BCC) and Margaret Greenway and Graham Jenkins from the School of Environmental Engineering, Griffith University (GU). André is the Focus Catchment Co-ordinator. Margaret's expertise is primarily in water quality monitoring, aquatic biota and wetland systems while Graham's expertise is in computational hydraulics and hydrology in natural urban drainage systems.

Darren Drapper has been appointed as a research assistant for the Brisbane Node. He has gained considerable experience in monitoring road runoff pollution through his PhD studies, in the School of Environmental Engineering at Griffith University.

Postgraduate

Tanja Mueller is the recipient of a CRC postgraduate scholarship - the title of her project is "The Role of Biofilms in Water Quality Improvement in Infiltration Systems, Swales and Constructed Wetlands". Tanya completed her honours degree in Biological Sciences at Monash University in 1998.

Major activities

During the past couple of months the Brisbane Node has been identifying major research activities that will provide significant input over the next three years into our understanding of pollutant characteristics and the effectiveness of a variety of stormwater improvement devices. This information will be used to develop an effective Decision Support System.

There are two discrete projects with the Urban Stormwater Quality program: Project 4.1 - Stormwater pollutant sources, pathways and impacts, and Project 4.2 - Stormwater best management practices.

NEW CRC TECHNICAL REPORT

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

by
Tony Wong
Peter Breen
Sara Lloyd

Report 00/1

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

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

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

QUESTION FOR THE CRC?

The CRC website Forum is now available for you to use at www.catchment.crc.org.au/forum

The Forum aims to assist you in understanding the CRC's research outcomes and their application by providing a direct communication link to the resources of the CRC for Catchment Hydrology.

You are welcome to use it anytime to answer your questions or to post requests for information.

Information on how to use the Forum is given on our website.

The Brisbane Node has identified a number of sub-projects relating to the following activities:

- Urban Stormwater Quality Modelling Toolkit and DSS

  Griffith University, through Graham Jenkins will investigate process models for gross pollutant traps and swale systems.

- Urban Stormwater Quality Monitoring

  BCC has stormwater monitoring data from 9 sites within the Brisbane River catchment. This information is currently being reviewed to characterise stormwater quality in different stream catchments. Griffith through Margaret Greenway has long term water quality data from 16 sites in urban, rural and forested tributaries of Native Dog Creek, Logan River catchment. Data gaps with respect to water quality constituents and the "level" of analysis with respect to pollutant speciation will be identified.

- Quantifying Ecosystem Responses to Catchment Urbanisation

  Aquatic biota in the tributaries of Native Dog Creek has been monitored by Margaret Greenway, Griffith. Honours student Carolyn Polsen is investigating the relationship between biotic diversity and water quality in the urban, rural and forested tributaries.

  BCC has been monitoring aquatic biota in the Keith Boden Wetland, a constructed stormwater wetland. Other target sites for future field based studies will be identified.

Caroline Poison and Tim Cross sampling aquatic biota and water quality in Native Dog Creek

- Field Experiments on the Role of Vegetation and Infiltration/Adsorption Mechanisms

  Mesocosm and pilot field experiments are currently being set up by Tanya Mueller as part of her investigation into the functional role of biofilms, biogeochemical processes and factors affecting pollutant removal.

  BCC has identified two sites for the installation of swale/infiltration systems. In addition to the role of vegetation and biofilms, the hydraulic characteristics of these systems will be modelled and monitored.

- Effectiveness of Non-Structural Stormwater Management Measures

  BCC has already undertaken several projects to target source control - they have been categorised as:
  - Education
  - Regulation
  - Enforcement
  - Technical guidelines and training

  A future project will investigate the effectiveness of enforcement on source control in new subdivisions.

- Monitoring and Evaluating Stormwater Quality Improvement Facilities

  BCC has installed a variety of SQID's (Stormwater Quality Improvement Devices) including Gross Pollutant Traps

A review of existing data on SQID performance is currently being undertaken.

A number of target sites have been identified for future monitoring and performance evaluation. These include four Gross Pollutant Traps to continue monitoring the performance of CDS and Ecosol device. There are also four Freewater Surface Flow wetlands – three of these (two existing, one planned) are retrofit wetlands receiving urban runoff, one is a full sized wetland treating stormwater surface runoff from rehabilitation of an old landfill site. Two infiltration systems will be designed and installed to monitor pollutant removal performance and hydraulic performance.

In conclusion, the Brisbane Node is gearing up for a busy and productive three years. Information collected from this sub-tropical biogeographical region will be vital for the wider applicability of a Stormwater Quality Management Tool Kit.

Margaret Greenway
Tel.: (07) 3875 7492
Email: m.greenway@mailbox.gu.edu.au

Margaret Greenway (Project leader) taking water samples in Native Dog Creek

CDS belowground gross pollutant trap, Calamvale, Brisbane (litter basket being removed)

Constructed wetland, Calamvale, Brisbane

WANT TO KNOW WHAT'S GOING ON?

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

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

LOOK UNDER 'EVENTS' ON OUR WEBSITE.

CRC WORKSHOP

HYDROLOGY AND HYDRAULICS FOR FLOODPLAIN MANAGERS

Workshop No. 3 - Flood Level Estimation

The third workshop in this successful series will be held at Monash University during 4-6 October 2000

More information about the workshop program is given in the flyer with this Catchword or contact Virginia Verrelli at the Centre Office on tel: 03 9905 2704.

INFORMATION

IF YOU WANT INFORMATION ABOUT CATCHMENT HYDROLOGY, START WITH OUR WEBSITE www.catchment.crc.org.au

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM McMAHON

Report by Bryson Bates

Stochastic Downscaling of Climate Model Simulations

Limitations of General Circulation Models (GCMs)

Modelling the response of water supply systems to climate forecasts requires daily or monthly data at local and regional scales. The need for improved and realistic assessments of the regional impacts of natural climate variability and possible climate change has generated increased interest in regional climate simulation. The desire for assessments based on physical rather than purely statistical models has led to interest in the use of general circulation models (GCMs). Although existing GCMs perform reasonably well in simulating climate with respect to annual or seasonal averages at sub-continental scales, it is widely acknowledged that they do not provide credible simulations of precipitation at the space and time scales relevant to local and regional impact analyses. Differences between GCMs, in terms of simulated precipitation and surface air temperature, also seem to be greater at local and regional scales.

Deriving local weather from larger scale atmospheric or climate models

The above problems have led to the development of statistical downscaling techniques to derive sub-grid scale weather from the coarse spatial resolution atmospheric data available from GCMs. In collaboration with the University of Washington and CSIRO Atmospheric Research, CSIRO Land and Water has investigated a nonhomogeneous hidden Markov model (NHMM) for downscaling atmospheric fields. The NHMM relates synoptic-scale, atmospheric circulation variables through a finite number of unobserved weather states to multi-site, daily precipitation occurrence data. The NHMM determines the most distinct patterns in a daily multi-site precipitation occurrence record rather than patterns in atmospheric circulation. These patterns are then defined as conditionally dependent on a set of atmospheric predictor variables. Unlike downscaling techniques that are based on classification schemes, the weather states are not defined a priori. A first-order Markov process defines the daily transitions from weather state to weather state. The process is described as nonhomogeneous as the transition probabilities are conditional on a set of atmospheric circulation predictors. The atmospheric predictors may include raw variables such as mean sea level pressure

(MSLP) or derived variables such as north-south MSLP gradient. In this way, the NHMM captures much of the spatial and temporal variability of the precipitation occurrence process.

Aspects of probability distributions for multiple sites

Within the NHMM, the joint distribution of daily precipitation amounts at multiple sites is evaluated through the specification of conditional distributions for each site. The conditional distributions consist of regressions of transformed amounts at a given site on precipitation occurrence at neighbouring sites within a set radius. An automatic variable selection procedure is used to identify the neighbouring sites that provide useful information about at-site precipitation amounts. The neighbourhood radius is determined by steadily increasing its size until further increases result in marginal improvements in the proportion of total precipitation variability explained by the precipitation occurrences at neighbouring sites.

Experiments in WA

Our downscaling experiments have focused on the application of the NHMM to daily 'winter' (May to October) precipitation across a network of 30 stations scattered throughout for south-west Western Australia (SWA). The region experiences a 'mediterranean' climate with abundant winter rains that are nearly double that of any similarly exposed locality in any other continent, and intense summer drought. Eighty percent of annual precipitation falls in the period from May to October, and the majority of winter rains come from low pressure frontal systems.

Findings to date

Some of our main findings to date are:

1. When fitted to and driven by historical atmospheric circulation data for SWA, the NHMM accurately simulates the wet-day probabilities, the frequency characteristics of dry- and wet-spell lengths, the daily precipitation amount distributions at each station, and the inter-site correlations for daily precipitation amounts.

2. Downscaled simulations from either the CSIRO general circulation model (CSIRO9) or the CSIRO limited area model (DARLAM) reproduce observed precipitation probabilities and dry- and wet-spell frequencies at the 30 precipitation stations in SWA. In contrast, the CSIRO9 and DARLAM simulations of precipitation tend to under-estimate the frequency of dry spells and over-estimate the probability of precipitation and the frequency of wet spells.

Contribution to CRC Project 5.1

CSIRO Land and Water's contribution to Project 5.1 will be to apply the NHMM to about 30 sites in the Murrumbidgee Basin. The model will be fitted to and tested against historical data, and applied to a 1000-year CSIRO9 GCM simulation. This will provide an ensemble of climate scenarios that can be used to drive the IQQM model for the Basin developed by NSW Department of Land and Water Conservation. This will facilitate an assessment of the reliability and resilience of the Basin's water supply system under multidecadal climate variability.

Bryson Bates
Tel.: (08) 9333 6330
Email: bryson@per.clw.csiro.au

THREE NEW CRC VIDEOS

THREE NEW VIDEOS ARE NOW AVAILABLE FROM THE CRC. THE PRESENTATIONS WERE DELIVERED AS PART OF OUR TECHNICAL SEMINAR SERIES IN CANBERRA EARLIER THIS YEAR

($27.50 each - includes postage and GST).

CRC Video 00/2
WATER BALANCE AND GROWTH PERFORMANCE OF A BREAK OF SLOPE AGROFORESTRY SYSTEM

Dr David McJannet
CRC for Catchment Hydrology
Monash University
March 2000

CRC Video 00/3
HOW TO GET PERENNIAL VEGETATION BACK INTO AGRICULTURAL LANDSCAPES

Dr Richard Stirzaker
Project Leader
CSIRO Land and Water
April 2000

CRC Video 00/4
AN INTRODUCTION TO THE TARSIER MODELLING FRAMEWORK

Dr Fred Watson
Postdoctoral Research Fellow
California State University
Monterey Bay
May 2000

CRC VIDEOS CAN BE ORDERED BY CONTACTING VIRGINIA VERRELLI AT THE CENTRE OFFICE ON 03 9905 2704

RIVER MANAGEMENT MANUAL

A REHABILITATION MANUAL FOR AUSTRALIAN STREAMS VOLUMES 1 AND 2

by

Ian Rutherfurd
Kathryn Jerie
Nicholas Marsh

The two volume (550+pp) set costs $27.50 (inc. GST) plus $10 postage in Australia.

This joint CRC for Catchment Hydrology and LWRRDC publication is now available in hard copy from the Agriculture, Fisheries and Forestry - Australia (AFFA) Shopfront.
Phone 1800 020 157 or fax your order to the Shopfront on 02 6272 5771.

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

PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Michael Stewardson

Project 6.7: Developing an environmental flow methodology: a trial on the Campaspe River

An overview

Background

The design and provision of environmental flows is one of the most important areas of research in Australian hydrology, and is critical for stream restoration. Project 6.7 is to develop a new approach to determining environmental flows that should have wide application. This is the principal activity on environmental flow research in the CRC for Catchment Hydrology.

Flow events for ecological function

Most environmental flow methods concentrate on what flows the stream system needs. The reality of most streams is that the availability of water for the environment is heavily constrained by the need to protect existing consumptive uses. The key question is "how can we make best use of the water that is available?". The method described here identifies the key flow events for ecological functions, and builds them into operating rules for the dam, or other aspects of a water resources scheme.

Past approaches

According to the "natural flow paradigm", environmental flow regimes should preserve some of the variability in flows that was present prior to regulation. In the past, environmental flow recommendations have relied of a selection of hydrological statistics to evaluate the change in flow variability. A major limitation of this approach is that the implications of changes in these statistics are poorly understood. Given the high level of demand for water in many river systems, it is important to provide a more meaningful and testable approach to developing environmental flow regimes.

Benefits of flow events method

The flow events method identifies aspects of the natural variability that are important for maintaining a "healthy" river. This approach is based on an understanding of the key mechanisms by which flow variations influence stream communities.

Examples of flow events that may be considered in this approach are:

1. low flow events that lead to exposure of the stream bed (which disturbs benthic organisms),

2. the flows that create pool habitat by forming alternate bars, and

3. high flows that inundate the floodplain, which maintains wetland processes.

Identifying key events

These and other flow events will be considered by a committee of experts that includes ecologists from the CRC for Freshwater Ecology and other organisations to identify a list of key events to be included in the new approach. The key strengths of the flow events method are that it:

- uses the natural variability in flows as a template for designing an environmental flow regime,
- represents the geomorphic and ecological impacts of flow variations in a meaningful way,
- provides a defensible approach to recommending environmental flows based on best available knowledge,
- is amenable to use with other environmental flow methods, and
- can be used to assess the combined benefits of environmental flow regimes and structural rehabilitation measures.

Threshold discharge models

Once key flow events have been defined, a major component of the research program is to develop simple models for predicting threshold discharges that trigger these flow events. These models will have to account for variations in flow conditions both along the river and with discharges. The final stage of the project will be to incorporate the flow events method into a water resources allocation framework. The project intends to provide a tool for designing streamflow management rules that maximise ecological benefits within the constraints imposed by consumptive water use.

Location and timing

The project will initially begin work on the Campaspe River, with hydrological data coming from Goulburn Murray Water. We plan to extend the methods and results to other streams in Victoria.

The project began in July 2000 and is due to be completed by December 2002. Please contact me if you would like more information.

Michael Stewardson
Tel. 03 8344 7733
Email: m.stewardson@civag.unimelb.edu.au

COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

by Daniel Figucio and David Perry

The Flow on Effect – August 2000

For your information...

In the May *Catchword,* we announced that the new CRC website was open for 'browsing business'. Over the last three months, a number of additional features have been added to provide land and water managers with better access to information about our research and activities. Whilst we appreciate that not everybody has access to the Internet, those who do will find the CRC for Catchment Hydrology website pages quick to download and an excellent source of information about our research, products, activities and staff.

I would like information about the CRC's research projects…

We have recently published more detailed information about each research project on our website. For each project, we have provided details of the project objectives, expected outcomes, target problems, the research plan, key research tasks, links to other projects, end-users and stakeholders and the staff involved. The project descriptions are available as web pages or can be downloaded as pdf files (~600K). There is a smaller (50K) pdf version of the projects sheets for people downloading through modems.

I have a question about the CRC's research…

The website now has an on-line forum for communication between practitioners and researchers. The forum page is designed to allow you to ask general or specific questions of CRC staff about our research, its application and other related activities by posting your question or request on our website. The Forum page may be accessed from the home page by a 'quick click' at the top right. From there you are given the choice of which CRC program is most relevant to your question or the information required. There is also a forum for queries of a general nature.

Type in your question or response, follow the instructions and soon your post will be available to see on the web. (The forums are moderated; so only after approval will it appear on the web page). This allows you to review other posts and responses in your area of interest. Depending on the nature of your query, another visitor to the site may respond, or if your posting relates directly to CRC activities, a CRC staff member will answer your query as soon as possible. We hope that, in time, the forum page will be a commonly used source of information about hydrologic research and its application.

If you are not sure where to find information about a particular issue, you could use the site's search engine. For example if you were interested in information about 'riparian buffer strips', a search of the website would direct you to our initial CRC's Waterway Management Program pages, and the publications page associated with that Program. The Program page provides details of the research we have completed, the outcomes and who to contact for further information. The publications page gives details of all the relevant technical and industry reports produced. The search engine is a useful device to quickly find out whether the CRC's research can assist you with the information you are seeking.

How do I find out about CRC events?

The CRC events calendar is another 'quick click' from the home page. The calendar allows you to browse, month by month, through upcoming events. All of the CRC's seminars, workshops and field days are posted here as soon as they are identified, either as confirmed or tentative dates. We also encourage other groups to use this facility. We intend this calendar to be a key source of information about hydrology-based activities suitable for land and water managers around Australia. If your organisation has an event that you would like listed on our calendar then please send details to us (see below) and we will add it to our calendar, often that same day.

How do I contact one of the CRC staff?

By the time this edition of Catchword is printed (or very soon after), the CRC staff contacts database will be on-line. The staff database can be accessed from the home page (click on 'Contacting the CRC'). The database lists staff contact details in alphabetical order of their surname. The usual contact numbers are listed, as well as details of their role in the CRC, and (often) a link to their personal home page

If you have suggestions or comments about our website, please drop us a line. The only reason it's there, is for your use!

Daniel Figucio
Website Communication Project
Tel: 02 6246 5822
Facs: 02 6246 5845
email: daniel.figucio@cbr.clw.csiro.au

David Perry
Communication and Adoption Program
Tel: 03 9905 9600
Facs: 03 9905 5033
email: david.perry@eng.monash.edu.au

SUBSCRIBE TO CATCHWORD ONLINE!

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.

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 describes 'Aquacycle' - a model developed by the CRC to assist in this process.

Copies available for $27.50 (inc. GST) from the Centre Office.

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

CRC PROFILE

John Fien

While doing my masters degree in London twenty or so years ago, I became friends with a prominent academic of the time called Donald who wrote a weekly feature for the back page of the Times Higher Education Supplement. It was called Don's Diary, taking advantage of the double meaning around his name and the English nickname of 'don' for a learned professor.

Don's Diary was just that, a slightly satirical retelling of one of his days in the past week. I do not have Don's wit for the satirical line, but thought I might be able to introduce myself to the CRC by telling about one of my days in the past week.

It was Tuesday. Tuesday began late Monday night, early Tuesday morning, finalising chapters for a book of twelve case studies of what community groups are doing around the world to build sustainability at the local level - wonderfully inspiring stories from Kenya, Uganda, Canada, India, Vanuatu, USA, Thailand, Mexico, Philippines and Australia. And, oh, the English in some of those chapters! So I was up late as I had promised Darlene Clover, my co-editor in Canada that I would have the English expression revisions to them ready for work on Monday morning their time. The benefits of international time differences and email!

Tuesday proper began with doing the email - as usual - and, thankfully, only twenty or so messages overnight. The one I had been looking for was there - confirmation from the Committee for Environmental Education and Communication of the State Environmental Protection Authority of China that there would be an Apple compatible (Rob Vertessy - you are no longer alone in the CRC in having a personal relationship with your computer) data projector for my keynote at its conference in Changchun City next week. Also a nice note from UNEP in Nairobi to say that my evaluation of the tender brief to develop a CDRom for school teachers based upon the new Global Environmental Outlook report, Geo-2000, had been useful.

9.30 meeting with Dana Thomsen, Clayton White and Margaret Gooch, the new PhD students in Program 8.2: *Public Participation and Community Change*. We were meeting with Tim Smith, the Research Fellow in the Coastal CRC responsible for developing the on-line toolbox for public participation in coastal and catchment management, a joint project of the Coastal and Catchment Hydrology CRCs. Dana has been working for the last four months as an RA developing the annotated bibliography which will be 'Chapter 1' of the toolbox. It will be on-line and linked to our website soon. So watch this space! Dana, Clayton and Margaret's theses are on participatory research, communication and volunteerism in catchment management, respectively, and will provide case studies to the toolbox.

Then it was a drive to the Gold Coast - to meet with Terry Delacey, the CEO of the CRC for Sustainable Tourism. Terry had heard of the great plans in hand (and soon to begin, I promise, now we have appointed James Whelan as our Lecturer in Science Leadership) for supplementary training for PhD students in the Coastal and Catchment Hydrology CRCs. The Board of the CRC for Sustainable Tourism had asked for a proposal to provide the same sort of program for its postgraduate students. Terry and I were meeting to finalise the budget for a Board Meeting on Thursday.

'Innovative', 'industry relevant' and 'cost-effective' (such words almost trip out these days, don't they?) were to be the catchwords when I spoke to the Board - and yes, we got the money - and so will be appointing a second full time lecturer in science leadership to work with James and me to provide supplementary PhD workshops across three CRCs.

A telephone call on the way back to Brisbane (how do you pull over on a motorway?). Dani Stehlik from CQU in Rockhampton, confirming that CQU will provide the other 50% for the appointment of a Coastal CRC funded 0.5 Research Fellow in Stakeholder Analysis. This is important to us as this person will be working with John Tisdell's Program 3 team on socio-economic issues in the Fitzroy.

Back to work to drop off the Faculty van and rush to an evening masters class on Education, Sustainability and Social Change. Topic: Opportunities for Environmental Change in Postmodern Times. A good topic for next year's CRC conference, I am sure.

Kate was chasing me. She is the new Griffith CRC admin officer (our version of Tanya Jacobson - and also a former Griffith Humanities student, Tanya). Sorry, Kate, I can't talk now. Just put the bundle of phone messages on my desk for tomorrow. Now where are those handouts I prepared on the weekend?

Assoc Prof John Fien
Director, Centre for Innovation and Research in Environmental Education
Theme Leader, Citizen Science and Education and Training, Coastal CRC
Program Leader, Education and Training, Catchment Hydrology CRC
Program Leader, Postgraduate Education, Tourism CRC
Australian School of Environmental Studies
Faculty of Environmental Sciences
Griffith University, Nathan, Brisbane
Tel: (07) 3875 7105
Email: j.fien@mailbox.gu.edu.au

WHERE ARE THEY NOW?

Nicholas Somes

Having spent six years at Monash University on research towards my PhD, I had a number of compelling reasons to leave. The first and most significant reason was that after such a time it is difficult to come up with new excuses to delay completion any longer. The second reason was more pressing and involved rescuing my ailing personal economy. In August of 1999 I took up an offer to join the Melbourne Office of WBM Oceanics Australia on a full time basis. This meant finishing my thesis part time - not an approach I would recommend to anybody who enjoys having weekends and nights free!

From endeavouring to know more and more about less and less, the broad range of projects that consulting has thrown up has been a welcome change. In the first 12 months I have had the opportunity to work on a variety of projects including flood plain mapping, constructed wetland designs, and the development of stormwater management plans.

The first few months were spent on a flood mapping project in Melbourne's eastern suburbs. This project required the development and application of RORB models, one-dimensional (1-D) hydraulic models (MIKE11) and the GIS interface used to define the flood surfaces. Learning the ins and outs of a range of new applications had the head swimming for a couple of weeks. Modeling and mapping complex urban drainage systems with a 1-D model was often a challenge due to the high number of flow paths and the necessity to model overland flows. Model development required many hours spent examining aerial photographs to try and predict likely flow paths through somebody's back garden or factory.

The development of stormwater management plans for a number of municipal authorities within Melbourne has occupied a lot of my time over the past 12 months. The plans are being prepared as part of the Stormwater Initiative, a program that was established to improve urban stormwater management in local government. Each plan is intended to identify and protect environmental assets within the municipality by minimising threats posed by polluted stormwater. As part of these projects, much of my time has been spent refining the process for preparing stormwater management plans and developing a series of analysis tools for risk assessment and management measure selection. More recently, I have been involved in rewriting the stormwater management planning process outlined in Chapter 3 of the Urban Stormwater Best Practice Environmental Management Guidelines.

An interesting part of the stormwater management plan development for me has been the development of reactive management strategies to mitigate specific threats. The development of a strategy requires the consideration of a number of structural and non-structural elements. Having spent six years looking at one specific treatment option, it is refreshing to examine a wide range of measures and select the most suitable for a given threat and set of catchment and drainage system conditions.

I have also had the opportunity to apply the research from my PhD on a number of artificial wetland design projects in Queensland, New South Wales and Victoria. At present I am working on a project in Lakes Entrance (East Gippsland) that involves the detailed design of an artificial wetland as part of a nutrient management plan. It has been interesting to review the different design specifications that are being produced by different management authorities around Australia. This process of review has been reassuring as in many cases I am coming across wetland terms and performance measures that were developed by my colleagues and myself at the CRC.

My time away from work has been busy also as I have bought and sold a house and tried to spend a bit more time having a life. The getting of a life has required me to go out for dinner and lunch and undertake long slow rides on my bike.

Nick Somes
WBM Oceanics Australia
5/99 King Street, Melbourne
Tel: (03) 9614 6400
Email: nsomes@wbmmelb.com

LINKS TO KEY HYDROLOGY WEBSITES

We have recently updated our web links database. Our links pages feature a wide range of addresses and descriptions of key hydrological websites relevant to the land and water management industry.

If you want information about catchment hydrology, start with our website.

www.catchment.crc.org.au

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY
Print Post Approved
PP338685/00026

If undelivered return to:

Department of Civil Engineering
PO Box 60
Monash University
Vic 3800

Surface Mail

Postage
Paid
Australia

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 •

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

CENTRE OFFICE:
CRC for Catchment Hydrology
Department of Civil Engineering
PO Box 60
Monash University, Vic 3800
Telephone: +61 3 9905 2704
Facsimile +61 3 9905 5033

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