

C&R CONSULTING

(Geochemical & Hydrobiological Solutions) Pty Ltd

Marine and Coastal Processes and Dynamics
Contaminated Site and Soil Assessment

Groundwater & Environmental Specialists
HydroGeomorphic Evaluations

Environmental Compliance and Monitoring
Chemical & Water Modelling
Spatial Analysis
GIS Services

HYDROLOGY, WATER RESOURCES AND EXTREME EVENTS

The Hydrology Unit is headed by Geoffrey Kavanagh, Dr. Cecily Rasmussen and Dr. Chris Cuff and supported by all other C&R Units.

Hydrology is the scientific study of water behaviour within a hydrological cycle involving the landscape both on and under the earth's surface. It considers water movement through soils, rocks, underground channels, karstic caverns, and the atmosphere. C&R's Hydrology Unit identifies and explores the HydroGeomorphic and HydroBiological system until the water resources and water flow characteristics as influenced by both human activities and natural events, are fully understood. Given the climatic variabilities of the seasonally arid tropics, and the increasing industrial, agricultural and urban development on flood plains, the consequent strain on both the physical and social environment has been extreme. C&R incorporate climatology, practical fieldwork and extreme event data into their research to attain the most accurate, cost effective solution to individual problems.

Areas of C&R focus include:

- **Whole of Catchment Study**
 - Identification of event size over the whole catchment
 - A detailed study of surrounding catchments.
 - Identification of transport processes through the catchments
 - Forensic geomorphic analysis to establish historic evidence for extreme flow events within the catchments.
- **Urban Catchment Analysis**
 - Identification of water flows and volumes through urban catchments.
 - Identification of inundated areas and analysis of causes (e.g. constructed landscapes, levees, etc).
 - Identification of affluxes and their causes.
 - Determine water volumes and compare flow rates between the urban context and adjacent river channels.



C&R operate under the premise that extreme events can be better managed through historical assessment, preparation, monitoring and notice.

C&R believe nothing exists in isolation, either in time or space. Ecosystems are inter-related and dependent on the physical environments (e.g. geomorphology, soil characteristics, geology and hydrology) in which they exist.

Our solutions to environmental problems are based on GeoMimicry, working with, rather than against the landscape, promoting solutions that are favourable to both the physical environment and the infrastructure that is essential to the efficient management of the industrial, agricultural and social network existing within that environment.

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Innovative solutions in a dynamic environment

EXPERTISE AND PAST JOBS

- 1990** Investigation of Charleville flood. This investigation demonstrated that the movement of flood waters across semi-arid, sub-tropical landscapes did not fit modelled predictions.
- 2000/2001** Investigation of the 1998 Black River Flood Event. This investigation clearly demonstrated that numerous factors needed to interact to create a flood event. The investigation also showed that the use of "averages" was useless when interpreting the physical processes applicable to the seasonally arid tropics.
- 2004** Investigations of Aquifer Recharge in the Black River Bore Field. This study indicated that aquifer draw down in certain soils caused rapid cementation in the fluctuation zone.
Changing cementation bands within the soil profile altered permeability of the soil profile, leading to a decrease in aquifer recharge and a corresponding increase in runoff.
- 2008** Investigations of the January 2008 Emerald Flood Event demonstrated that:
- ◆ Modelled ARIs constructed from inadequate climatic data were unreliable and inadequate.
 - ◆ River gauging stations must be increased to incorporate all major tributaries within the catchment, and must be correctly placed to truly represent the water flowing through the system if the data are to be used for predictive purposes.
 - ◆ Rainfall stations must be considerably increased and placed in areas to truly represent rainfall within the catchment.
 - ◆ Local rainfall gauges (soft data) must not be considered valueless.
 - ◆ Anecdotal information from long-term residents often provides invaluable understanding of local conditions during major flood events.
 - ◆ Radar Stations must be of sufficient number, and in adequate geographic locations to avoid the creation of "black holes" and perimeter blurring (weakening of the radar signal with distance from the centre). This should be considered of utmost importance in Central Queensland where the catchment supports industries of major national significance.
 - ◆ Water travelling down unmonitored streams severely crippled river monitoring accuracy.
 - ◆ The cumulative impacts of varying topography, geomorphology, and the pre-condition of soil surfaces should be considered in all modelling procedures.
 - ◆ Where data are limited, long-term ARIs may have uncertainties up to +/- 95%.
 - ◆ Rainfall records >100 years are consistently sparse in the seasonally arid tropics and, on analysis, show a number of long period ARI events that are inconsistent with the length of record.
 - ◆ Incorrectly located river gauging stations of consequence to the Emerald 2008 flood event did not record approximately 80% of the flow down the system when out of bank flow was dominant.
- Mid 2009 – 2011** Development of research data base focusing on a general interpretation of the Emerald 2008 flood event, including:
- ◆ Weather patterns across tropical Australia;
 - ◆ Alpha 1990 flood event;
 - ◆ Validation of Emerald 2010/2011 events.
- Sep 2010** Creation of a monte-carlo based water balance and chemical model of an open-cut coal mine in Central Queensland and development of water management strategies to minimise discharges. Subsequent water management strategies were created to ensure minimal risk of un-compliant discharges.
- Nov 2010** Research Seminar presentation at QUT relative to development of applied mathematical / analytical techniques for real rainfall / stream flood events.
Predictive assessment of floods as self-organising systems.
Chemical modelling to support Transitional Environmental Programmes for two Central Queensland Coal Mines
- Jan 2011** Detailed analyses of early 2011 rainfall events in Central Highlands.
Expression from UK of the need to integrate Extreme Event studies into global weather patterns in light of concurrent flooding in Australia, Sri Lanka, South Africa, and Brazil.
Recognition of possible preference to site an initial node of the Centre in Emerald, an area that has experienced:
- ◆ two recent extreme flooding events;
 - ◆ human and sociological impact; and
 - ◆ is a centre for coal mining with huge inputs into Queensland Australian economies.
- Recognition of the impact caused to the Queensland and Australian economy by disruption to production and transport caused by extreme flooding in the Central Queensland region.
- Jan 2011**
- Continuing investigations around the Central Queensland Coal Fields in association with the Emerald Flood Event.
 - Continuing investigations of mine water discharges into high base flows in rivers (DERM).



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