Annual Report 2010
Vision Statement

Australia’s water future will require synthetic understanding coupled with innovative approaches to all aspects of the water cycle; water use and reuse; aquatic environments; flooding; estuaries and the coast.

Our vision for the UNSW Water Research Centre is to continue UNSW’s 61 year history of leading water research within a holistic perspective of water from catchment to ocean.
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1) Directors Report

2010 proved to be another exciting and challenging year, which saw the continued growth of the centre as measured by its grants success, increased applied research with industry, publication impacts, and outreach activities.

The WRC has continued to be an active participant in the international water community by hosting of the 5th IWA International Young Water Professionals (YWP) conference at UNSW. This was truly an international conference with over 140 YWPs from 27 different countries. The conference was a resounding success both academically and socially for future water leaders of the world.

Research Initiatives

2010 was another very productive year for the WRC in terms of success in obtaining competitive ARC Discovery and Linkages grants and papers accepted for publication in prestigious international journals. We published 103 peer reviewed research papers during the year.

Research publication productivity was matched by success in applications for competitive grants. The centre had several new ARC projects commence in 2010 and was successful in securing new ARC Discovery and Linkages grants for 2011.

Some of the new projects for 2010 include:

1. Interdisciplinary Greenhouse Gas Assessment – Nitrous Oxide Emissions from Marine Wastewater Disposal, lead by Dr Bill Pierson

2. Olfactory Characterisation of Odours for Optimising Impact Assessment, lead by Prof Richard Stuetz

3. Optimisation of Nutrient Removal, Membrane Fouling and excess Sludge Dewatering in Hybrid Coagulation/Submerged Membrane Bioreactor (SMBR) Treatment of Wastewaters, lead by Prof David Waite

4. Synthesis of Activated Carbon Supported Zero Valent Iron Nanoparticles and Application to Contaminant Degradation in Benthic Sediments, lead by Prof David Waite
Dr Stuart Khan, Dr Chris Blenkinsopp, A/Professor Ian Turner, and Dr Bill Peirson have also secured future funding from the ARC during 2010 that will see four new projects commence in 2011. These projects are:

- Source - Receptor Analysis of Lignin and Lipid Macromolecules in Karst to Quantify Stalagmite Biomarker Proxies of Vegetation and Temperature Change

- Bed Shear Stress on Beach Sediment and Coastal Structures under Wave Run-up

- Australian Coastal observation Network; Monitoring and Forecasting Coastal Erosion in a Changing Climate

- Erosion of Embankment Dams and Dam Spillways

Our People

During 2010, the WRC also welcomed two new committee members to its Industry Advisory Committee (IAC); Neil Lawson, Operations Manager, South-East Asia & New Zealand, Discipline Leader, Coastal, Ocean & Environment, CARDNO, and Keith Craig, Technical Director, Veolia Water Australia. The WRC is most grateful for the continued strategic and technical support by the IAC members.

The year also saw Dr. Rita Henderson receive the IWA Young Water Professional Award at the biennial IWA World Water Congress (WWC) in Montreal. This award is presented biennially to recognise young professionals under the age of 35 who are either water sector practitioners or from research/academia. Rita was also award an ARC Post-doctoral fellowship Industry as part of her Australian Research Council (ARC) Linkage grant on optimising dissolve air flotation.

Dr. Kate Murphy also commenced an ARC Postdoctoral fellowship under a discovery grant that aims to optimise the characterization of odorous emissions using chemometric analysis. One of our honours students, Louise Gates, was awarded the Sydney Water Gold Medal for 2010.

During 2010 it has been a pleasure to welcome new staff to the WRC - Dr Yuan Wang, Melissa Mole, and Jamie Ruprecht. In the November graduation ceremony WRC had several PhD graduates - Nanda Altavilla, Fiona Johnson, Bradley Morris, Gavin Parcsi and Tom Shand.

Next year in July 2011, we look forward to hosting the 7th IWA specialist conference on Assessment and Control of Micropollutants /Hazardous Substances in Water.

We thank all of our stakeholders for their continued interest and support during 2010.
The UNSW Water Research Centre (WRC) is a large multidisciplinary water research group and plays a major role in the training of Australia’s future water engineers. The water industry in Australia underpins the entire Australian economy. The WRC derives approximately 60% of its total research funding directly from industry and 20% of its revenues from industry partnership.

Consequently, the WRC is advised by senior water industry leaders who advise the Co-Directors regarding strategies to ensure the ongoing relevance of the centre and its ability to address and anticipate contemporary Australian water issues. Our present industry advisory committee members are as follows:

**Angus Gordon**

*Chair*

Completing a Civil Engineering degree in 1969 Angus commenced work on water and coastal projects in 1970 at WRL. In 1973 he obtained a Master of Engineering Science and in 1973 took up positions at the NSW government’s Manly Hydraulic Laboratory and then in the Coastal Branch of Public Works NSW. For 40 years he has been involved in coastal engineering, coastal zone management, and planning projects in all states of Australia and in Brunei, Dubai, Kuwait, Indonesia and Hong Kong. He has also been engaged by the UN as an international expert.

In 1976 he established the NSW Governments Beach Improvement Program and led the team that, in 1978 produced NSW’s first comprehensive coastal investigation and management report “Byron Bay – Hastings Point Erosion Study”. As a direct result of that study Angus then became involved in the drafting and implementation of the 1979 NSW Coastal Protection Act. Angus has 45 technical papers published nationally and internationally on coastal engineering and coastal zone management.

Angus first became involved in the issue of climate change in 1976 when he was seconded to the Antarctic Division of the Department of Science for a 12 month period. In 1987 he published a paper in the CSIRO’s book “Greenhouse 87”; the paper linked sea level rise to coastal erosion at 32 locations in NSW where his team had undertaken studies over the preceding decade. He has published a number of
papers on climate change and was the lead author of the Engineers Australia 1991 guidelines for adaption to climate change in the coastal zone.

**Douglas Rhodes**  
*B.Rur.Sc.*  
*Office of Hawkesbury-Nepean, Manager Community Relations*

Doug's career has included semi-arid land management, erosion and mining rehabilitation in the Western NSW and Northern Tablelands of NSW, catchment management and a long-term involvement in water resource planning within the Sydney Basin. Interaction with the communities and the natural resource managers was a critical component in delivering a sustainable outcome within all these areas.

**Colin Nicholson**  
*Sydney Water*

Colin has a BSc and honours degree in Civil Engineering from the University of Sydney plus postgraduate qualifications in public health engineering from UNSW.

He is currently the General Manager of Operations Division for Sydney Water Corporation. He manages the operation of Sydney Water’s systems and processes including treatment plants, networks, telemetry and control systems and monitoring services. He also has teams providing specialist technical advice and managing energy supply, emergency management, security and the operational interface with regulators.

**Bruce Coates**  
*Principle Data Specialist (Coastal)*  
*Department of Environment, Climate Change and Water*

Bruce has over 25 years experience in coastal and estuarine processes, coastal policy development, and coastal zone management. He has worked in a range of scientific and management roles in various NSW government agencies and held an adjunct position at the University of Sydney. He has a degree in marine science from the University of Sydney.

Bruce has previously been on the advisory board for the Centre for Research on Ecological Impacts of Coastal Cities, and is currently on the NSW Council of the Australian Marine Science Association.

**Will Strachan**  
*BE (Hons), F.I.E. Aust., CPEng*  
*NSW Dept of Commerce*

Will Strachan is a civil engineering graduate from the University of NSW (1972). Will leads NSW Water Solutions, a government business, which delivers expert services and solutions to the water, environmental and infrastructure sectors. NSW Water Solutions is a multi-disciplinary team of around 250 personnel of engineers, scientists, economists, technical and administrative personnel. This team of people undertakes in the order of 1000 projects per year; which involve the investigation and design of dams, water supply and wastewater schemes, and natural resources infrastructure. The Manly Hydraulics Laboratory is also part of NSW Water Solutions.
Ian Tanner  
*General Manager, Water Supply Division*  
*Sydney Catchment Authority*  
*B.Sc (Eng.)*

Since graduating in 1980 from UNSW Ian has had 37 years of experience and achievements in the Water Industry. He is an experienced practitioner in the fields of: water and waste water systems investigations and design; construction management (including Project, Program and Contract management); operational management of catchments, dams, water supply systems, water filtration plants and sewage treatment plants; management of Engineering Services consultancy business; and a Leader and Change agent.

Neil Lawson  
*Operations Manager, South-East Asia & New Zealand, Discipline Leader, Coastal, Ocean & Environment, CARDNO*  
*B.E (Hons), M Eng Sc, University of NSW*  
*Fellow Engineers Australia & Member National Committee Coastal & Ocean Engineering*

Neil’s skills and proficiency in ocean, estuarine and the marine environment are sought after worldwide. Neil has more than 30 years of industry experience and has provided professional services in project management of major coastal and ocean data acquisition systems, data analysis, mathematical modelling and environmental design criteria.

He has high level knowledge in flood and floodplain management and provided advice on flooding aspects of development, on-site detention, water resource management and water quality. His services have also been required in an expert witness capacity. During his career Neil has provided ship simulation systems and project management – leading to safer and more efficient practices at ports worldwide.

Neil has also designed and implemented real time data acquisition systems in marine and ocean environments across the globe. Neil’s love of the ocean and marine environment is also a passion outside work. He is the proud owner of a 1975 classic 36ft timber cruiser and is regularly seen on Sydney Harbour.

Keith Craig  
*Technical Director Veolia Water Australia*  
*Bachelor of Engineering (Hons), University of Newcastle, 1976.*  
*Master of Engineering (Sc), University of Newcastle, 1978.*

Keith has been involved in the water industry for over 30 years and has been at the leading edge of technology developments in Australia. He has worked in both the public and private sector and served on a number of key committees and advisory groups. His current role includes activities in the areas of water operations, research and development and projects.

Professor Graham Davies  
*BSc, PhD, DSc, CEng, FIET, FIInstP, FIoM3, FREng*

Graham Davies is the Dean of Engineering at the University of New South Wales, Sydney, Australia. He has held senior posts in academia at the University of Birmingham and corporately as director in charge of British Telecom’s Corporate Research.
3.1 Our Structure

Operating out of two locations – Kensington campus (established in 1987) and the Water Research Laboratory at Manly Vale (established in 1959), the UNSW Water Research Centre (WRC) is at the forefront of multidisciplinary research in water resources, engineering, management and the development of tools for environmental management and sustainability for improving the aquatic and atmospheric environments. The two Co-directors for the WRC are Prof Richard Stuetz and Dr Bill Peirson.

As an externally funded research centre within the School of Civil and Environmental Engineering, the WRC interacts and collaborates with industry, both State and Federal governments, and research groups in other universities in Australia and overseas. It maintains the largest postgraduate and undergraduate teaching programmes in water engineering in Australia, and currently supports 55 research scientist and engineers and 40 PhD researchers, with an external income of $7.4M in 2010.

The Centre is active in fundamental water research in Australia, particularly in the fields of:

**Surface and groundwater hydrology** - ongoing Australian leadership of the quantifying of rainfall, runoff and groundwater flows at catchment scales.

**Public health and water treatment** - fundamental investigations of the chemistry and microbiology of water for urban use - providing multidisciplinary research in water & wastewater engineering and the development of tools for environmental management & sustainability for improving the aquatic and atmospheric environments.

**Civil and environmental hydraulics** - undertaking practical project-based and theoretical hydraulics research. This research is undertaken using the unique large-scale facilities of the Water Research Laboratory at Manly Vale.
Executive Committee

The following Executive Committee undertakes management of the Water Research Centre (WRC):

**Professor Richard Stuetz**
Co-Director, WRC

**Dr Bill Peirson**
Co-Director, WRC

**Prof David Waite**
Head, School of Civil & Environmental Engineering

**Assoc Prof Ian Turner**
Deputy-Director (Research), Water Research Laboratory

**Prof Ashish Sharma**
School of Civil & Environmental Engineering

**Mr Brett Miller**
Business Manager, Manly Vale

**Mr Robert Steel**
Business Manager, Kensington

This committee meets on a quarterly basis to discuss strategy, performance and research opportunities within WRC.

Centre Management Committee

As required for all UNSW Centres, a Management Committee for WRC was established by the Vice-Chancellor, on advice from the Pro-Vice-Chancellor (Research) and the Dean of Engineering. This Management Committee is responsible to the Vice-Chancellor for ensuring the objectives of the Centre are pursued and the terms of reference of the Centre are implemented. During 2010, the Management Committee for WRC was made up of the following members:

**Prof Graham Davies**
Dean, Faculty of Engineering (Chair)

**Prof David Waite**
Head, School of Civil & Environmental Engineering

**Prof Richard Stuetz**
Co-Director, WRC

**Dr Bill Peirson**
Co-Director, WRC

**Prof Jason Middleton**
Department of Aviation, Faculty of Science

**Prof Staffan Kjelleberg**
School of Biotechnology and Biomolecular Sciences, Faculty of Science

**Associate Prof Laura Poole-Warren**
Associate Dean (Research), Faculty of Engineering

3.2 Program Areas

WRC has 12 core program areas of research and applied research activities, supported by academic and researchers from the centre and PhD students from the School of Civil and Environmental Engineering: The 12 core program areas area:

- Civil and Environmental Hydraulics
- Coastal Engineering
- Biogeochemical Processes
- Waste Management
- Hydroclimatology
- Risk Assessment
- Sustainability Assessment
- Groundwater
- Trace Organics
- Water and Wastewater Treatment
- Atmospheric Emissions and Odours
- Estuarine Engineering
4.1 Awards & Honours

Each year WRC staffs receive distinguished awards within their field. In 2010 Rita Henderson and Kate Murphy were bestowed two such awards.

**IWA Young Water Professionals Award**

Rita Henderson was the recipient of the IWA Young Water Professional Award at the biennial IWA World Water Congress (WWC) in Montreal, in September 2010.

This award is presented biennially to recognise young professionals under the age of 35 who are either water sector practitioners or from research/academia. Awardees have both outstanding career achievement (either through their scientific contribution as researchers or working in the water industry) and the potential to play a large and influential role in the water industry in the future. Rita received the award due to academic research achievements in the water treatment field at both the University of New South Wales and Cranfield University (UK), as well as active involvement in YWP activities over the last 2 years.

Rita will be the ambassador for both IWA and the IWA YWP programme for two years after receiving the Award.

The 2010 Water Congress was attended by 4500 delegates and exhibitors. Rita found the experience both rewarding and enriching. Rita said, “Overall, I believe the congress provided a venue for water professionals (both young and not so young alike), to meet, exchange ideas and debate the key issues impacting the water sector today. Also the YWP programme certainly enriched the experience for me and many others and I would encourage those who have not previously participated in YWP activities to engage in the future.”

*Rita receiving the award in Montreal*
The Australian Research Council (ARC) provides opportunities for researchers at the postdoctoral level to undertake research of national and international significance, and to broaden their research experience. ARC Postdoctoral Fellowships are available to researchers with up to three years of research experience since the award of the PhD or equivalent research doctorate.

In 2010, Kate commenced an ARC Postdoctoral Fellowship under a discovery grant that aims to characterise odorous emissions from industry using a sensory analysis approach. Her focus is on utilising chemometric approaches to gain a better understanding of odour quality characteristics and of the relationship between process operations and olfactory annoyance.

Kate has Honours degrees in Zoology and Environmental Engineering from the University of Western Australia, and a PhD (1997) from the University of New South Wales. Between her undergraduate and graduate degrees, she moved abroad to conduct research at the Smithsonian Environmental Research Center in USA, where she studied chemical tracers for determining sources of ships’ ballast water. Recently, she has been involved in a UNSW linkage project aiming to characterise and distinguish organic matter sources in water recycling treatment systems. In her research, she makes extensive use of multivariate data analysis and chemometrics. These data-analytical skills were an important factor influencing the success of her fellowship bid.

For more information on ACR Fellowship: http://www.arc.gov.au/applicants/researcher_fellowships.htm
4.2 Research Initiatives

2010 was another productive year for WRC in terms of significant research initiatives and findings ranging.

**Nitrous Oxide Emissions from Marine Wastewater Disposal—a Laughing Matter?**

Some 300 times more powerful per kilogram than carbon dioxide, nitrous oxide (N$_2$O) is an important greenhouse gas that plays a significant role in several aspects of atmospheric chemistry. Recent research also suggests that N$_2$O is likely to remain the single most important ozone-depleting emission throughout the 21st century. Over the last few decades the concentration of N$_2$O has steadily increased, reaching around 319 parts per billion by volume (ppbv) in 2005 from longstanding and stable pre-industrial levels of around 287 ppbv. This trend of increasing atmospheric N$_2$O levels seems set to continue and is the subject of international concern.

N$_2$O generation occurs during conventional wastewater treatment during both microbial nitrification and denitrification of the nitrogen-containing compounds present (e.g., urea, ammonia and nitrate). In oceanic waters, N$_2$O is also emitted as a by-product of nitrification and as chemical intermediate during denitrification. Existing wastewater management practices internationally result in the disposal of large quantities of untreated or primary-level effluent to the marine environment. In Australia, Sydney sees hundreds of millions of litres of nitrogen-rich primary wastewater discharged to the coastal environment every day. Currently, there is little data available to enable the determination of so-called ‘fugitive’ N$_2$O emissions resulting from the disposal of primary treated effluent to coastal waters. Existing national and international (IPCC) methodologies for N$_2$O emission calculations include gaps relating to downstream point-of-disposal emissions to marine environments, and consequently, error margins associated with national emissions estimates for this greenhouse gas source are wide. For the water sector, this ‘unknown’ represents a potentially significant un-costed liability in its carbon profile and such uncertainty is deemed unacceptable in the emerging business environment of carbon economics.

Through a combination of field surveys, controlled laboratory experiments, hydrodynamic modelling and the application of life cycle assessment methods, this ARC-funded Discovery Project seeks to address key knowledge gaps in our current understanding of full cycle N$_2$O emissions from wastewater management practices. Improving the current characterisation of this emission source will enable more accurate assessments of the water industry’s carbon footprint and will ultimately facilitate more environmentally and economically sustainable management of the water sector both in Australia and internationally. The Chief Investigators involved with this research are Associate Professor Greg Peters (Chalmers University of Technology), Dr Bill Peirson and Professor Nick Ashbolt (US EPA), with Dr Michael Short coordinating the experimental components of the project. Having commenced early 2010, the project is in its early stages and is due for completion early 2013.
Coastal Australia was once a land with teeming wildlife and abundant native species. Over the past 150+ years the rivers and tidal estuaries of Australia have been cleared, drained, leveed, and floodgated to promote agriculture and general development. While this has helped to create modern Australia, in many locations this legacy of development has resulted in degraded land lacking biodiversity and environmental values. At these and other sensitive locations, research is coalescing around how to re-create or rehabilitate the natural environment.

The lower Hunter River estuary in NSW has become a major research ground for investigating tidal wetland rehabilitation and creation. Due to the increasing industrial pressures, the legacy of development and the important environmental values of this estuary, significant on-ground work is currently underway.

One important component of this research is a large tidal wetland restoration study being conducted at the Tomago Wetlands within the Hunter Estuary Wetland Ramsar site. Researchers at the Water Research Laboratory, led by Dr William Glamore, have been working at this site for the past 6 years with staff from the NSW Department of Climate Change and Water, the local Catchment Management Authority and NSW Department of Industry and Investment to understand the role of hydrology, hydraulics and hydrodynamics in wetland rehabilitation.

Based on a series of on-ground research projects, a restoration plan was developed for the site with the primary aim to restore salt marsh habitat for migratory wading birds. Numerical model results combined with on-ground sampling provided the necessary information to understand the existing and
potentially restored hydrologic regime. Based on these results, on-ground engineering was undertaken to prepare the site, including the design and installation of SmartGates to control tidal inundation. Tidal flushing was restored to the western portion of the site (>200 hectares) in 2008 and innovative techniques have been used to adaptively monitor the progress of the site towards a functioning tidal wetland.

Current research at the site is focused on restoring tidal flushing to the western portion of the site (another 350 hectares) and restoration plans and research outcomes are being developed and implemented. The collaborative approach between WRL-WRC staff and staff from state agencies is the primary reason for the long-term success of this project. Similar research and training into hydrologic restoration is also currently being undertaken at a range of other sites across Australasia. Dr William Glamore can be contacted directly at w.glamore@wrl.unsw.edu.au

For more information on this project please visit:

or

General information on wetland restoration projects can be found at:
Optimisation of nutrient removal, membrane fouling and sludge dewatering in hybrid coagulation/submerged membrane bioreactor treatment of wastewaters

The objective of this project is to improve nutrient removal, minimize membrane fouling and aid the dewatering of excess sludge in hybrid coagulation/submerged membrane bioreactor (SMBR) treatment of wastewaters by:

• experimental examination of the impact of coagulant addition on SMBR performance; and

• Kinetic modelling of key coagulant transformation processes within the SMBR.

Coagulant addition is used widely in both conventional and membrane-based water treatment as an essential aid to floc formation and is also recognized to assist greatly in reducing the extent of transmembrane pressure (TMP) build-up in submerged membrane bioreactor treatment of wastewaters. Coagulant addition may also assist in removal of phosphorus in treatment of wastewaters and is also recognized to aid the dewatering of the highly gelatinous sludge that is typically produced in submerged membrane bioreactor wastewater treatment.

Despite the apparent advantages, there has been only limited investigation of the impact of coagulant choice and dosing conditions on nutrient removal, membrane fouling and excess sludge dewatering in SMBR treatment of wastewaters. One reason for the limited research undertaken to date in this area relates to the complexity of the SMBR system and the variety of reactions that can occur on addition of a coagulant to a membrane bioreactor. Some of the unanswered questions are:

• Does the coagulant precipitate and, if so, is the major form an oxide or phosphate solid?

• Do these solids transform to more crystalline entities over time?

• If, rather, the coagulant initially forms dissolved complexes with the organic matter present, how stable are these complexes?

• If Fe(III) salts are added to the anoxic chamber, is iron reduced to Fe(II) species?

• On transport to the aerated chambers, does Fe(II) oxidise and, if so, what are the oxidation products?

Judicious use of both laboratory-based and pilot-scale experimentation using both synthetic and real wastewaters coupled with advanced mineral characterisation techniques (EXAFS, SAED, HRTEM) combined with systems-based kinetic modelling will assist greatly in elucidating the key processes operating in hybrid coagulation/submerged membrane bioreactor (C/SMBR) systems.

This project commenced in July 2010 and the expected to take three years to complete. The project team includes Prof. David Waite, Dr. Yuan Wang, Yongjia Xin, Pradeep Maheshwari, in collaboration with A/Prof. Greg Leslie, UNESCO Centre for Membrane Science & Technology, UNSW; Professors Xia Huang and Xianghua Wen, Tsinghua University, China. The ARC has awarded a linkage grant for this project, which will be undertaken with the
collaboration of Sydney Water, Water Quality Research Australia, Beijing Origin Water Technology and Tsinghua University in China.

Since the commencement of the project three small scale membrane bioreactors (MBR) have been established in the UNSW Civil Engineering building and one pilot scale MBR at Sydney Water’s Bondi Sewage Treatment Plant. Full scale testing will be at Brooklyn Sewage within 1½ to 2 years time. Tsinghua University has been conducting several tests in laboratories in Beijing. Beijing Origin Water Technology are providing membranes and also conducting a pilot plant at Huairou in Beijing. Full scale study in Miyun in Beijing has already commenced.

As the project proceeds in both Australia and China, results are reviewed and compared with the objective of deriving operating protocols for membrane bioreactors that will allow the development of cost effective operating methods and in turn reduce the overall operating costs.

Investigation of trends in mean and extreme wave climate around the Australian continent using long-term wave buoy records

The Australian coast is subject to a spatially and seasonally varied mean wave climate periodically affected by large wave events. These large wave events, particularly when they coincide with high water levels, may cause widespread coastal inundation, beach erosion, damage to property and marine structures, and risks to public safety. Having accurate predictors of the likelihood and magnitude of large wave events is necessary for the quantification of extreme beach erosion and inundation, design of nearshore structures, and for climate change adaptation planning.

With funding by the Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (ACCARNSI) a study was commenced in August 2010 by a project team comprising of Dr Tom Shand, Melissa Mole, James Carley, Dr Bill Peirson, and Assoc. Prof. Ron Cox. This study reviews Australian coastal storm climatology and previous extreme wave analyses undertaken using instrument and numerical data. Traditional extreme value assessment is critically dependent on temporally stable statistics. Wave data from nine wave buoys Australia-wide has been assessed and trends in mean monthly wave height and in the frequency and magnitude of storm events has been statistically analysed. Changes in buoy location and exposure over time has been found to notably influence results, with small changes in buoy position able to introduce apparently significant but fictitious trends. After removing such influences, small upward and downward trends (<5 mm/decade) are observed in shorter length records, possibly related to climatic cycles, but longer records (> ~10 years) remain temporally static. No significant temporal trends in storm magnitude were found and one east coast buoy showed a small increase in storm frequency.

Using this wave buoy data, extreme wave heights, wave periods and cumulative storm energy have been estimated for a range of return events. Typical storm shapes were assessed and all buoys were found to exhibit a moderate positive skew, indicating a faster increase in wave height before the storm peak than decrease following the peak. This storm shape was combined with extreme wave height, period and energy information to construct synthetic design storm time series for each buoy for average recurrence intervals of between 1 and 100 years. Spatial differences are noted in the derived events as a function of the dominant storm climatology for the different regions around Australia.

Extreme waves off Narrabeen in Sydney (Photo taken by Andy Short 1976)
A Novel Process for Algae Treatment

Optimising dissolved air flotation by bubble modification for algae removal in drinking water and advanced wastewater treatment systems.

Algal and cyanobacteria blooms are of particular concern in drinking water resources due to their adverse impact on treatment processes, as well as their potential to release harmful toxins and taste and odour compounds into water supplies. Waste stabilisation ponds used for the advanced treatment of wastewater are also highly susceptible to algal activity which can limit recycled water production.

Dissolved air flotation (DAF) is commonly employed for algae removal but often times with only limited success. Traditionally, DAF is preceded by coagulation/flocculation in which chemical modification of the algal cell surface and associated organic matter leads to agglomeration of colloidal and dissolved matter to form a floc that is more easily floated.

A new project that commenced in January 2010 will investigate modifying the process by developing a novel polymer that will functionalise the surface of the bubbles generated in DAF such that they are attractive to algae and associated dissolved organic material. Such a modification has the potential to improve process robustness and efficiency while reducing chemical consumption and sludge production. The intended outcome of this research is the delivery of a modified-DAF process offering a more robust, sustainable and economical barrier to algae by increasing algal cell removal efficiency while decreasing chemical consumption and sludge production. 2010 has seen development of novel polymers and the design and construction of a 5m3/h pilot DAF plant. The project is expected to be completed by December 2012.

The chief investigators for this research are Dr Rita Henderson, Prof Richard Stuetz and Dr Bill Peirson, all from the UNSW Water Research Centre and Dr Michael Whittaker from the Centre for Advanced Macromolecular Design. Other investigators include Dr Bruce Jefferson from Cranfield University, UK, Assoc. Prof. Gayle Newcombe from the Australia Water Quality Centre and Dr Volga Bulmus from the Izmir Institute of Technology. The PhD student on this research is Mr. Russell Yap. Russell has also been awarded a WQRA PhD Scholarship to conduct this project.

The ARC awarded a linkage grant to this project and industry partners include United Water International, SA Water, Melbourne Water and SEQ Water.
Australian Rainfall and Runoff 2D numerical and large-scale 3D physical modelling research for refinement of Engineers Australia flooding guidelines

The recent floods in Queensland and Victoria in 2011 have been a timely reminder of how destructive and dangerous these types of natural disasters can be. While State and Local government authorities are busy with the important task of restoring infrastructure for communities in these flood affected areas, researchers at the University of New South Wales Water Research Laboratory (WRL) are working to assist planners and emergency managers to more effectively deal with future floods.

Sophisticated two-dimensional numerical computer models are commonly used to provide baseline data describing flood levels, depths and velocities in flood prone areas. Statistically analysed, these data can be used by planners and managers to define the risk and relative hazard (safety) of flood prone areas. The data can be used to determine a wide range of planning outcomes from safe evacuation routes out of flooded regions to whether areas are suitable for rebuilding or future development.

But how accurate and reliable are the baseline data from these models? A research project that commenced in April 2010, by Grantley Smith and Conrad Wasko, using funding from the Federal Department of Climate Change and Energy Efficiency and Engineers Australia, as part of the review of Australian Rainfall and Runoff, has used the advanced numerical and physical modelling capabilities of WRL to review current industry modelling practice. A physical model of an urban floodplain in Merewether, a suburb of Newcastle, NSW has been built at WRL and calibrated to the famous ‘Pashar Bulker’ storm of June 2007. Detailed flow measurements from the physical model (pictured below) have been compared with predictions of the June 2007 flood from various numerical flood software packages commonly used by industry. The research has shown that there are numerous areas where modelling approaches can be improved. WRL’s report will inform the revision of industry guidelines and be included in the next edition of Australian Rainfall and Runoff. A draft report will be available in March 2011. The findings and can also be used to provide an improved assessment of building stability on floodplains.
Snake Paddle Commissioning at Water Research Laboratory

During 2010 the Water Research Laboratory was commissioned to build a cutting edge Snake Paddle wave generation system. Consisting of a sequence of closely spaced multi-bladed systems, the snake paddle is used in WRL's wave basin to generate multidirectional seas similar to the open wind-forced ocean. Funded by the Australian Research Council under Discovery Project and developed at WRL by Ph.D. candidate Michael Allis and Dr William Peirson, the Snake Paddle system extends wave generation capabilities at WRL to include directionally programmable waves.

The stimulus for development of the snake system is the generation of realistic short-crested ocean waves for which directional effects are important. This is a major research frontier in air-sea interaction, driven by the need for accurate parameterisation of the strong influence of wave breaking on air-sea fluxes that underpin climate change assessment, and the prediction of sea state and weather, particularly for severe marine events.

Despite the widespread occurrence of breaking waves, which are characteristically three-dimensional in nature, and their central importance in air-sea coupling, the onset and strength of wave breaking has eluded physical understanding and predictive capability. This project will fill the critical knowledge gaps for directional sea states and thereby address the pressing contemporary demand for more accurate forecast models of sea state, weather and climate.

The Snake Paddle itself comprises a sequence up to 14 modular programmable paddle units mounted within 0.59m wide folded steel housings driven by individual electromagnetic linear motors. Each linear motor is attached to a bottom-cantilevered flexible plate mimicking the motion of a deep water wave and can achieve paddle positions within ±1mm of the desired position. The software user interface was developed to allow straightforward generation of various wave profiles, with provision for future expansion of directional capabilities. Paddle stroke is electronically limited to 320mm but can be modification to 900mm allowing a larger range of waves to be generated. Sequencing the individual paddles allows us to generate directional wave systems.

The snake system significantly expands existing WRL wave generation capabilities and will permit specific investigation of:

- The formation of extreme sea states
- The impact of sea-state directionality on the loads on coastal and ocean structures.
- The influence of directionality on the occurrence and intensity of wave breaking
- Directional effects on wave energy generators.
4.3 Staff Focus

In 2010 we welcomed Jamie Ruprecht (Manly Vale) and Dr Yuan Wang (Kensington).

Jamie Ruprecht

In 2006, Jamie received the Stan Hall Rural Scholarship, one of 20 scholarships awarded among a group of over 700 applicants, to study Civil Engineering at UNSW. In late 2008 his strong interest in Coastal Engineering and high academic achievement over the course of his degree granted him the opportunity to receive one of two ‘UNSW Engineering Taste of Research Summer Scholarships’ being offered at the Water Research Laboratory.

After completing a Bachelor degree in Civil Engineering at UNSW, graduating in 2009 with First Class Honours, Jamie began working as a Project Engineer for the Water Research Laboratory at Manly Vale. Jamie is currently involved in a range of commercial and research projects including physical and numerical modelling of coasts, rivers and estuaries; and has been involved in two large scale contaminate fate and transport (tracer) studies in Sydney and New Zealand.

As a recipient of the D.N. Foster Memorial Fellowship, Jamie attended the 2009 Coasts and Ports Conference in Wellington New Zealand with the WRL contingent. Typically up to four Awards can be offered to final year undergraduate engineering students selected from Australian Universities on a biannual basis. In 2011 Jamie hopes to attend the 2011 Coasts and Ports Conference in Perth to present a conference paper based on his honours thesis, which investigated extension of conventional international approaches to tidal inlet stability to incorporate prevailing climatic conditions unique to Australia.

Jamie is building the foundations of his career in the field of civil engineering, returning to study part-time in 2011 as he commences a Masters in Engineering Science.

Dr Yuan Wang

After completing her Bachelor of Engineering (Chemical) at Tianjin University in China, Yuan worked as a Visiting Research Assistant in the Environmental Bioengineering & Drug Laboratory, Tsinghua University China. After that she was an Assistant Chemical Engineer at the China Petrochemical Corporation. In 2003 she came to UNSW to do a Master’s of Science (by research on reverse osmosis fouling in seawater desalination process) at the School of Chemical Engineering.

Yuan commenced as a research fellow in the Water Research Centre in July 2010 following the completion of a PhD from UNESCO Centre for Membrane Science & Technology at School of Chemical Engineering, UNSW. Her PhD work was entitled “Evaluation of Membrane Bioreactor (MBR) Mixing Performance via Computational Fluid Dynamics (CFD) Modelling” which combined CFD modelling techniques and field trials to study the effects of membrane configuration on mixing and energy consumption of full scale MBR plants in Australia. Her research area remains in the MBR process treating municipal wastewater however her interests move to the coagulant behaviour and the addition of coagulant on MBR performance.

Yuan’s CFD techniques will be extended to the current research to gain insight into the flow paths of liquid and solid phases in the reactor and their impacts on the transformation of coagulants. She recently completed the design of a pilot scale MBR with the capacity of 4 m3/day. This pilot scale MBR will be installed at Sydney Water’s Bondi Sewage Treatment Plant.
4.4 YWPs congregated from all over the world for YWPC 2010

On the 5-7th July, 2010, the future water leaders of the world met to network, exchange ideas and learn from state-of-the-art Australian water projects at the 5th IWA International Young Water Professionals (YWP) conference, held at University of New South Wales, Sydney. Over 140 YWPs from all corners of the globe attended, covering 27 countries, including Kenya, Mexico, UK, Canada, and of course, Australia – this event also being the 3rd IWAA-AWA National YWP meeting. YWPC 2010 kicked off with a pre-conference ice-breaker designed to improve communication – jet-lagged YWPs were soon performing with the aid of NIDA facilitators, and within minutes had already met at least 10 new people!

The conference officially began with a plenary session Chaired by David Garman, President of the IWA. The YWPC was privileged to have Ken Matthews (CEO National Water Commission), Glen Daigger (President Elect of the IWA) and Kerry Schott (Managing Director of Sydney Water) presenting on the challenges facing the water industry, the solutions, and the YWP role in their implementation. The technical programme then continued with presentations on climate change adaptation, treatment processes, and sustainability, among others, which were chaired by water industry experts and YWP National Prize winners. Poster sessions were also held, providing further opportunities for knowledge exchange.

The Professional Development Day showcased leading edge Australian projects and research, with projects presented from each state. Careers panel comprising water industry leaders were quizzed for
tips on how to succeed in the water sector. The finale was the World Café facilitated by Now For Future, which provided a forum for discussing Our Water Future, asking the question “what is our ideal water future in 2020 and what can YWPs do to see it?” The room was buzzing with ideas and plans for action.

The conference was not without a social agenda, and YWPs made the most of the Welcome Reception and Conference Dinner that was held at the Coogee Bay Hotel. A highlight was a trip to the Cruise Bar overlooking the iconic Opera House, for a networking night organised by the NSW YWP Committee. These evenings certainly helped to cement friendships that were fast established between the delegates.

Finally, the technical tours were organised to the Sydney Desalination Plant, and to the Rouse Hill and St Marys Recycled Water Plants. To complete the Australian experience, both tours treated delegates to encounters with native wildlife as whales swam along the coast.

Congratulations to our conference Prize winners – Best Poster: to Jessie Roe of the University of Birmingham, UK; Best Paper: to Vishnu Pandey, of the University of Yamanashi, Japan; Best Presentation: Charlotte Yates, McGill University, Canada; and commendation awards to Eunice Ubomba-Jaswa (South Africa), Carol Martinson (Australia) and Haizhou Liu (US).
### 5) Research Grants for 2010

#### ARC Grants

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<tr>
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<th>Granting Organisation</th>
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<tr>
<td>S. Khan</td>
<td>Fluorescence as a tool for sensitive detection of failures in recycled water treatment and distribution systems ARC Linkage Project LP0776347</td>
<td>ARC, Sydney Water Corporation Gold Coast City Council Sydney Olympic Park Authority Melbourne Water Water Corporation South East Water City West Water Varra Valley Water</td>
</tr>
<tr>
<td></td>
<td>ARC Discovery Project DP087188 - Resolving Critical Knowledge Gaps relating to Light and Free Radical Mediated Transformation of Iron and Copper in Oxic Natural Waters</td>
<td>ARC</td>
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<tr>
<td>D. Waite</td>
<td>ARC Discovery Project DP097478 - Characterizing the hydrological cycle using water isotopes, land + surface models and satellite observation</td>
<td>ARC</td>
</tr>
<tr>
<td>R. Stuetz</td>
<td>ARC Linkage Project LP0989365 - Optimising Decentralised Membrane Reactors for Water Reuse</td>
<td>ARC MidCoast Water Bega Valley Shire Council NSW Department of Health Hunter Water Corporation</td>
</tr>
<tr>
<td>A. Sharma</td>
<td>ARC Linkage Partner LP0883296 - Integrated assessment of climate change, climate input errors and land-use change on soil-moisture and carbon-balance in a catchment simulation framework</td>
<td>ARC NSW Department of Environment and Climate Change APAL</td>
</tr>
<tr>
<td>R. Henderson</td>
<td>Arc Linkage Project Grant 2009 Round 2 - LP0990189. Optimising dissolved air flotation (DAF) for algae removal by bubble modification in drinking water and advanced wastewater systems</td>
<td>ARC Melbourne Water Corporation United Water SEQWater S A Water</td>
</tr>
<tr>
<td>M. McCabe</td>
<td>ARC Linkage project Shared Grant / Subcontract - A new paradigm for improved water resource management using innovative water modelling techniques</td>
<td>ARC/University of Melbourne</td>
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<tr>
<td>D. Waite</td>
<td>ARC Discovery Project LP0883561 - Physico-Chemical controls on Growth, Toxicity and Succession of microcystis and Anabaena Species in Sydney Water Supply Reservoirs</td>
<td>ARC WQRA Sydney Catchment Authority</td>
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<tr>
<td>R. Stuetz</td>
<td>Optimal Management of Corrosion and Odour Problems in Sewer Systems - ARC Linkage Project LP0882016 through UQ</td>
<td>ARC/UQ</td>
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<tr>
<td>G. Peters</td>
<td>ARC Discovery Grant DP1095722 - Interdisciplinary greenhouse gas assessment - nitrous oxide emissions from marine wastewater disposal</td>
<td>ARC</td>
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<tr>
<td>W. Peirson</td>
<td>Offactory Characterisation of Odours for Optimising Impact Assessment - ARC Discovery DP1096691</td>
<td>ARC</td>
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<tr>
<td>N. Ashbolt</td>
<td>Synthesis of Activated Carbon Supported Zero Valent Iron Nanoparticles and Application to Contaminant Degradation in Benthic Sediments. LP100100852</td>
<td>ARC DECCW Sydney Ports Corporation Orica Australia Maritime Authority of NSW Sydney Catchment Authority</td>
</tr>
<tr>
<td>S. Khan</td>
<td>Assessment and optimisation of N-nitrosamine rejection by Reverse Osmosis for planned potable water recycling applications LP0990705</td>
<td>ARC / Uni Wollongong</td>
</tr>
<tr>
<td>D. Waite</td>
<td>Optimisation of nutrient removal, membrane fouling and sludge dewatering in hybrid coagulation/submerged membrane bioreactor treatment of wastewaters - ARC Linkage LP100100056</td>
<td>ARC Beijing Origin Water Technology Co Ltd Sydney Water Corporation Linkage Partner - WQRA</td>
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<tr>
<td>Investigators</td>
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<tr>
<td>G. Peters</td>
<td>Sustainability of water and wastewater treatment chemicals</td>
<td>ARC Linkage as South Australia Water Corporation, Melbourne Water, Yarra Valley Water, Water Corporation, Gold Coast City Council.</td>
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<tr>
<td>H. Coleman</td>
<td>Investigation of endocrine disruption in Australian aquatic environments</td>
<td>ARC Linkage through Griffith University</td>
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<tr>
<td>D. Waite</td>
<td>BioGeoChemical Controls on efficacy and sustainability of uranium heap leaching</td>
<td>ARC Linkage as Energy Resources of Australia</td>
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**Other Research**

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<td>S. Khan</td>
<td>Development of an Ecotoxicity Toolbox to Evaluate Water Quality for Recycling</td>
<td>Department of Water, WA</td>
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<tr>
<td>D. Waite, J. Guan, Y. Wang</td>
<td>DEST International Science Linkage CH070180 – Fouling Control in Hybrid Membrane Systems.</td>
<td>DEST International Science Linkage Programme with Tsinghua University, China.</td>
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<tr>
<td>D. Roser</td>
<td>Premiers Water Fund- University of Western Australia – Assessing the Public Health Impacts of Recycled Water Use. Subcontract to UWA</td>
<td>UWA/PWF</td>
</tr>
<tr>
<td>G. Peters, H. Rowley</td>
<td>University of Sydney Subcontract- Water Services Association of Australia Limited (WSAA) Subcontract Software Development for Chemical Fate Modelling in Ecological Footprint Analysis</td>
<td>U. Sydney</td>
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<tr>
<td>A. Sharma</td>
<td>Project 4. Continuous Rainfall sequences at point locations</td>
<td>NWC through Engineers Australia</td>
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<tr>
<td>M. McCabe</td>
<td>Using satellite observation to investigate land surface – atmosphere interaction</td>
<td>CSIRO Flagship Postgraduate Scholarships (Top-Up for Yi Liu)</td>
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<tr>
<td>S. Khan</td>
<td>WERF Research Subcontract – Evaluation of QSQR techniques for wastewater treatment processes</td>
<td>Colorado School of Mines, WERF</td>
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<tr>
<td>A. Sharma</td>
<td>Australia-India Strategic Research Fund ST030111 – Managing change in Soil Moisture and Agricultural Productivity under a Global Warming scenario using a Catchment Scale Climate Change Assessment Framework</td>
<td>Department of Innovation, Industry, Science and Research</td>
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<tr>
<td>R. Stuetz</td>
<td>Postdoctoral Fellowship for Gavin Parcsi</td>
<td>Poultry CRC</td>
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<tr>
<td>R. Cox, W. Randolph, W. Peirson</td>
<td>National Climate Change Adaptation Research Facility. Climate Change Adaptation Research Program – Settlement and Infrastructure</td>
<td>ACCARNSI</td>
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<tr>
<td>D. Waite, R. Collins, A. Jones</td>
<td>Water Quality Research Australia – Scale formation and prevention in small water supplies reliant on groundwater (1019/09)</td>
<td>WQRA</td>
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<tr>
<td>R. Collins</td>
<td>Speciation of Arsenic in the roots of non-accumulator Eucalyptus spp.</td>
<td>Australian Synchrotron Research Program</td>
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<tr>
<td>R. Collins</td>
<td>The effect of silicate on Uranium reduction during the Fe(III)-catalytic crystallisation of ferrihydrite</td>
<td>Australian Synchrotron Research Program</td>
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<tr>
<td>S. Westra</td>
<td>Project 18 – Interaction of Coastal Processes and severe weather events: Phase 1 Pilot Study into joint probability modelling of extreme rainfall and storm surge in the coastal zone</td>
<td>NWC through Engineers Australia</td>
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<tr>
<td>S. Khan</td>
<td>WQRA2002 – A national approach to the health risk assessment, risk communication and management of chemical hazards from recycled water projects</td>
<td>Water Quality Research Australia</td>
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<tr>
<td>R. Henderson</td>
<td>Optimising dissolved air flotation (DAF) for algae removal by bubble modification in drinking water and advanced wastewater systems – Scholarship</td>
<td>Water Quality Research Australia</td>
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<tr>
<td>R. Collins</td>
<td>AS_JA101_ESRF_3002960 – Cobalt (II) sorption to Mn and Fe Oxides</td>
<td>Australian Synchrotron Research Program</td>
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<tr>
<td>R. Collins</td>
<td>AS102/WAS2484 – Quick scanning XAFS to determine Fe-O-Fe bond formation during iron precipitation and iron oxide transformations</td>
<td>Australian Synchrotron Research Program</td>
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<tr>
<td>R. Collins</td>
<td>AS103/XAS-2981 Capacity of uranium incorporation in Fe(II)-transformed Fe(III) oxide</td>
<td>Australian Synchrotron Research Program</td>
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<tr>
<td>D. Waite</td>
<td>Australian Synchrotron Postgraduate Award</td>
<td>Australian Synchrotron Company</td>
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<tr>
<td>R. Stuetz, G. Parcsi</td>
<td>Fate of Volatile Organo-Sulphur Compounds (VOSCs) in Odour Assessment – Scholarship</td>
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## Applied Research

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<td>S. Dever, X. Wang</td>
<td>Landfill Flux testing</td>
<td>Various</td>
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<tr>
<td>W. Wang, G. Parcsi</td>
<td>Various Odour and emission analyses</td>
<td>Various</td>
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<tr>
<td>A. Kinsela, R. Collins, D. Waite</td>
<td>Sources of Environmental Contaminants: Upper &amp; Southern Christies Creek Catchment, North East New South Wales</td>
<td>Tweed Shire Council</td>
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<tr>
<td>D. Roser, B. Van den Akker</td>
<td>Quantitative Risk Assessment</td>
<td>Various</td>
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<tr>
<td>D. Roser, S. Khan</td>
<td>Review of Stormwater Treatment system proposal</td>
<td>Willoughby City Council</td>
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<tr>
<td>B. Steel, B. Van den Akker</td>
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<tr>
<td>M. Schulz, G. Peters, E. Rocheta, S. Lundie</td>
<td>Life Cycle Assessment and Carbon Foot printing</td>
<td>Various</td>
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<tr>
<td>G. Peters, M. Schulz</td>
<td>Sustainability Covenant</td>
<td>EPA Victoria</td>
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<tr>
<td>R. Henderson</td>
<td>Analytical Services</td>
<td>Various</td>
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<tr>
<td>S. Westra</td>
<td>Climate change water security study</td>
<td>SKM</td>
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<tr>
<td>S. Khan</td>
<td>Development of a fugacity model to model and predict the fate of cyanobacterial toxins in Warragamba Dam</td>
<td>SCA</td>
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<tr>
<td>B. Miller, S. Pells, G. Smith, J Ruprecht, C. Wasko, D Rayner</td>
<td>Development of An EGOWS Manual</td>
<td>NSW UNSW</td>
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<tr>
<td>B. Miller, S. Pells, G. Smith, J Ruprecht, C. Wasko, D Rayner</td>
<td>Testing of the Outfall Drop Structure for the Adelaide Desalination Plant</td>
<td>SMEC</td>
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<tr>
<td>B. Miller, S. Pells, G. Smith, J Ruprecht, C. Wasko, D Rayner</td>
<td>Hydraulic Testing Of Atlantis Drainage Cells</td>
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<tr>
<td>B. Miller, S. Pells, G. Smith, J Ruprecht, C. Wasko, D Rayner</td>
<td>Australian Rainfall And Runoff Revision Project: Appropriate Stability Criteria For Vehicles</td>
<td>Engineers Australia</td>
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<tr>
<td>B. Miller, S. Pells, G. Smith, J Ruprecht, C. Wasko, D Rayner</td>
<td>Newcastle City Council City Wide Floodplain Management Plan</td>
<td>Newcastle City Council</td>
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<tr>
<td>B. Miller, S. Pells, G. Smith, J Ruprecht, C. Wasko, D Rayner</td>
<td>Hydraulic Testing of Outfall Duckbill Valves</td>
<td>Melbourne Desalination Plant</td>
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<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Advice and Guidelines for Temporary Coastal Protection Works on the NSW Coast</td>
<td>DECCW</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Batemans Bay: Detailed Wave Analysis</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Coastal Storm Data Analysis: Provision of Extreme Wave and Water Level Data</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Geoscience Australia: Review of Inundation Modelling</td>
<td>Geoscience Australia</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Guidelines for Assessing and Managing the Impacts of Long Term Coastal Protection Works</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Mornington Pier Upgrade: Model Testing</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Narrabeen-Collaroy 12-Month Surveys</td>
<td>Warringah Council</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>NSW Coastal Inundation Hazard Studies: Extreme Waves and Elevated Coastal Water Levels</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>St Kilda Southern Breakwater: Physical Model Testing</td>
<td>Parks Victoria</td>
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<tr>
<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Tutong River Entrance Physical Modelling - Brunei</td>
<td>Ove Arup</td>
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<td>J Carley, M. Blacka, T Shand, B. Peirson, I Turner, A. Mariani, I. Coghan</td>
<td>Tweed Sand Bypassing Argus Monitoring</td>
<td>NSW LPMA</td>
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<tr>
<td>B Miller, W. Glamore, G. Smith, D Rayner, C. Wasko, I Coglan, J Ruprecht</td>
<td>Darwin Harbour - Hydrodynamic Modelling - East Arm Port Expansion</td>
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<tr>
<td>B Miller, W. Glamore, G. Smith, D Rayner, C. Wasko, I Coglan, J Ruprecht</td>
<td>Detailed Concept Design of Yamba-Iluka Ebb Tide Release</td>
<td>Dept of Commerce</td>
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<tr>
<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Field Commissioning Tests Of Christchurch Ocean Outfall, New Zealand</td>
<td>Christchurch City Council</td>
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<tr>
<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Hunter River Water Quality Model</td>
<td>Hunter Water Corporation</td>
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<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Hydrodynamic Modelling of Tomago Wetlands, Hunter River, NSW</td>
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<tr>
<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Independent Expert Advice To Federal DEWHA Regarding Ramsar Wetlands</td>
<td>DEWHA</td>
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<tr>
<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Physical Modelling of the Victorian Desalination Plant Outfall Discharges</td>
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<tr>
<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Sydney Desalination Plant - Field Validation of Outfall Plume Geometry And Dilutions</td>
<td>Veolia Water</td>
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<tr>
<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Tutong River Entrance Numerical Modelling - Brunei</td>
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<td>B Miller, W Glamore, G Smith, D Rayner, C Wasko, I Coghlan J Ruprecht</td>
<td>Tutong River Hydrosurvey And Data Collection - Brunei</td>
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<tr>
<td>W Timms, S Pells, C Wasko</td>
<td>Christchurch Saltwater Instrusion into Coastal Aquifers</td>
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<td>W Timms, S Pells, C Wasko</td>
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<td>W Timms, S Pells, C Wasko</td>
<td>Hat Head Effluent Disposal Site - Ongoing Groundwater Monitoring</td>
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<td>W Timms, S Pells, C Wasko</td>
<td>Lake Cathie - Groundwater and Surface Water Interaction Assessment</td>
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<td>W Timms, S Pells, C Wasko</td>
<td>Ranger Uranium Mine - Groundwater Flow Modelling</td>
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<td>W Timms, S Pells, C Wasko</td>
<td>Scientific Advice In Relation to Proposed Sustainable Diversion Limits for Groundwater</td>
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6.1 WRC Staff

Co-Directors
Dr Bill Peirson
Professor Richard Stuetz

Deputy Director (Manly Vale)
Dr Ian Turner

Business Manager
Brett Miller
Robert Steel

Academics
Professor David Waite
Associate Professor Ron Cox
Associate Professor Ashish Sharma
Dr Bruce Cathers
Dr Matthew McCabe
Dr Stuart Khan
Dr Greg Peters
Dr David Roser
Dr Eric Sivret
Associate Professor Sven Lundie

Senior Project Engineers
James Carley
Dr William Glamore
Dr Wendy Timms
Steven Pells
Grantley Smith

Research Staff
Dr Hoori Ajami
Dr Xavier Barthelemy
Dr Sivakumar Bellie
Dr Chris B lenkinsopp
Dr Mark Bligh
Leearna Brown
Dr Heather Coleman
Dr Chris Duesterberg
Dr Beatrice Giambastiani
Dr Shikha Garg
Dr Richard Collins
Dr Aurelie Godrant
Dr Mitchell Harley
Dr Rita Henderson
Dr Adele Jones
Christine Kaucner
Dr Andrew Kinsela
Dr Marcus Klein
Andrew McCallum
Dr James McDonald
Dr Rajeshwar Mehrotra
Dr Xianhong Meng

Dr Kate Murphy
Gavin Parcsi
Dr An Ninh Pham
Eytan Rocheta
Gabriel Rau
Dr Andrew Rose
Matthias Schulz
Dr Michael Short
Dr Josiah Strauss
Trang Trinh
Dr Ben Van den Akker
Dr Xianguang Wang
Dr Xiaomaowang
Dr Yuan Wang
Dr Seth Westra

Associate Professor Jan Cordery,
University of New South Wales
Dr Daniel Deere, Water Future, Sydney,
Australia
Dr Stuart Dever (GHD, Australia)
Professor Jorg Drewes, Colorado School
of Mines, Colorado, USA
Dr Manabu Fujii, University of Tohoku
University, Japan
Dr Bruce Jefferson (Cranfield University,
UK)
Dr Marion Minouflet, University of
Geneva, Switzerland
Dr Timothy Payne (ANSTO, Australia)
Associate Professor Andrew Rose
(Southern Cross University, Australia)
Professor Mel Suffet (UCLA, USA)
Dr Gareth Swarbrick, Pells Sullivan &
Meynink, Sydney Australia

Visiting Students
He Di, Harbin Institute of Technology
Commencing practicum: 01/03/2010
until: 30/06/2010
Supervisor: Professor David Waite

Julie Le Gouezigou, INSA Lyon
Commencing Practicum: 05/04/2010
until: 03/09/2010
Supervisor: Professor Richard Stuetz

Solene Guillet, University of Poitiers -
France
Commencing Practicum: 28/06/2010
until: 17/09/2010
Supervisor: Dr Rita Henderson

Leonardo Hoinaski, Universidade
Federal de Santa Catarina - UFSC
Commencing Practicum: 25/03/2010
until: 25/10/2010
Supervisor: Professor Richard Stuetz

Hiroaki Ito, Tohoku University
Commencing practicum: 01/04/2010
until: 31/03/2011
Supervisor: Professor David Waite

Harpreet Kaur, Indian Institute of
Technology Bombay
Commencing Practicum: 25/05/2010
until: 25/07/2010
Supervisor: Dr Stuart Khan
Raquel Lebrero Fernandez, University of Valladolid
**Commencing Practicum:** 15/08/2010
until: 20/12/2010
**Supervisor:** Professor Richard Stuetz

Mareva Marietti, University of Poitiers - France
**Commencing practicum:** 28/06/2010
until: 17/09/2010
**Supervisor:** Dr Rita Henderson

Ankit Sharma, Indian Institute of Technology (Kanpur)
**Commencing practicum:** 01/06/2010
until: 31/07/2010
**Supervisor:** Professor David Waite

Trung-Nghi Tiet, Technical University of Berlin
**Commencing practicum:** 28/07/2010
until: 31/03/2011
**Supervisor:** Professor David Waite

Adrien Vouille, University of Poitiers - France
**Commencing Practicum:** 28/06/2010
until: 17/09/2010
**Supervisor:** Dr Eric Sivret

Dorothea Weingaerten, Karlsruhe Institute of Technology
**Commencing practicum:** 06/04/2010
until: 01/06/2010
**Supervisor:** Professor David Waite

Mao Yanpeng, Shandong University
**Commencing practicum:** 01/03/2010
until: 31/10/2011
**Supervisor:** Professor David Waite

6.3 PhD Graduates

Nanda Altavilla
Fiona Michelle Johnson
Bradley David Morris
Gavin Peter Parcsi
Tom Shand

6.4 ME Graduates

Jose Beya
**Completing a Masters by Research, Funded by Chilean Government.**

6.5 Continuing Research Students & Topics

Allis, Michael James
**Ocean Engineering**
Supervisor: Peirson; Co-supervisor: Banner

Alvarez Gaitan, Juan Pablo
**Sustainability Assessment**
Supervisor: Peters, Moore; Co-supervisor: Schultz

Azcourra, Cecilia
**Isotopes in Hydrology**
Supervisor: McCabe; Co-supervisor: Baker

Beya, Jose Francisco
**Ocean wave dynamics**
Supervisor: Peirson; Co-supervisor: Banner

Boland, Daniel
**Fate of metal contaminants during iron oxide crystallisation**
Supervisor: Waite; Co-supervisor: Collins

Cai, Yingzhe Mick
**Isotope hydrology, water resources**
Supervisors: Evans, McCabe; Co-supervisor: Anderson

Coad, Peter William
**Estuarine algal bloom prediction**
Supervisors: Cathers, VanSenden; Co-supervisor: Ball

Dang, The Cuong
**Waste water**
Supervisor: Waite

Ershadi, Esmaeilabadi, Ali
**Remote sensing hydrology**
Supervisor: McCabe; Co-supervisors: Walker, Evans

Hambly, Adam Christopher
**Fluorescence as a tool for detection of failures in recycled water treatment**
Supervisors: Stuetz, Khan; Co-supervisor: Henderson

Hashim, Nor Haslina
**Use of chiral pharmaceutical compounds to characterise sewage treatment processes and sewage contamination in surface water**
Supervisors: Khan, Stuetz

He, Di
**Natural organic matter-mediated generation of reactive oxygen species**
Supervisor: Waite; Co-supervisor: Garg

Higgins, Rebecca Irene
**Hydrology - Groundwater – Climate**
Supervisor: McCabe; Co-supervisors: Ajami, Evans

Jeremiah, Erwin Joachim
**Hydrology**
Supervisor: Sharma; Co-supervisors: Marshall, Sisson, Nott

Jury, Karen Lillian
**Investigation of the role of antibacterial drugs in municipal wastewater as a selective influence on the spread of bacterial resistance**
Supervisor: Stuetz; Co-supervisor: Ashbolt

Khan, Urooj
**Semi-distributed modeling**
Supervisor: Sharma; Co-supervisor: McCabe
Kwok, Sei Lung  
Computational hydraulics  
Supervisor: Cathers

Lai, Elizabeth  
Development of an integrated sustainability assessment for urban water management  
Supervisors: Moore, Lundie; Co-supervisor: Ashbolt, Lu

Le, Hung Viet  
Fate of volatile Organo-Sulfur compounds in odour assessment  
Supervisor: Stuetz; Co-supervisor: Sivret

Le, Minh Nhat  
The removal of sulphonamides and trimethoprim antibiotics in municipal wastewater by biological treatment  
Supervisor: Stuetz; Co-supervisor: Khan

Liu, Yi  
Hydrology, remote sensing, climate variability  
Supervisor: McCabe; Co-supervisor: Sharma

Ma, Tian  
Physico-chemical controls on growth, toxicity and succession of cyanobacteria  
Supervisor: Waite; Co-supervisor: Garg

Maheshwar, Pradeep  
Optimisation of coagulant addition to submerged membrane bioreactors using computational and experimental methods  
Supervisor: Waite; Co-supervisor: Collins

Maruthai Pillai, Sashikala  
Headspace analysis of chemical odorants  
Supervisor: Stuetz; Co-supervisor: Moore

Miller, Christopher James  
The transformation and implication of reactive oxygen species in natural aquatic systems  
Supervisor: Waite; Co-supervisor: Rose

Pui, Alexander Charles  
Stochastic hydrology  
Supervisor: Sharma; Co-supervisor: Mehrrota

Rowley, Hazel Victoria  
Decision making for sustainability  
Supervisor: Peters; Co-supervisors: Lundie, Moore

Singh, Sachin  
Fluorescence as an online monitoring tool for water recycling  
Supervisor: Khan; Co-supervisors: Stuetz, Henderson

Thomas, Jacqueline Marie  
Pathogen ecology within drinking water biofilms  
Supervisors: Ashbolt, Stuetz; Co-supervisor: Kjelleberg, Storey

Torbaty, Mohammadali  
Computational hydraulics and computational fluid mechanics  
Supervisor: Cathers, Yeoh; Co-supervisor: Peirson

Tran, Thao Minh  
Fouling of anaerobic membrane bioreactors  
Supervisor: Stuetz; Joint supervisor: LeClech

Trinh, Trang Thi Thanh  
Decentralised MBR for water reuse  
Supervisors: Khan, Coleman; Co-supervisor: Stuetz

Wang, Bei  
Treatability of odorants in abatement system  
Supervisor: Stuetz; Co-supervisor: Parsci

Wang, Lili  
Risks associated with trace organics in MBR-treatment of waste waters  
Supervisor: Khan; Co-supervisor: Stuetz

Woldemeskei, Fitsum Markos  
Hydrology  
Supervisor: Sharma

Xin, Yongjia  
Membrane fouling control  
Supervisor: Waite

Yan, Xia  
Environmental engineering  
Supervisor: Peirson; Co-supervisor: Banner

Yap, Russell Kong Leng (ME)  
Water treatment  
Supervisors: Peirson, Henderson; Co-supervisor: Whittaker

Yeung, Anna Chi Ying  
Factors influencing the growth and toxicity of cyanobacteria in drinking water supplies  
Supervisor: Waite; Co-supervisor: Neilan

Yuan, Xiu  
Light and free-radical mediated transformation kinetics of iron species in natural waters  
Supervisor: Waite; Co-supervisor: Pham

6.6 UNSW Summer scholarship students

Water Quality Research Australia (WQRA) Summer Scholarships

This Scholarship is an introduction for undergraduate students to experience a “taste” of real life research with a “hands-on” approach. The Summer Scholarships provide the students with the opportunity to gain “hands on” knowledge and learn skills such as problem solving, laboratory techniques, presentation skills & report writing. These scholarships are open to domestic students. Students may be located at a range of member organisations such as UNSW Water Research Centre (WRC). For more information go to: http://www.wqra.com.au/education-program/

In 2010 Paul Ly was the WQRA Summer Scholarship recipient at WRC.

Taste of Research Summer Scholarship

The UNSW Faculty of Engineering offer 3rd year students a unique opportunity to find out what research is truly about, and develop great skills and knowledge in the process. The Scholarship provides students the chance to undertake a 12-week project with an existing research team within the Engineering Faculty, and receive a tax-exempt allowance. There are about 200 projects on offer each year. For more information go to: http://www.eng.unsw.edu.au/undergrads/scholarships

In 2010 Eroni Verevukivuki was the Taste of Research recipient at WRC.
7) Publications

**Book - Scholarly Research**


**Book - Edited**


**Chapter - Scholarly Research**


**Journal - Refereed & Scholarly Article**


Journal – Other Refereed Article


Conference – Full Paper Refered


Conference - Full Paper, Not Referenced


Conference - Abstract Only


Conference - Proceedings Editor


Conference - Presentation, not Published


Technical Report


### UNSW Water Research Centre
#### Statement of Financial Performance for the 4th Quarter ended 31st December 2010

<table>
<thead>
<tr>
<th></th>
<th>4Q</th>
<th>Full Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2010</td>
<td>2009</td>
</tr>
<tr>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External Funds*</td>
<td>7,011,303.15</td>
<td>6,820,571.49</td>
</tr>
<tr>
<td>Internal Grants</td>
<td>158,864.00</td>
<td>192,915.62</td>
</tr>
<tr>
<td>Internal Revenue</td>
<td>220,970.06</td>
<td>39,312.57</td>
</tr>
<tr>
<td><strong>Total Income</strong></td>
<td>7,391,137.21</td>
<td>7,052,799.68</td>
</tr>
<tr>
<td><strong>Expenses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payroll</td>
<td>4,691,827.98</td>
<td>3,767,252.89</td>
</tr>
<tr>
<td>Equipment</td>
<td>567,378.86</td>
<td>549,447.61</td>
</tr>
<tr>
<td>Materials</td>
<td>1,145,119.79</td>
<td>1,297,039.31</td>
</tr>
<tr>
<td>Scholarship Stipends</td>
<td>271,780.29</td>
<td>228,885.43</td>
</tr>
<tr>
<td>Travel</td>
<td>368,213.96</td>
<td>314,340.26</td>
</tr>
<tr>
<td><strong>Total Expenses</strong></td>
<td>7,044,320.88</td>
<td>6,156,965.50</td>
</tr>
<tr>
<td><strong>Operating result</strong></td>
<td>346,816.33</td>
<td>895,834.18</td>
</tr>
<tr>
<td>Surplus(Deficit) Bfwd from Prior Year</td>
<td>2,704,701.31</td>
<td>1,413,289.17</td>
</tr>
<tr>
<td>Accumulated Funds Surplus(Deficit)</td>
<td>3,051,517.64</td>
<td>2,836,187.31</td>
</tr>
</tbody>
</table>

*Excludes debtors (unpaid invoices)
The Internal research grants are funds awarded by the Faculty or University and linked to specific research projects.

These grants are either awarded through a competitive application process or may be made available as part of the University’s commitment to participation in a Co-operative Research Centre (CRC).

In the latter case the funds are used to support research projects awarded through the CRC.

The Centre contributed to and maintained a staff redundancy fund until February 2010 when the University removed the funds.

This fund was started in 2003 to preserve funds for the situation where a termination payment was due.
9) With Thanks

We wish to acknowledge and thank the following Association, Industry, and Research Partners for their continued support in 2010:

ALS Environmental
Australian Government
- Australian Research Council
- National Water Commission
- Department of Innovation, Industry, Science and Research
Australian Poultry CRC
Australian Synchrotron Research Program
Australian Water Association
Bega Valley Shire Council
Beijing Origin Water Technology
Bovis Lend Lease
Brookfield Multiplex
CH2M Hill
City West Water
Clearwater Recruitment
Comcast
CSIRO
DCM
DECCW
DEEDI
Degremont Suez Environmental
Department of Environment and Climate Change
Department of Water WA
DEST
DIISR
Ecowise Environmental
Energy Resources of Australia
Engineers Australia
Environmental Biotechnology CRC
EPA Victoria
FontERRA
GHD
Gold Coast City Council
Gold Coast Water
Hostmann-Steinberg
Hunter Water Corporation
International Water Association
International Water Centre
Maritime Authority New South Wales
Meat and Livestock Australia
Melbourne Water
MidCoast Water
Moreton Bay Regional Council
National Research Centre for Environmental Toxicology
New South Wales Health
NSW Department of Environment
OneSteel
Orica Australia
Packaging Trader Pty Ltd
SA Water
SEQ Urban Water Security Research Alliance
Seqwater
Sigma – Aldrich
SKM Sinclair Knight Merz
South East Water Limited
Sydney Catchment Authority
Sydney Olympic Park Authority
Sydney Ports Corporation
Sydney Water Corporation
Tweed Shire Council
United States Army Engineer
Hydraulics and Coastal Laboratory, USA
United States Army Engineer
Institute for Water Resources, USA
United Water International
WA Water Corporation
Waste Technologies of Australia
Water Corporation
Water Quality Research Australia
Water Services Association of Australia
Warringah Council
Willoughby City Council
Yarra Valley Water
Yarra Valley Water

University Collaborators

Centre de Mathématiques et de Leurs Applications, ENS Cachan, France
Cranfield University, UK
Colorado School of Mines, USA
Curtin University
Griffith University
Institut de Recherche sur les Phénomènes Hors Équilibre, France
Melbourne University
Monash University
RMIT
Tsinghua University, China
University College Dublin, Ireland
University of Colorado, USA
University of Columbia, USA
University of Newcastle
University of Plymouth
University of Queensland
University of Sydney
University of Tasmania
University of Technology, Sydney
University of Western Australia