

Water Industry Research - Collaborating Today for Tomorrow's Solutions

Overview of
Water Research Australia
Research Symposium 2017



Presented by Water Research Australia

WaterRA Research Symposium 2017 – An Overview

2 Days: 7 Themes

Climate Change and Extreme Events

Catchments

Customers

**Smarter Monitoring – Methods &
approaches**

Pipe Bursts

Treatment – Wastewater & Drinking Water

What's in the Future?



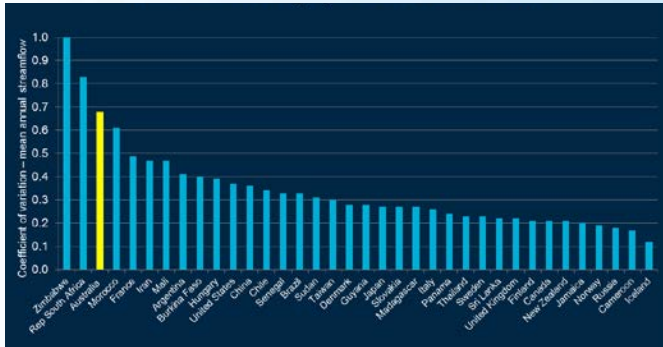
**Water
Research
Australia**



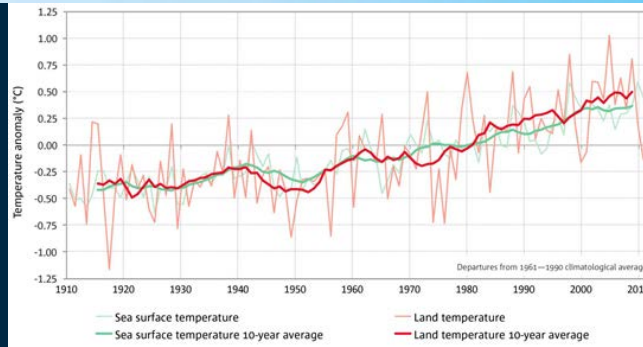
Theme 1

Climate Change (CC) and Extreme Events (EE)

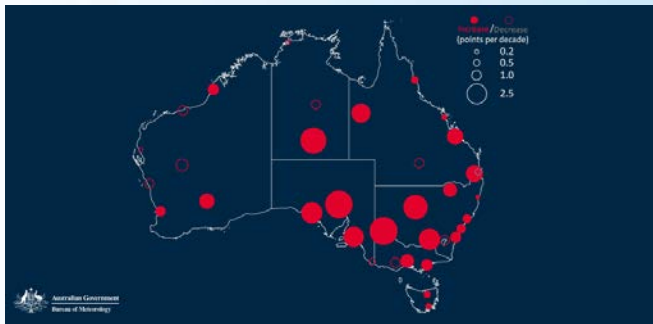
Australia's highly variable stream flows



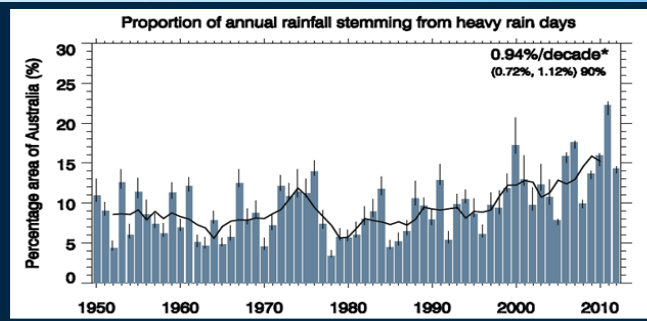
Increasing land and sea temperatures



Increasing fire frequency



Increasing rainfall intensity



Climate change and reservoir water quality #1050

Water quality risks and EE #1063

Bayesian risk assessment and modelling tools for EE #1071

Assessment of the Impacts of Climate Change on Reservoir Water Quality in a Range of Climatic Regions

– Dr Leon van der Linden/SA Water

Water Research Australia

Water Research Foundation

Taiwan Water Corporation

University of Adelaide

Justin Brookes, Anna Rigosi, Chaturangi Wickramaratne

Virginia Tech

John Little, Adil Godrej, Glen Moglen, Tom Grizzard, Mehdy Barandouzi

Australian Water Quality Centre – SA Water

Mike Burch, Robert Daly

National Cheng Kung University

Tsair-Fuh Lin, Chih-Hua Chang, Long-yang Cai, Chia-Ling Chung; Wan-Hua Chang



3 Climatic regions



Assessment of the Impacts of Climate Change on Reservoir Water Quality in a Range of Climatic Regions – Leon van der Linden/SA Water

Context

Climate change presents a potential risk to water supply businesses. Impacts on water quantity are well documented, while potential impacts on water quality were less well understood, and may be system and regionally specific.

Description of Research

This research project consisted of the development of integrated assessment models of catchment-reservoir systems in three climatic regions: Mediterranean (Myponga, SA, SA Water & UofA), Temperate (Lake Manassas, VA, USA, Virginia Tech) and Tropical (Hsinshan Reservoir, Taiwan, National Cheng Kung University). Various downscaling and impact assessment techniques were applied within the family of 'top down' assessment methods. Impacts were analysed from a change in risk perspective, i.e. probability of exceedance of relevant water quality thresholds of temperature, dissolved oxygen, nutrients, chlorophyll concentration and blue-green algal density.



Assessment of the Impacts of Climate Change on Reservoir Water Quality in a Range of Climatic Regions

Description of Research (cont)

- *Average water temperature was projected to increase, however stratification dynamics was more complex and system dependent.*
- *Changes in oxygen concentration will be the result of both physical and biological processes and responses varied between the different sites.*
- *While metalimnetic (mid water column) oxygen concentrations were projected to increase in two of the three locations, there was a general trend of increased risk of hypolimnetic anoxia.*
- *The functional group phytoplankton model applied at Myponga Reservoir projected that cyanobacteria would become more prevalent, on average, in the future.*

Potential Impact

This work highlights that maintaining the status quo in terms of catchment and reservoir conditions will likely result in a degradation of water quality. Management of hypolimnetic anoxia is likely to become more challenging in a warmer future.



Theme 2

Catchments

Cryptosporidium,
Giardia and
water

Responsible for
95.5% of all
water-associated
outbreaks



Each water quality
incident that is
avoided through
better management
potentially saves at
least \$100 million

Risk
Management
Cryptosporidium
and *Giardia* in
Australian
Catchments
#1068

Health Based
Targets: Sanitary
Surveys and
Operational
Monitoring
Guidance
#1109

Risk management of *Cryptosporidium* and *Giardia* in animals in Australian catchments LP130100035

Prof. Una Ryan, Murdoch University, WA 6150.

Context

- *Cryptosporidium* & *Giardia* (C&G) - major public health concern of water utilities - responsible for 95.5% of waterborne protozoan outbreaks worldwide
- Key knowledge gap: the lack of quantitative data on human infectious sp.

Description of Research

- 1st large scale multi-state analysis (undertaken by Alireza Zahedi – PhD student)
- 5,774 faecal samples and 730 STP samples collected from WA, NSW & QLD catchments
- Oocyst numbers determined by qPCR - Positives typed using Sanger sequencing
- Next Generation Sequencing (NGS) used to characterise STP samples and mixed infections in faecal samples
- *Cryptosporidium*: 18.3% overall prevalence (3.2% mixed infections) in faeces



Risk management of *Cryptosporidium* and *Giardia* in animals in Australian catchments LP130100035

Prof. Una Ryan, Murdoch University, WA 6150.

Description of Research (cont)

- 15 *Cryptosporidium* species and 6 genotypes detected - 12 capable of infecting humans
- *C. hominis* in cattle and kangaroos – reservoir of human infection?
- High prevalence of *C. parvum* in cattle
- Wide diversity of species in STP samples - Implications for source tracking?
- *Giardia* analysis ongoing - Assemblage E in humans

Potential Impact

- Importance of kangaroos and cattle as a source of human-infectious oocysts
- Much more informed QMRA analysis
- Implications for more targeted catchment management



Theme 3

Customers



Assessing,
understanding,
and influencing
customer
perceptions of
water quality
#1076

Understanding, Assessing and Influencing Customers' Perception of Water

Dr Gayle Newcombe, SA Water



Context

Customers can have a negative perception of the quality of the water provided by their utility. Our research goals were to:

- Understand what these perceptions are, where they come from
- Assess the depth and degree of the misconceptions and consequent behaviours associated with drinking water
- Share information with customers in a positive, interactive way and influence negative perceptions

Description of Research

We developed and implemented a suite of four community engagement activities to help us achieve our research goals



Understanding, Assessing and Influencing Customers' Perception of Water

Description of Research

The activities are described in the final project report. They are:

- **Blind taste testing**
- **Systematic taste testing**
- **Customer perception survey**
- **Water quality fact sheets**

The project team has been surprised at the **success and level of engagement** provided by the blind taste testing ("**Take the Tap Test**", TTT) and the **media interest** it has generated in SA. As a result it is considered **one of our most effective customer engagement tools at SA Water.**

Potential Impact

With the number of customers directly participating in TTT, and radio, television and print media interest, we estimate that TTT may have **reached up to 15% of the population of SA.** With ongoing implementation, TTT has the potential to influence our customer's perceptions to a measurable extent.

Theme 4

Smarter Monitoring (Methods & Approaches)



**UF Integrity
Testing using
nanoparticles
#2044**

**Review of
Stormwater
Protocols
#3038**

**Concepts
behind
WSAA's
Smart
Controls
Project**

**Evaluation of
Cryptosporidium
surrogates for
granular
filtration media
#1079**

**Optimising
existing
instrumentation
for better
process
performance
#1075**

**Decentralised
treatment
solutions for
regional and
remote water
supplies
#1102**

**Monitoring
from a
Distance
#1090**

Development of direct UF membrane integrity testing using novel nanoparticles as virus surrogates

Dr Marlene Cran, Victoria University

Context

This project aims to develop of a robust, cost-effective direct integrity test for UF membranes to replace MS2 bacteriophage challenge testing. The objective is to develop fluorescent, biodegradable nanoparticles (NPs) from renewable resources.

Description of Research

The early research design was to synthesise fluorescent NPs directly from a range of starch sources (i.e. rice, corn, potato, tapioca etc.). Although NPs were produced easily by a number of methods, the fluorescence was inadequate for the application.

Development of UF integrity testing using novel NPs...

Description of Research (cont)

Alternative NPs were developed based on a biopolymer, poly(lactic acid) (PLA), and a highly fluorescent natural compound, curcumin which is obtained from the turmeric plant. The formation of the PLA/curcumin NPs is based on a simple, rapid method and there is no clean-up required before the NPs can be used. The NPs degrade in water after the test leaving no harmful residues. Bench-scale trials on hollow fibre UF membranes have been successful with >4 log removal of the particles demonstrated. A full-scale plant trial is currently being planned and engagement with health regulators has commenced.

Potential Impact

The outcomes will offer water utilities an alternative to the current challenge tests that is cost-effective, environmentally friendly, that can be performed quickly and with rapid, on-site results.

Theme 4

Smarter Monitoring (Methods & Approaches)



UF Integrity
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Monitoring
from a
Distance
#1090

Protozoan mimics: *Cryptosporidium* surrogates for validation of granular media filtration

Dr Paul Monis, AWQC



Context

- Health-based targets provide default pathogen LRVs for treatment processes
- Actual performance may be better or worse than the default, representing risk of over-treatment or under-treatment
- The numbers of *Cryptosporidium* in drinking water sources are too low to allow direct measurement of granular media filtration performance for oocyst removal

Protozoan mimics: *Cryptosporidium* surrogates for validation of granular media filtration

Description of Research

- Research was conducted at RMIT and SA Water/AWQC
- Teams led by Felicity Roddick and Paul Monis
- Potential **oocyst surrogates were identified** by a literature review
- Candidate **surrogates were evaluated** in bench-scale and pilot-scale trials to compare surrogate and oocyst removals

Potential Impact

- **Turbidity and UV absorbance were identified as the most practical surrogates** since they are naturally present and can be monitored on-line
- **Future work needs to evaluate these surrogates under a wider range of operational conditions**
- If successful it could allow **real-time monitoring of *Cryptosporidium* removal performance**

Other Topics and Research Ongoing...

Pipe Bursts
#1091

Treatment
(Wastewater
& Drinking
Water)

What's in the
Future?!



Want to join on the next project?
<https://www.waterra.com.au/research/initiating-projects/communities-of-interest/>
Claire.mcinnis@waterra.com.au