



IWA affiliate

**Global Water  
Research Coalition**

*Worldwide cooperation for the generation and exchange of knowledge on water through research for the improvement of public health and the environment.*

*A partnership among leading water research organisations.*

**Annual Review 2012 - 2013**

## Global cooperation for the generation and exchange of water knowledge

In 2002 twelve leading research organisations have established an international water research alliance: the Global Water Research Coalition (GWRC). GWRC is a non-profit organisation that serves as a focal point for the global collaboration for research planning and execution on water and wastewater related issues.

The Coalition focuses on water supply and wastewater issues and renewable water resources: the urban water cycle. The function of the GWRC is to leverage funding and expertise among the participating research organisations, coordinate research strategies, secure additional funding not available to single country research foundations, and actively manage a centralised approach to global issues. GWRC offers its members the opportunity to leverage resources through cooperative planning and implementation of research.

The present members of the GWRC are:

CWN – Canadian Water Network (Canada), KWR – Watercycle Research Institute (Netherlands), PUB – Public Utilities Board (Singapore), Stowa – Foundation for Applied Water Research (Netherlands), SUEZ Environnement – CIRSEE (France), TZW – German Water Center (Germany), UK Water Industry Research (UK), Veolia Environnement VERI (France), Water Environment Research Foundation (US), Water Research Australia Limited (Australia), Water Research Commission (South Africa), Water Research Foundation (USA), and the Water Services Association of Australia.

The US Environmental Protection Agency has been a formal partner of the GWRC since 2003. The Global Water Research Coalition is affiliated with the International Water Association (IWA).

GWRC members represents the interests and needs of 500 million consumers and has access to research programs with a cumulative annual budget of more than €150 million. The research portfolio of the GWRC members spans the entire urban water cycle and covers all aspects of resource management.

## GWRC Activities in 2012 – 2013 in brief

The focus of the **eleventh year** was on the development and implementation of research strategies for the selected priority issues including the areas energy and climate change, the review and expansion of the joint research agenda, and the exchange of information and discussion of emerging issues regarding present and future developments within the urban water cycle. The main activities completed during the period are summarised below.

**Research workshops** for Wastewater Treatment (Singapore) and Waterborne Pathogens (Bordeaux) were held and meetings of the GWRC working group Water Quality and Emerging Pollutants (Busan and Zürich) were organised.

New projects and joint efforts on Water Quality (EDC Toolbox, Analytical Methods for Nanoparticles and Sensors) and Pipe Materials (Rapid Aging of Plastic Pipe Materials) are started in this period.

The projects on Toolbox for Water Utility Energy and GHG Emission Management and Key Asset Data for Water Sector Utilities are successfully completed.

The procedure for the inventory of new **emerging parameters** identified possibilities for new joint activities and supported the exchange of information and the development of common views within the membership. Special topics on the radar screen include Chromium VI, a range of organic micro-pollutants (i.e. carcinogenic volatile organic compounds, new DBPs, neonicotinoids), antibiotic resistance, and micro plastics. The impact of hydraulic fracturing on water quality which is of growing concern and study.

**Reports** on the projects in the research areas Asset Management (Key Asset Data for Water and Wastewater Utilities) and Energy and Climate Change (Toolbox for Water Utility Energy and Greenhouse Gas Emission Management and Desalination – Residual Management) were produced. A Science Brief on non CO<sub>2</sub> GHG Emissions by Wastewater Collection and Treatment Systems is released. Together with IWA Publishing five new books are released as part of the GWRC Research Series.

The **exchanges of information** between members and partners has developed to a very valuable part of the Board meetings.

The presentations by the hosting organisations in Karlsruhe and Bordeaux, and the workshops and topic discussions on The Role of Water Reuse in the Urban Water Cycle, Acceleration of the Implementation of Innovative Technologies, GWRC Research Agenda and the GWRC Evaluation 2011 – 2012 gave an additional dimension to the Board events.



*Former vice chair Jacques Leenen*

Jacques Leenen resigned as vice chair and member of the GWRC Board which he has served as STOWA representative since the start of the GWRC in 2002. Josef Klinger was elected as vice-chair of the Board of Directors for the period 2013 – 2015.

A number of **presentations** were given at specialised conferences including the topics Water Quality and Emerging Substances, Energy Efficiency, GHG emissions, and Future of Wastewater Treatment Systems. This type of international presence is important in building up the credibility of the GWRC.

## GWRC Research 2012 – 2013

The joint research agenda of the GWRC addresses the urban water cycle and covers a number of research areas including Water Quality, Asset Management, Wastewater Treatment, Water Reuse, Energy, and Climate Change. For each of these areas research strategies have been developed including a set of specific projects. For the projects, tailor-made teams of experts from GWRC members are formed and agreements are made on the joint funding and execution of the projects.

### New Research Areas

The joint research agenda was reviewed by the GWRC members at the Bordeaux meeting and new areas were added to the agenda:

- Green Infrastructure
- Disinfection Practices

For each of the areas teams of experts of the collaborating members will be formed to address knowledge gaps and research needs.

### Water Quality

Water Quality has been one of the main research areas from the start of the GWRC. This research area deals with topics such as algal toxins, endocrine disruptors (EDC), pharmaceuticals and personal care products (PPCP), water-borne pathogens (WBP) and emerging substances like nitrosamines, hardness and cardiovascular diseases, and nanoparticles. The GWRC undertakes twice per year a survey on emerging substances to keep abreast of the developments in this area.

### Endocrine Disruptors

The occurrence of estrogenic endocrine disruptors in water is still of international concern because of potential adverse health effects on wildlife and humans. Bio-analytical methods have become increasingly popular and are seen as a possible screening tool for measuring estrogenic activity in water.

Following the successful project ***Tools to detect estrogenic activity in environmental waters*** a similar GWRC project was started which will include in addition to estrogenicity bioassays for analysing androgen, thyroid, glucocorticoid and progestogen activity in environmental waters.

A GWRC team of experts from research groups in Australia, Europe and South Africa has reviewed all the information and knowledge available on the developed bioassays for the different endpoints.

The most relevant endpoints and related bioassays are selected for further study and are presented in the review report ***Bio-analytical Tools to analyse Hormonal Activity in Environmental Waters***. The second stage of this project by GWRC members and associated research groups is ongoing to evaluate the application of the selected bioassays using different water matrices (surface, drinking water, wastewater).

### Sensors

Members of the GWRC have started a joint effort ***Guidance on Sensors in the Global Water Industry***. The scope of the project is to develop a compendium of case studies of real-world experiences of the water industry with the use of available online sensors in the urban water cycle including the catchment areas and receiving waters.



A web based database is developed, and a large number of surveys and interviews with utilities in different countries are performed and ongoing. The results will be available in 2014.

### Emerging Substances

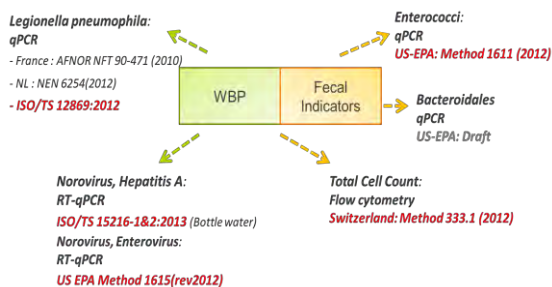
An important activity of the GWRC is the regular survey of emerging substances related to water quality. To keep the membership informed review papers are produced on priority topics of common interest. Examples are Hardness and Cardiovascular Diseases, BMAA and Alzheimer, and Avian Influenza and Risk to Water Supply.

Special topics on the radar screen include Chromium VI, a range of organic micro-pollutants (i.e. carcinogenic volatile organic compounds, neonicotinoids, biosolids), antibiotic resistance, and micro plastics as well as the possible impact of hydraulic fracturing on water quality. The loss of well integrity, subsurface transportation and surface spills are possible routes of exposure of groundwater to pollution by the fracking fluids used.

## Waterborne Pathogens

One of the key parameters regarding the reliability of drinking water, recreation water, wastewater effluent and reclaimed water is the biological quality. Despite the importance for water quality, the majority of the biological methods that are routinely used have a long response time and are quite labour-intensive.

Following the expert workshop as part of the project *Harmonisation and International Evaluation of Molecular Methods used for the Detection of Waterborne Pathogens* where the possibilities of more rapid analytical methods based on qPCR technologies were evaluated, data on occurrence of waterborne pathogens and indicators in water resources are collected by the involved GWRC members using qPCR methods. The results of this joint effort demonstrate the good sensitivity and specificity of real-time PCR methodology and supports its status as the best methodology since few years. But the results also show the important need to establish standardized practices for water analysis by these molecular tools. Experts of GWRC members are involved in these activities that are undertaken by a number international standardisation bodies.



To support these activities and exchange of information within the GWRC framework the first biennial workshop Waterborne Pathogens was organised by the GWRC working group on qPCR in Bordeaux (May 2013).

At the workshop the members also reviewed and updated the WBP Map of Knowledge which gives an overview of the priority pathogens and the availability or absence of information on occurrence, impact, monitoring and water treatment.

MAP OF KNOWLEDGE: WATERBORNE PATHOGENS 2009

Global Water Research Coalition

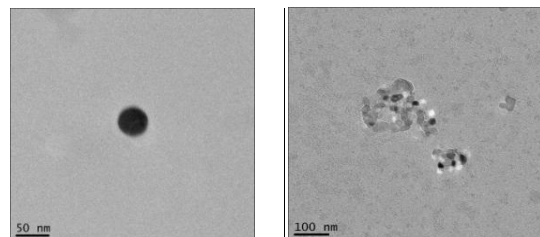
Pathogen	Ecology / water resources			Human Health		Detection in water			Treatment				
	Reservoir	Occurrence	growth	Transmission	Epidemiology	Raise response	Culture	Molecular biology	Clarification	Ozone	UV	MBRO	UV
Campylobacter spp.	■	□	□	□	■	■	■	■	□	□	□	□	□
Escherichia coli (EHEC)	□	□	■	■	■	■	■	■	■	■	■	■	■
Legionella pneumophila	□	□	□	□	□	□	□	□	□	□	□	□	□
Salmonella spp.	■	■	□	■	■	■	■	■	□	□	□	□	□
Shigella spp.	■	□	□	■	■	■	■	■	□	□	□	□	□
Yersinia spp.	■	□	□	□	□	□	□	□	□	□	□	□	□
Aeromonas spp.	■	■	□	□	□	□	□	□	□	□	□	□	□
Burkholderia pseudomallei	■	□	□	□	□	□	□	□	□	□	□	□	□
Cytophaga	■	□	□	□	□	□	□	□	□	□	□	□	□
Legionella spp.	■	■	■	■	■	■	■	■	■	■	■	■	■
Non-tuberculous mycobacteria	□	□	□	□	□	□	□	□	□	□	□	□	□
Adenovirus	■	□	□	□	□	□	□	□	□	□	□	□	□
Calicivirus	■	□	□	□	□	□	□	□	□	□	□	□	□
Enterovirus	■	□	□	□	□	□	□	□	□	□	□	□	□
Hepatitis A	■	□	□	□	□	□	□	□	□	□	□	□	□
Hepatitis E	□	□	□	□	□	□	□	□	□	□	□	□	□
Rubivirus	■	□	□	□	□	□	□	□	□	□	□	□	□
Cryptosporidium	■	■	■	■	■	■	■	■	■	■	■	■	■
Giardia	■	■	■	■	■	■	■	■	■	■	■	■	■
Cyclospora	□	□	□	□	□	□	□	□	□	□	□	□	□
Microsporidia	□	□	□	□	□	□	□	□	□	□	□	□	□
Acanthamoeba spp.	□	□	□	□	□	□	□	□	□	□	□	□	□

■ documented □ insufficiently documented □ not documented

## Nanotechnology and Nanomaterials

The risk associated with the use of nanotechnology and nanomaterials (NM) and the possible negative impact of nanomaterials on humans and the environment cannot be excluded.

The present activities by the GWRC members are focussed on *Analytical methods and collection of occurrence data of NM in water*. An inventory of analytical methods used by GWRC members and associated research organisations was made. For the comparison of analytical methods C60 and, Ag and TiO<sub>2</sub> based nanomaterials are selected as targets.



TEM images by PUB of a gold nanoparticles (left) and TiO<sub>2</sub> cluster (right)

Test samples of nanomaterials in water have been prepared and analysed for concentration and size distribution with the different analytical methods available at the laboratories participating in this first inter-laboratory study. The results show that the application of these techniques for the chemical and physical characterisation of the particles is rather robust.

## Pipe Materials

Understanding the behaviour of the different pipe materials used in the urban water cycle is an important aspect of asset management. At present mainly cement mortar and also epoxy lined and plastic pipes (PVC or PE) are applied.

Recently, plastic pipes were under discussion because of the release of organic substances like antioxidants. Also rubber materials used in fittings are under special consideration because of the possible release of nitrosamines. Additionally, it was observed in the field that with the use of disinfectants like

chlorine dioxide expected lifetime is dramatically decreased for certain materials.

A workshop was organised in Karlsruhe (2012) to review the present knowledge and experiences. The follow up is focused on the issue of unexpected rapid aging of plastic pipes under specific conditions. A project **Rapid aging of Plastic Pipe Materials** with a phase approach to collect data from case studies and define the key parameters involved in the deterioration process and the development of improved test methods and a lifetime expectancy model is ongoing.

## Energy and Climate Change

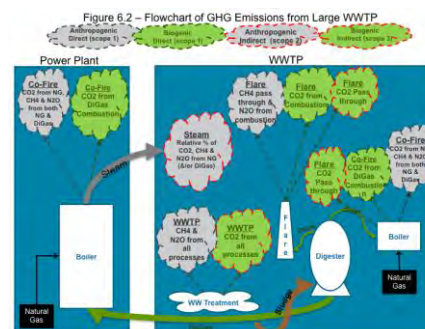
As part of the global developments regarding the availability and cost of energy as well as the mitigation and adaption measures needed to manage the risks associated to climate change, the GWRC members supports the water and wastewater industry in its review of their present way of operations with a three phase approach and related set of actions including :

- Implement the present State of the Art: *picking the low hanging fruit*;
- Reduce of the energy consumption by 20%: *optimisation and innovation*;
- Further reduction of the energy consumption with another 80%: *a paradigm shift!*

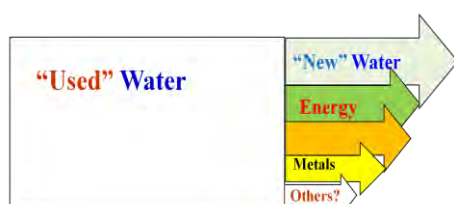
Joint activities and projects to support this approach are undertaken including the projects **Compendium Energy Efficiency in the Water Industry** and **Wastewater Treatment Technology in 2030**. The results of the projects indicate that a reducing of 25-50% of energy use is possible and even energy neutrality is well feasible in conventional systems. Further actions are focussed promising anaerobic treatment options.

The report of the project **Toolbox for Assessment Energy Use and GHG emission** was realised early 2013. The project identified performance indicators, including process models and assessment methods, used by water utilities in around the globe to evaluate their energy use and greenhouse gas (GHG) emissions and recommends strategies for working toward harmonisation of the tools.

At the workshop Wastewater Treatment (Singapore) the representatives of 6 members have discussed their ongoing research activities and more in details the possibilities of the **Anammox based wastewater treatment** technologies. A joint activity is started to collect and compare the results of the different research programs which addresses various parameters and operational conditions (i.e. low and high temperatures, low and high ammonium loads) at pilot and full scale plants. In addition, a start was made with a similar effort on **Resource Recovery**.



The joint activity regarding GHG emissions by wastewater treatment systems including **Methane and Nitrous oxide emissions** is completed. It was concluded that N<sub>2</sub>O emissions are highly variable among different WWTPs and at the same WWTP during different seasons or during the day. A generic emission factor is not feasible. However, it was demonstrate that WTPs with a good effluent quality (TN < 5mg/l) have a low risk of N<sub>2</sub>O emissions! These overall messages are included in a GWRC Science Brief on this topic.



Resources in wastewater increasingly more concentrated &/or valuable.

What's the value & the market?  
What can we "mine" and How?

## Communication

One of the key assets of the Global Water Research Coalition is the rapid and intense exchange of information, knowledge and know-how within the membership including GWRC members sharing information with their stakeholders and vice versa.

The meetings of the Board of Directors play a vital role to keep the research agenda up-to-date and to set the course for the joint activities and projects. The research strategy workshops are a unique platform for the members staff to discuss their ongoing programs and to design research projects to address remaining knowledge gaps and research needs of agreed highest priority. Workshop topics covered in this period included Wastewater Treatment (Singapore) and Waterborne Pathogens (Bordeaux) and meetings of the GWRC working group Water Quality and Emerging Pollutants (Busan and Zürich) were organised. These face-to-face meetings are a valuable investment to secure long lasting cooperation's and effective collaborations in the project steering groups of the individual projects.



In this period member **visits and meetings** with staff were organised with the members CIRSEE, PUB, TZW, UKWIR, VERI, WERF and with our partner US EPA. Links were made with a number EU projects relevant for the GWRC research agenda.

A number of GWRC reports are also released as a joint edition with IWA Publishing as part the GWRC Reports Series and in this way made available to the global water community at large.



At specialised conferences presentations were given including the topics Water Quality and Emerging Substances, Energy Efficiency, Greenhouse Gas Emissions, and the Future of Wastewater Treatment Systems. This type of international presence and recognition is important in building up the credibility of the GWRC and its members.

## GWRC Board of Directors

The GWRC Board of Directors is made up of the representatives of the GWRC members. At the Bordeaux meeting Jacques Leenen resigned as vice chair and member of the GWRC Board which he has served as STOWA representative since the start of the GWRC in 2002. Joost Buntsma is the new representative of STOWA. Josef Klinger was elected as vice-chair of the Board of Directors for the period 2013 – 2015.

**Board meetings, workshops, side visits and topic discussions** were organised in Karlsruhe (October 2012) and Bordeaux (May 2013) and covered the topics The Role of Water Reuse in the Urban Water Cycle, Acceleration of the Implementation of Innovative Technologies, GWRC Research Agenda and GWRC Evaluation 2011 – 2012. The presentations by the hosting organisations and their stakeholders like in 2012 - 2013 by representatives of the different research organisations in Germany and by staff of the water supply and wastewater utility in the Bordeaux area give an additional dimension to the Board events. The connection of the Bordeaux meeting with the IWA Leading Edge Conference on Water Wastewater Technologies was very productive.



### Members of the Board are:

Bernadette Conant	Executive Director, Canadian Water Network
Theo van den Hoven	Director Research, KWR
Harry Seah	Director Technology & Water Quality, PUB
Joost Buntsma	Executive Director, STOWA
Philippe Gislette	Scientific, Technical and Innovation Director, SUEZ Degrémont
Josef Klinger	Managing Director, TZW (vice chair)
Hans Jensen	Executive Director, UK Water Industry Research
Hervé Suty	Manager of Veolia Environnement – VERI research centers
Glenn Reinhardt	Executive Director, Water Environment Research Foundation
Dhesigen Naidoo	CEO, Water Research Commission
David Halliwell	Acting CEO, Water Research Australia Limited
Rob Renner	Executive Director, Water Research Foundation (chair)
Adam Lovell	Executive Director, Water Services Association Australia
Frans Schulting	Managing Director, GWRC (secretary/treasurer)

Suzanne van Drunick (National Program Director Safe and Sustainable Water Resources, US EPA) and Keith Roberson (Director Operations and Congress, IWA) have an ex-officio position in the Board.