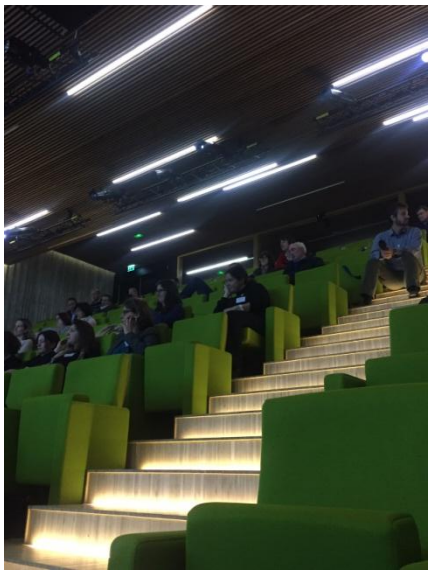
Global Water Research Coalition

GWRC Workshop Summary

Predictive Bioanalytical Tools in Water - From Research to Implementation -

21st & 22nd of February 2017, Paris, Hosted by Veolia new headquarters



Co-organised by GWRC and Veolia Research & Innovation

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Global Water Research Coalition

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" Platform for global cooperation for the exchange and generation of water knowledge "

The Global Water Research Coalition (GWRC) is a non-profit organisation that serves as the collaborative mechanism for water research. The services the GWRC offers its members is water research information and knowledge. The GWRC will not compete with any of the member organisations. Each member organisation will still focus on national and regional water research issues.

The aim of the GWRC is to leverage funding and expertise amongst 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.

The present members of the GWRC are listed below.

- Canadian Water Network (Canada)
- KWR Water Cycle Research Institute (Netherlands)
- PUB, Singapore's National Water Agency (Singapore)
- Suez (France)
- STOWA - Foundation for Applied Water Research (Netherlands)
- TZW (DVGW) - Water Technology Center (Germany)
- UK Water Industry Research (UK)
- Veolia (France)
- Water Environment & Reuse Foundation (US)
- Water Research Australia (Australia)
- Water Research Commission (South Africa)
- Water Research Foundation (US)
- Water Services Association of Australia (Australia)

The member organisations are all in charge of a national research program addressing the urban water cycle. They have provided the impetus, credibility, and initial funding for the GWRC. Each member and associated partner brings a unique set of skills and knowledge to the Coalition. The US Environmental Protection Agency was the first partner of the GWRC, with the first partnership agreement signed in July 2003.

In addition, the GWRC is affiliated with the International Water Association, whose strong international network of scientific professionals and water managers will aid in the development of a solid global research agenda and the dissemination of knowledge.

Through its member organisations, the GWRC represents the interests and needs of 500 million consumers and has access to a research program with an annual budget of more than € 125 million.

Please find more information about the Global Water Research Coalition at:
http://www.globalwaterresearchcoalition.net/

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1. Workshop overall objectives

The overall goal of this workshop was to present the outcomes of recent projects on assessing endocrine active compounds in environmental and drinking waters, and by extension on the use and application of bioassays to measure the overall water quality regarding chemical contaminants along with the whole water cycle. The aim of the workshop was to summarise the results in this field over the last 5 years, and specifically to highlight large scale networking research actions at international level of academic, institutional and industrial experts, to better assess and monitor ecosystem and human health exposure towards complex mixtures of chemicals along the water cycle including conventional and alternative water schemes. The workshop provided an overview of the policy and research actions undertaken in this field and set the scene for joined research and policy goals.

2. Participants

Target audience included 65 expert participations from North America (Canada Water Network, USEPA, WE&RF), Australia (Griffith Univ), Europe (KWR, OECD, EAWAG, JRC, TZW, UFZ, EC/DG-ENV), France (Onema/Agence de la Biodiversité, CES Eau ANSES, Ineris, SEDIF, VEDIF, Cirsee-Suez, Veolia, EPAS, WatchFrog, IRCM) and international organisations (GWRC) (see appendix for list of participants).

This workshop also aimed to gather the GWRC and Norman expert networks as both have similar activities on emerging substance assessment issues in the water cycle and may identify some synergies or initiatives.

3. Workshop Programme

The programme was organized in 7 sessions over 2 days listed below and summarized in an appendix. In addition, for further specific details, the complete pdf book including the 20 oral presentations is attached.

1. Endocrine Toolbox : Knowledge transfer based on GWRC work on EDCs
2. Drivers of current implementation contexts
3. Bioanalytical tools in Risk Assessment - Validation and Experimentation (BRAVE) think-tank
4. US Prioritisation and Research Plan
5. Water professionals applications of innovative monitoring tools
6. Current EU projects scopes: from water treatment technologies to large river basin
7. Current actions at european level: Norman Expert networking & EC-DG Environment-Europe

These 7 sessions were organised in such a way to provide water managers and policy-makers with recent quality international scientific & technical knowledge transfer regarding innovative monitoring using bioanalytical tools applied on environmental and drinking water.

4. Discussion groups

Two discussion group sessions were conducted to identify the relevant gaps that could be addressed by targeted research, and to draft further into collaborative project proposals in order to successfully implement and deploy this innovative water chemical contaminant monitoring framework.

Group Discussion on Collaborative Opportunities addressed the three following open questions:

- Q1: What practical issues do you think are currently limiting greater adoption of bioanalytical tools in water quality monitoring?
- Q2: What would be the benefits of greater uptake of bioanalytical tools for the different stakeholders of water (including public/customers, municipalities, water utilities, health and environmental regulators)?
- Q3: What concrete steps do you think are needed to overcome regulator reticence and foster acceptance of bioanalytical tools by health and environmental regulators?

Each question was discussed by 6 groups of 8-10 persons from different organisations. The summaries of all comments, discussions and gaps to fill is summarized below for each of the three questions.

- **Question 1: Issues limiting greater adoption**
  → No bioassay regulation → optional use → no market
  → Lack of laboratory capability and capacity for bioassay analysis, need interlab validation and QA/QC

→ No standardised methods (eg. ISO)
→ Education (operators, managers, scientists, regulators, ...)
→ Communication (results, uncertainties, limitations, benefits)
→ Lack of regulatory and operational interpretation framework
→ Lack of clear Cost Benefit Analysis
→ Too many assays ... How to choose the right one for me?
→ Link to human health and risk assessment (human and ecol)
→ New testing paradigm (fear of the unknown, limited confidence in results, may lead to higher treatment requirements)

- **Question 2: Benefits of greater uptake**
  → Better understanding of water quality
  → Improved assessment of mixture toxicity, knowns and unknowns, bioactive transformation products
  → Faster adaptation to new and emerging chemicals
  → Fine tune treatment train (treatment performance evaluation, fit for purpose)
  → Improved public communication tool (greater transparency, demonstrate operational excellence)
  → Identify emission sources and hotspots
  → Streamlined monitoring, cost-effectiveness
  → Makes the water safer (closer to health, provides safety net)
  → Improved understanding of the whole system (source control)
  → Real-time alert system (faster, cheaper, online)

- **Question 3: How to foster greater acceptance**
  → Interpretation framework for various matrices incl. development of trigger values (Regulator, Operator Manual, Public communication)
  → Demonstrate link between *in vitro* effect and *in vivo* response
  → Cost benefit analysis
  → Method standardisation and lab accreditation
  → Benchmarking against validated and accepted chemical and risk assessment methods
  → Practical guidance on bioassay selection (which endpoint, which assay...)
  → Automation and on-line application
  → Demonstrate that it makes the water safer (inc. case studies)

Participants were then given a number of votes to rank the different proposals to tackle the above questions.

Proposals ranking based on discussion Groups (all stakeholder on board)		**Voting institutions***
20	Interpretation Frameworks Development of regulatory interpretation incl. Trigger values	UFZ(×2), Griffith Uni×2, Vitens(×2), Suez, Veolia(×3), BDS, EAWAG, Waternet×2, NORMAN, KWR(×2), Watchfrog, Syndicats des Eaux, EU Commission
14	Risk assessment : demonstration link between in vitro effects vs vivo response	KWR(2x) – EAWAG – UFZ – TZW – Univ Rennes – NORMAN – Griffith Uni -Suez - WatchFrog – Waternet (2x) – Syndicats des Eaux – EU Commission
13	Demonstrate that it makes the water safer	TZW, KWR, Griffith Uni×2, Veolia(×4), UFZ, Syndicats des Eaux×2, Suez, Waternet
13	Interpretation Frameworks /development of operator manual - guidance	TZW(x2), EAWAG, Veolia, WatchFrog, Univ-Rennes, Syndicats des Eaux, Norman, GU, BDS, KWR, UFZ
11	Communication Frameworks (Added values – Limits -benefits) for stakeholders *(operators, managers, scientists, regulators, consumers, citizens)/ Focus groups*	TZW, Syndicats des Eaux (x2). Watchfrog, Suez, Waternet, Griffith Uni, BDS, EAWAG, Veolia, EU Commission
11	Benchmarking against established chemical vs risk assessment methods (LCA ?)	KWR, EAWAG, TZW, Univ Rennes, BDS, NORMAN, Veolia, Watchfrog, Suez, EU Commission
10	Cost benefits analyzis	Griffith Uni (x2), KWRC, BDS, EAWAG, TZW, Vitens (x2), EU Commission, Waternet
10	New Methods developments / On line / Automation	Vitens (x3), EAWAG, Univ Rennes, NORMAN, UFZ, Waternet, Watchfrog (x2)
9	Standardization of Methods : QA/QC, ISO (7)	EAWAG, Univ Rennes, NORMAN, Waternet, UFZ (x3), Watchfrog, EU Commission
7	Standardization of Methods : ISO & Labs accreditation	BDS, EAWAG, NORMAN, YZW, Syndicats des Eaux (x2), EU Commission
1	Regulatory review: where are we at ?	Griffith Uni

* Note that "institution" here represents the institution that the voting participant was attached to, but it does not necessarily represent the views of the whole institution.

Four draft project scopes were developed during the second day of the workshop and on the following four most highly ranked topics (as listed in the table above). Note that these project scopes are currently being fine-tuned, but early drafts are provided below for the sake of completeness.

1. Development of Effects-based trigger (EBT) values

The aim would be to develop a traffic light system?

  - Green: acceptable effect (no risk)
  - Yellow: keep alert
  - Red: trigger for further action
  - Or alternative: Swiss rainbow approach (five colors)
- Help operators to take decisions
- Overall risk score for all effects/bioassays?

2. Demonstrating the link between in vitro effect and in vivo response: Confidence building for stakeholders and end-users to adopt bioassays: the predictivity of in vitro bioassays

The aim of this proposed research is to evaluate the predictivity of in vitro assays for effects in intact organisms (including humans), to increase the confidence of stakeholders and end-users in bioassays. The goal is to gain insight in the uncertainties that may be different for but are inherent to both analytical chemistry and bio-assays. This can aid in matching the level of confidence that they have in analytical chemistry and bioassays, so both approaches will be weight equally in decision-making processes.

The predictivity of in vitro bioassays will be evaluated by comparing the effects of water-relevant chemicals and water extracts on water-relevant measured endpoints (AOPs), measured in in vitro and in vivo models. In vitro and in vivo kinetics need to be taken into account.

We also talked about the necessity to use animal models for research related to this topic (only for targeted studies if the information is not yet available in historical data/databases), this topic could be linked to the development of Adverse Outcome Pathways relevant to water-related exposures, QIVIVE that can aid in the reduction of uncertainty with regard to the predictivity of in vitro bioassays, that this topic will be addressed first from a human health point of view, whether epidemiological information should be included (how?). Besides the evaluation of the predictivity of in vitro bioassays (as in this proposal), it was also brought to the table that a better understanding (also quantitatively) of the physiological link between cellular and molecular effects in vitro and potentially associated downstream adverse outcomes in the intact organism may give insight in the which effect range of cellular or

molecular effects the intact organism may adapt with protective mechanisms, and at what effect size irreversible adverse effects can occur.

3. Demonstrate that the application of bioanalytical tools makes the water safer

- To apply bioassays
- To generate a protocol (methodology) how to use bioassays
- Get experience on the selection of frequency (costs? / source variation)
- To demonstrate the safety of water / reassure the consumer in the safety of drinking water

… the idea is to provide an ultimate test that if passed ensures the safety of water

4. Interpretation Frameworks /development of operator manual - guidance

- The aim of this project is to build an Interpretation Frameworks for Water Quality (Safety) Assessment on the whole water cycle in order to develop/provide an guidance manual (for water professional's including water utilities, operators).
- Based on the panel of most relevant MoAs (*i*), appropriated for each water bodies (WW, SW, DW or alternative waters produced for aquifer recharge, irrigation, agriculture or urban reuse….), regarding their population targets (ecosystem vs human health) and the respective set of effect-based trigger values (EBTV) currently under further elaboration (see outputs of EBT form)
- Develop a decision making framework based on traffic light system (associated to water quality classes, established on gradient of risk quotient calculated on BEQ_i /$EBTV_i$) as in Swiss rainbow approach (five colors)
- In case of orange-red light ($_i$) → tiered screening targeting relevant knowns chemicals from the Watch List
- Tiered screening assessment combining bio & analytical approach will drive the best treatment/abbatment options (see outputs of current FP7 Solutions project / Abbatment options Work Area coordinated by AM van Wezel-KWR)
- Help operators to take decisions and optimize operating practices (from the WWTP to the tap)
- The final aim of this project would be a decision support framework applicable to conventional water schemes as well as to alternative water schemes, based on a) the fundamental pillar: which (effect-based) quality for which use (regarding ecosystem vs human health targets), and b) the relevant proposal in terms of abbatment options to apply to reach/achieve the recommanded (effect-based) safe quality level.

5. Conclusions

This workshop was organised to share insights in the development of bioassay applications and the advantages of the implementation and addition of bioassays to the water quality toolbox. The workshop was a good opportunity to communicate and discuss the implementation of bioassays in water quality monitoring.

It was encouraging to hear that both the operators and regulators expressed the expectation that the application of bioassays will aid in the demonstration and communication of safer and cleaner water - not only between people working in the water sector, but also with the public and clients of drinking water companies.

In the workshop discussion groups on the first day, there was clear consensus on the advantages of the addition of bioassays to the water quality toolbox but the limitations were also expressed in regards to the hurdles that need to be overcome, in particular related to interpretation of and confidence in the bioassay results.

On the second day, clear common goals were defined and discussed, and concrete proposals were drafted for efforts to efficiently overcome these hurdles and to continue the collaboration and support the implementation of bioassays. These project scoping documents are currently being finalised in consultations with all project participants.

6. Appendix

1. List of Participants

Last Name	First Name	Company
Hebert	Armelle	Veolia R&I
Escher	Beate	UFZ
Perceval	Olivier	Agence française pour la biodiversité (formerly Onema)
Poussade	Yvan	Veolia
Hercule	Sarah	Veolia
GATEL	Dominique	Veolia
Arnal	Charlotte	VERI
Rinck Pfeiffer	Stephanie	GWRC
Dingemans	Milou	KWR Watercycle Research Institute
Delabre	Karine	Veolia

Kools	Stefan	KWR Watercycle Research Institute
Habauzit	Denis	University of Rennes 1
Penru	Ywann	SUEZ Groupe
Du Pasquier	David	WatchFrog
Scheurer	Marco	DVGW: Water Technology Center
Behnisch	Peter	BioDetection Systems bv
David	Boris	Veolia
Schaan	Stéphanie	European Commission, DG ENV
Chagniot	Muriel	Veolia (Eau France)
Belhadj-Kaabi	Faten	Veolia
Ribardiere	Carole	Veolia Research & Innovation
Raclot	Dalel	VERI
Cantet	Jean	VEOLIA EAU FRANCE
Kienle	Cornelia	Ecotox Centre Eawag-EPFL
Dumoutier	Nadine	Suez
Loret	Jean-François	Suez
Levi	yves	University Paris sud
Enault	Jérôme	Suez
El Bahloul	Ismahane	VEOLIA WATER TECHNOLOGIES - Hydrex
Del Re	Maurizio	VEOLIA WATER TECHNOLOGIES ITALIA SPA
de Roubin	Marie-Renée	Veolia Research and Innovation
MEHEUT	GAELLE	Veolia Recherche & Innovation
van der Wal (OECD)	Leon	Organisation for Economic Co-operation and Development
Meeker	Melissa	Water Environment & Reuse Foundation (WE&RF)
Simon Dübendorf,	Eszter	Swiss Centre for Applied Ecotoxicology, EAWAG-EPFL,
Sanz	Joan	Veolia Water Technologies Iberica (Spain)
Doquang	Zdravka	SUEZ
Feliers	Cedric	VEOLIA EAU D'ILE DE FRANCE
Lecarpentier	Caroline	VEOLIA EAU D'ILE DE FRANCE

Leusch	Frederic	Griffith University
Doulami	Farida	EPAS- SEURECA-VEOLIA Water Lab
Van der Oost	Ron	Waternet/STOWA
Machinal	Claire	VERI
Werner	Inge	Swiss Centre for Applied Ecotoxicology
Schriks	Merijn	Vitens (Netherlands)
Houtman	Corine	The Water Laboratory
Christelle	Pagotto	Veolia Eau France
Cantet	Jean	Veolia Eau France
Helmi	Karim	Veolia Recherche & Innovation
Daines	Catherine	VEOLIA
Baratto	Gilles	Veolia Eau
Mosqueron	luc	Veolia Recherche & Innovation
Sourisseau	Sandrine	Veolia
Dulio	Valeria	Executive Secretary of the NORMAN Association Academic
Oberti	Sandrine	Veolia
Benanou	David	VERI
Lambolez	Lucie	VERI
Thibert	Sylvie	Syndicat des Eaux d'Ile de France
Heim	Véronique	Syndicat des Eaux d'Ile de France
Bruno	Tisserand	VEOLIA RECHERCHE & INNOVATION
Panetier	Pascale	Anses
Seriki	Kemi	Veolia R&I
Hollert	Henner	RWTH-AACHEN
Enguehard	François	VERI

2. Presentations (pdf booklet) (attached separately)