

QAEHS Annual Report Year to 30 June 2020





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Director's report

Our alliance with Queensland Health

Queensland Alliance for Environmental Health Sciences' (QAEHS') vision, to improve human health through environmental health science, reflects our central role in facilitating Queensland Health's (QH) access to a broad range of academic and scientific expertise to assist the State to manage environmental sources of risk to human health. Specifically, QAEHS' key objectives are to:

- provide an opportunity for QH, through enhanced engagement with the research sector, to influence the research agenda in the field of environmental health science;
- build the capacity of key QH and Hospital and Health Service (HHS) staff to assess and manage risks to human health from environmental threats;
- encourage ongoing innovation and research in the environmental health science field; and
- facilitate timely access for QH and HHS to a range of scientific and academic environmental health experts from the university research sector to ensure government policy and advice reflects the latest scientific findings.

The year in focus

The year to 30 June 2020, the second year of the current three-year contractual term with QH, has been our most successful since QAEHS' inception in 2016. This year has seen unprecedented growth in new grant successes (2019: \$12 million in 2019; 2020 to date: \$18 million) and research outcomes across our broad program of interdisciplinary research, represented by eight research themes. Our continued success in the Australian Research Council (ARC) grant programs includes the award of a Laureate Fellowship to Prof Jochen Mueller, Theme Leader for Emerging Environmental and Public Health Risks, and the successful partnership of A/Prof Abdullah Mamun, Theme Leader for Environmental Epidemiology, in a \$32 million

Centre of Excellence. Our ARC grants were supplemented by achievements in recent NHMRC grant rounds and partnership with a new philanthropic donor to further understanding on human exposure to a range of chemical and other stressors.

This year, we have welcomed seven new researchers, five professional staff and eleven students to the QAEHS team, doubling our numbers since 2016. Joining our existing three QAEHS scholarship holders, six students were awarded QAEHS scholarships in 2019 and commenced projects across six different QAEHS research themes. This brings our total student numbers to 31 with seven new international students awarded scholarships this year but currently unable to enter Australia to start their studies due to COVID-19 travel restrictions.

The Masters of Environmental Health Sciences (MEHS) program, which was launched in 2019 as a core component of the Alliance's vision, is rapidly gaining momentum and recognition. Despite disruptions due to COVID-19, we have seen a substantial increase in enrolments in 2020 reflecting the need for this type of program and the suitability of the MEHS to address this gap.

Our research

Our research in 2019-20 included surveillance of emerging health markers in our wastewater to monitor community health, new ways to understand human chemical exposures through devices such as wrist bands and breast implants, removal of antimicrobial resistance in water treatment processes, new methods to sample an increasing range of contaminants in our critical water resources, effect of prolonged heat waves on health and health services, exposures to plastics through our diet and household environment, remediation of and exposure to perand polyfluoroalkyl substances (PFASs) as well as communicating risk information about PFAS in Australia. Most recently we have worked closely with QH to deliver a state-wide program to provide early warning of SARS-CoV-2, the COVID-19 virus, in Queensland's wastewater.



Reflecting this active research program, QAEHS Theme Leaders and their teams have been highly productive throughout the year, with a total of 141 publications in 2019 and 125 in 2020 to date. The high significance of their work is demonstrated by a consistent increase in citations, up by ~50% in 2019 (to 7,900 citations) compared to the previous year, with 2020 on track for a similar increase.

Deliverables for the year

The strategic and operational overview presented in this report outlines the Centre's continued effective governance and considerable success (see highlights in the next sections) in meeting QAEHS' strategic goals and objectives. The research development priority that was addressed in 2019-20 – to further develop high quality interdisciplinary research within the Environmental Health Sciences across UQ – has built on and continues to expand the success of our first four years.

The last section of this report shows, at a glance, how QAEHS has met the specific QH deliverables for the year. Of note, our research goals were facilitated through several stakeholder workshops and the award of QH partner cash contributions to thirteen ARC, NHRMC and QLD Government grant applications. Three of these applications have been successful so far, with the outcomes of a further two still pending and four proposals to be submitted in the second half of 2020.

QAEHS through COVID-19

As with most organisations, COVID-19 has impacted QAEHS' operations this year. In March 2020, we took the decision to close our main labs



Dr Phil Choi (left), Prof Kevin Thomas and Dr Fisher Wang (right) at the 10th National Conference on Environmental Chemistry at Tianjin, China in August 2019

for four weeks and then slowly re-introduce a skeleton staff and student team to manage priority analytical work, operating alternate rosters. We are now back to near-full capacity in the lab and are working hard to catch up. Our collaborators and funding organisations have been very supportive through this time and we continue to work to minimise the impact on our research activities. Whilst inter/national travel remains restricted, I am encouraging our staff and students to take advantage of the emerging on-line opportunities for continued engagement both within UQ and externally.

Looking ahead

Notwithstanding our recent success in furthering the Centre, our exceptional relationship with QH remains key to the Alliance's relevance, ability to identify and address priority environmental health issues and deliver future impact. The position we are in at the close of 2019-20 means QAEHS is well placed to further build on our research strengths in the final year of the QH agreement.

The number and quality of grant application submissions in 2019 and 2020 to date are forecast to continue into 2021 and will hopefully see similar returns. The 2021 ARC Centre of Excellence round provides a timely opportunity to pursue funding to expand our inter/national capabilities in human biomonitoring, linked to the 2022-2023 Australian Health Survey. Other schemes, such as the NHMRC Synergy program, provide ideal opportunities to bring several of the QAEHS Theme Leaders and inter/national colleagues into a collaborative, interdisciplinary proposal. These new opportunities combined with our growing capacity and state-of the-art laboratories at UQ, provide a solid platform for QAEHS to continue to lead environmental health science both nationally and internationally.

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Prof Kevin Thomas **Director, QAEHS**



Research highlights for the year



QAEHS is continuing to deliver **world class** research outcomes across a range of research applications, the outcomes of which are consistently being translated into regulatory and public health initiatives

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266 Publications in collaboration with over 150 different institutions

15,000+ Citations across 104 countries around the world

Delivery of

professional

development

and research

workshop

intiatives



PhD students



\$25 million in new grants

13 QH leveraging funds

applications awarded

3 proposals successful

to date (\$430K, funding

ratio 2.9)





6 QAEHS

scholarships

awarded

Total of 9 QAEHS

scholarship

holders across

QAEHS' research

themes

7 new researchers 5 new professional staff

Increased er Masters o Health Sci program

Increased enrolments in QAEHS' Masters of Environmental Health Sciences (MEHS)



Major collaborations with 10 industry/ government organisations and 16 national and international research organisations

Delivery of state-wide program to provide early warning of SARS-CoV-2, in Queensland's wastewater



10 TV interviews
10 Radio interviews
213 online and print news articles
Potential audience reach of 3+ million



Financial highlights





Strategic direction

Key outcomes

- The current strategic direction of QAEHS is supported by the AMC
- Considerable success towards achieving the agreed strategic goals were recognised for 2019-20

Through its research and education themes, QAEHS addresses local, national and global environmental health science challenges and aims to achieve first class outcomes in research, education and partnership engagement while meeting the needs of Queensland and the wider community. The ongoing strategic goals and objectives of the Centre are outlined in Table 1.

Through these strategic goals, QAEHS is positioned to achieve the following outcomes:

- A high quality and dynamic program of interdisciplinary research that solves current and emerging global environmental health challenges
- An established environmental health sciences education and training program that builds national capability
- QAEHS, as the recognised expert, will be the first point of call for environmental health science in Australia
- QAEHS delivers science-based knowledge that leads to policies aimed at improving health outcomes.

The 2019-20 outcomes towards QAEHS' strategic goals, presented here according to the deliverables defined in the 2018-2021 QH contract i.e. research and research outputs, education, communication and governance, are addressed in the subsequent sections.

Looking ahead

The Centre's development priorities during the remaining year of the second contract period and beyond are:

- continue to critically review and refine the QAEHS research themes and projects to meet priority environmental health issues
- continuously improve engagement with QH, confirming positive interactions
- mentor mid-career researchers to progress within QAEHS through developing a cohesive research program, working towards leading an effective research group and seeking timely promotion/career advancement
- lead the development and coordination of new research ideas in order to compete for large-scale transdisciplinary external funding in priority research areas such as:
 - o microplastics
 - antimicrobial/antibiotic resistance (AMR/ABR)
 - advanced technologies to support exposure science



Prof Chris Higgins, Colorado School of Mines, US (left) and Prof Michael McLachlan, Stockholm University, Sweden (right), visiting QAEHS Theme Leader Prof Jochen Mueller (centre) to discuss new collaborations and research approaches around perfluorinated compounds (PFAS) and human biomonitoring.



- In order to increase competitiveness for large scale funding, introduce strategies to promote/support genuine collaborative research across QAEHS themes and key personnel. The goal should be cohesive multidisciplinary teams with a broad range of environmental health science expertise
- identify opportunities and apply for longterm, large-scale funding, such as an ARC Centre of Excellence
- promote and increase enrolments in the Masters of Environmental Health Sciences (MEHS) program and develop and improve unique courses for delivery within the program
- maximise efforts to attract exceptional domestic and overseas PhD students, offering centrally funded top-up scholarships and joint university degrees (e.g. UQ-Exeter) where possible.

Strategic Goal	Objectives	Measures of Success			
Identify and contribute to solving current and emerging environmental health challenges	Establish a program of high- quality interdisciplinary research	Grant income, peer-reviewed publications, conference presentations, RHD completions			
Build an expert capability in the environmental health sciences	Establish an Environmental Health Sciences education and training program	Established training program, stakeholder for a Masters of Environmental Health			
To be Australia's internationally recognised Research Centre within the environmental health sciences	Engage with internal and external partners to deliver transdisciplinary environmental health science	Representation on national advisory and expert panels. Number of publications co- authored with non-UQ co-authors			
Provide science-based knowledge to Queensland Health	Work with Queensland Health to deliver improved health outcomes for Queenslanders	Translation of science to policy, QAEHS sought after by stakeholders as a provider of advice, Commissioned projects			
and the wider community	Provide a working environment that fosters interdisciplinary research				





QAEHS laboratories at UQ'S PACE building in Woolloongabba



Performance – research activities

Key outcomes

- Research highlights are presented for the year across eight of QAEHS' multidisciplinary research sub-programs that are closely aligned with QH priorities, outlining:
 - o some of the work that has taken place in 2019-20
 - o the theme leaders working in each space and numbers of research fellows and students
 - \circ the key funding sources.

Human biomonitoring and epidemiology

Key research activities

In 2019-20, the human biomonitoring program led by Prof Jochen Mueller continued to advance understanding of human exposures across a wide range of priority contaminants of concern (such as, plastics additives – phthalates and bisphenols, pesticides, PFAS, and personal care products) in cohorts across Australia and New Zealand. The current program has been augmented by several grant successes in the year and is expected to take great strides over the next five years under an ARC Laureate Fellowship grant awarded to Prof Mueller. The Laureate will fund two new postdoctoral researchers and four PhD students.

Prof Mueller and team were also contracted to undertake a feasibility study for an Australian Human Biomonitoring Program linked to the Australian Health Survey (part of the 2021 Census). Working with key stakeholders, including the Australian Bureau of Statistics, criteria to consider for the scope, logistics and costs for a national program were developed.

A core component of the HBM and wastewater (see next topic) programs is access to long-term specimen banking facilities, which allows retrospective assessment of samples for emerging contaminants of concern. Prof Mueller's current specimen bank (>35,000 samples) is nearing capacity and an ARC LIEF was submitted this year for a purpose-built facility at a UQ campus. A/Prof Abdullah Mamun, Theme Leader for Environmental Epidemiology, has had several grant successes in 2019-20 to advance his theme. He was awarded NHMRC Partnership funds to investigate the effect of exposure to trihalomethanes during pregnancy on the risk of low birth weight. He also partnered in a successful ARC Centre of Excellence (\$32 million, 2020-2027) for Children and Families over the Life Course. A/Prof Mamun recruited a new student who was awarded a QAEHS Scholarship and has commenced his project on community environmental exposures and the development of respiratory health.

Staff and students

- Theme Leaders: Mueller, Thomas, Mamun, Ng
- 8 Research Fellows, 13 PhD students

Key funding

Current:

- ARC Laureate Fellowship (Mueller)
- ARC Discovery (Mueller, Thomas)
- NHMRC Partnership (Mamun, Thomas)
- NHMRC Project (x2) (Mueller)
- NHMRC-EU Collaborative grant (Mueller)
- NHMRC-NAFOSTED Collaborative (Thai)
- Philanthropic donation (Thomas, Mueller)
- Commonwealth government (Mueller)
- Science and Technology Portuguese Foundation (Wang, Bräunig)





Dr Mike Gallen, Analytical Chemist (GC Technical Lead), operating a GC-MS in one of QAEHS' analytical labs

Wastewater surveillance for chemical and biological hazards (including SARS-CoV-2)

Key research activities

The scope of QAEHS' work in wastewater-based epidemiology (WBE) continues to expand. A core component is the National Wastewater Drug Monitoring Program (NWDMP) funded by the Australian Criminal Intelligence Commission (ACIC). The program delivers long-term trends in licit and illicit drug use in the Australian community and is now into its fifth year. The NWDMP complements an ARC Linkage program that collects wastewater from across Australia connected to the Australian Census. An extension to the first Linkage grant (2016-20) has just been awarded (2020-2024) focusing on the 2021 Census.

The long-term samples collected from the Linkage Census projects and NWDMP enable numerous projects to investigate consumption and exposure patterns of chemical or biological agents by Australian communities. Recent work has also identified new biomarkers of health that can be measured in wastewater to indicate various health factors in communities. By linking the sample collections to the Australian Census, patterns in the wastewater data can be related to socioeconomic and other data for the community gathered through the Census surveys.

Many other allied projects are underway in this field including investigation of performance enhancing drugs in collaboration with Australia's sports integrity authority and understanding how sewer conditions impact on the samples collected through, for example, chemical degradation.

Most recently, QAEHS' work in WBE facilitated a new collaboration with CSIRO and UQ's Australian Centre for Ecogenomics to detect SARS-CoV-2 (the COVD-19 virus) in wastewater. This led to a program with QH to provide an early warning surveillance program during the second wave of the COVID-19 pandemic in Queensland.

Staff and students

- Theme Leaders: Mueller, Thomas, Gartner
- 4 Research Fellows, 9 PhD students

Key funding

Current:

- ARC Linkage (x2) (Mueller)
- ARC Discovery (O'Brien)
- ACIC (NWDMP) (Mueller, Thomas)
- QH (COVID-19) (Mueller, Thomas)
- EU H2020 Marie-Curie Fellowship (Thomas)
- Sport Integrity Australia PhD Scholarship (Thomas)

Per- and poly-fluoroalkyl substances (PFAS)

Key research activities

QAEHS researchers, Profs Mueller and Thomas and A/Prof Fielding, have established themselves as leading experts in Australian PFAS exposure science and communication. Significant funding has been received through PFAS-specific initiatives from ARC (Special Research Initiative for PFAS remediation) and NHRMC (Targeted Call for Research (TCR), four projects related to human exposure to PFAS).

Human biomonitoring work with PFAS included a five-year follow-up study for firefighters with Airservices Australia. Nearly 800 individuals participated in the study, the results of which are currently being disseminated. Other areas of PFAS research include the development of novel passive sampling techniques for aquatic systems, including groundwater. This work is being funded by the US Department of Defence.



Risk communication is an important element in the NHMRC TCR PFAS and Health grants. Through these projects, A/Prof Fielding and colleague, Dr Kylie Morphett, will deliver important insights about how to communicate about PFAS.

A PhD student with Prof Jack Ng has been investigating the cytotoxicity of selected PFAS individually and in mixed combinations.

Staff and students

- Theme Leaders: Mueller, Thomas, Fielding, Ng
- 6 Research Fellows, 6 HDR students

Key funding

Current:

- ARC Special Research Initiatives (x3) (Mueller, 2 x external)
- ARC Linkage (Mueller)
- NHMRC Targeted Call for Research (x4) (Mueller, Thomas, Fielding, Wang)
- Advance Qld Industry Res Fellowship (Shukla)
- SERDP (US DoD) (Kaserzon, Mueller)
- Airservices Australia (Mueller)



The Environmental Health Risk Assessment team in the QAEHS metals analysis lab

Microplastics

Key research activities

Prof Kevin Thomas and team are developing new methods to quantitatively measure, for the first time, microplastics in our environment. Recent publications include quantification of plastics in Australian seafood and tyre rubber vulcanizers in Australian waterways. A new student funded by the UQ-University of Exeter alliance (QUEX) PhD Scholarship Scheme is looking at microplastic surface interactions in natural waters. Contracts are currently being finalised with a philanthropic donor to support plastics and plastic additive research in humans across Profs Thomas and Mueller's groups. The funding will support a new lab facility, instrumentation and staff.

A/Prof Fielding's research program this year has included health risk communication related to microplastics. Papers are about to be released on 'Microplastics in the Media' and on public concern about and desire for research on the human health effects of marine plastic pollution (coauthored with Prof Thomas). A/Prof Fielding has also worked with QAEHS students to design a survey on people's knowledge of microplastics.

Dr Cheng Peng has been investigating the potential health impacts of microplastics in collaboration with the Shandong Academy of Occupational Health and Occupational Medicine, China. His work showed that microplastics may induce inflammation and DNA damage and further work is ongoing to confirm these results.

Staff and students

- Theme Leaders: Thomas, Fielding
- 5 Research Fellows, 4 PhD students

Key funding

Current:

- Philanthropic donation (Thomas, Mueller)
- ARC Discovery (Kaserzon)
- Global Change Institute Flagship (Fielding)
- Research Council of Norway (Thomas)
- QUEX (x3) (Fielding, Thomas)



Dr Sarit Kaserzon (Research Fellow) and Gabriele Elisei (Senior Research Technician) preparing PDMS passive samplers



Microbiology and anti-microbial resistance

Key research activities

Theme Leaders A/Prof Jianhua Guo and Dr Gilda Carvalho have been involved in seven publications related to Environmental Health Microbiology this year. One paper on nonantibiotic pharmaceuticals linked to antibiotic resistance attracted high media coverage. They will submit a new ARC Linkage proposal this year focusing on pathogenic microorganisms (e.g. legionella and nontuberculous mycobacteria) in plumbing biofilms.

Supported by A/Prof Guo and Prof Mueller, Dr Ji Li at the Advanced Water Management Centre (AWMC) was awarded an Advance Queensland Industry Research Fellowship to investigate ways to combat transmission of coronavirus in urban water systems.

QAEHS continued to co-support the operation of the microbiology lab at AWMC and PhD project of Casey Huang during the year. Casey has recently been working on pathogen risks associated with stagnant water in low occupancy or shutdown buildings during the COVID-19 pandemic. Seed funding from QAEHS is also supporting a new project into exposure assessment of the braineating amoeba *Naegleria fowleri* in Queensland.

Prof Kevin Thomas' work in antimicrobial resistance (AMR) this year has built on proof of concept studies on AMR using wastewater funded by QUEX. A QUEX Scholarship was awarded in 2019 on detecting chemicals in wastewater that select for AMR and a new student will start 2021 to assess antibiotics in environmental systems.

Prof Thomas and Dr Jake O'Brien have partnered with the University of NSW to submit a proposal on AMR monitoring in wastewater and Dr O'Brien is preparing Fellowship applications to continue this work at QAEHS.

Staff and students

- Theme Leaders: Guo/Carvalho, Thomas
- 2 Research Fellows, 2 PhD students

Key funding

Current:

- ARC Linkage (x2) (Bond, Carvalho)
- Advance Qld Industry Research Fellowship (Li)

Climate Change

Key research activities

A/Prof Linda Selvey, Theme Leader for Climate Change and Health, is working with colleagues at UQ's School of Public Health to define a climate change and health research and teaching strategy. A Trans-disciplinary Impact Research Network (TIRN) in relation to climate change and health is being established with three sub-themes: food security and nutrition, social wellbeing and environmental hazards. A/Prof Selvey has worked closely with QH this year; for example, facilitating a workshop for stakeholders to provide input into the QH climate risk strategy. She also led a scoping review for QH of the impacts of prolonged heat on morbidity, mortality and health services.

A new PhD student commenced with A/Prof Fielding in the year to understand whether positive or negative messages are more important in communicating the risks of climate change.

Staff and students

- Theme Leader: Selvey, Fielding
- 1 PhD student, 1 Research Assistant

Key funding

Current:

- QH (Selvey)

Clandestine labs

Key research activities

QAEHS researcher Dr Phong Thai has submitted an ARC Linkage proposal to investigate the extent to which household residents are exposed to third hand smoke from methamphetamine use. The project, if successful, will start early 2021.

Indirectly related to health issues, work has commenced with ACIC to explore the possibility of using wastewater analysis to test for the presence of clandestine illicit drug manufacturing sites in sewer catchments.



Staff and students

- Theme Leaders: Thomas, Mueller
- 3 Research Fellows

Key funding

Current:

- ACIC (Thomas)

Advanced surveillance techniques

Key research activities

QAEHS Theme Leaders Profs Thomas and Mueller and Research Fellows in their teams are leading several research projects to advance global sampling and analytical capabilities to achieve improved surveillance of chemical hazards in humans and the environment.

Prof Thomas secured ARC funding for a new GC instrument in 2019 to expand QAEHS' non-target analytical capabilities into non-polar compounds.

The team, together with three new PhD students and recent ARC funding, are developing new high-resolution mass spectrometry approaches to screen for and identify emerging contaminants.

Dr Sarit Kaserzon has been awarded funding, including an ARC Linkage to expand passive sampling approaches to emerging chemical classes of concern. The project for the US Department of Defence will develop sampling capabilities for PFAS and target US and Australian defence sites.

Staff and students

- Theme Leaders: Thomas, Mueller
- 6 Research Fellows, 5 HDR students

Key funding

Current:

- ARC Discovery (Thomas, Kaserzon)
- ARC Linkage (Kaserzon)
- ARC LIEF (Thomas)
- SERDP (US DoD) (Kaserzon)



Performance - total research outputs

Key outcomes

• The quality of QAEHS' research outputs ranks above average compared to leading Australian research institutions

Research quality

Comparison of the research outputs (all years) of the QAEHS team with leading Australian research institutions shows that QAEHS researchers are ranking above average with respect to quality of outputs (three key metrics are shown in Figure 1). The citation rate (i.e. citations per publication) for QAEHS researchers also exceeds the Australian average (data not shown) attesting to the contemporary relevance of QAEHS' research objectives.



Figure 1: QAEHS' research metrics compared to The University of Queensland (UQ), CSIRO and the Group of Eight Universities (Go8). Plotted is the field weighted citation impact (a measure of the citation impact compared to global averages in the field) against the percentage of publications in the top 25% of journals. Each bubble represents the percentage of publications in the top 10% worldwide based on number of citations (see legend).

For 2019-20, QAEHS researchers were active across twenty subject areas and achieved:

 High relevance and impact of our work, demonstrated through increasing publication and citation:

- 141 publications in 2019 and 125 in 2020 to date
- 7,900 citations in 2019 and 7,600 in 2020 to date
- High quality of our 2019-20 work:
 - 88% of publications in Q1 journals (top 25% of journals)
 - 11 papers in the top 1% cited publications worldwide.

Further details on the reach of QAEHS' outputs are given under 'Performance – communication' below.



UQ's Prof Christina Lee and CEO of the Australian Criminal Intelligence Commission, Michael Phelan APM, signed a new four-year partnership to deliver drug surveillance in wastewater in October 2019.



Performance - education

Key outcomes

- The Masters of Environmental Health Science (MEHS), led by QAEHS Theme Leader A/Prof Coral Gartner, has increased enrolments in 2020 following a high impact promotional campaign and the award of six Commonwealth-supported places for the program
- The cohort of 36 Higher Degree by Research students at QAEHS now includes nine students holding QAEHS scholarships, the first of whom is nearing thesis submission
- Professional development workshops (one delivered, one deferred and being developed online due to COVID-19) and two research workshops were delivered by QAEHS in 2019-20

Masters of Environmental Health Science (MEHS)

The Masters of Environmental Health Science (MEHS), under the directorship of QAEHS Theme Leader A/Prof Coral Gartner, commenced in first semester 2019 with three award options – Masters, Graduate Certificate and Graduate Diploma in Environmental Health Sciences. To target increased enrolments for 2020, A/Prof Gartner, together with the UQ Faculty of Medicine media team, developed a high impact marketing campaign. A specific approach to Commonwealth government led to six Commonwealth-supported places for the program for domestic students, to be awarded competitively. Other activities have included:

- A series of Master Classes to attract overseas students, with particular support from UQ's Global Engagement offices in China and India
- A series of networking events within Australia, including evening events for students working during office hours
- Targeted promotion through organisations such as Austrade
- Promotion of the program to existing undergraduate students enrolled in the UQ Bachelor of Health Sciences and third year students undertaking Environmental Health as an elective.

The longer-term impact of COVID-19 is unknown and will most likely affect new international enrolments in the program; however, continuation of the recent marketing initiatives, one-to-one liaison with existing and potential students, and increasing word of mouth recommendations are expected to mitigate the possible downturn.





QAEHS Theme Leaders and team members are teaching into several of the MEHS courses. Four new core courses have been developed and have been adapted for flexible delivery (incorporating both on-line and face-to-face activities) for:

- Biological Hazards (delivered Semester 1, coordinated by Theme Leader Dr Gilda Carvalho)
- Physical hazards (delivered Semester 1)
- Chemical Hazards (delivered Semester 2, coordinated by Theme Leader Prof Kevin Thomas)
- Risk Communication (delivered Semester 2, coordinated by Theme Leader A/Prof Kelly Fielding)
- Pharmacokinetics, Pharmacodynamics and Toxicology (elective), to be delivered Semester 1 2021, being developed and coordinated by a QAEHS Research Fellow.

The aim of the MEHS program - as a flagship integrated multidisciplinary postgraduate degree at UQ – is to prepare mid-career professionals and future leaders, regardless of profession or discipline, to more effectively manage complex environmental health challenges. It aims to build on the demonstrated strengths of multidisciplinary teams and perspectives for addressing complex challenges, rather than focus on a single discipline.

The MEHS is designed to address the demand expressed by enHealth and reinforced by the UQ process of research, review and consultation, specifically related to preparing graduates for roles and responsibilities including, for example, providing information and advice based on science, formulating or contributing to the development of policy, regulations and guidelines, and identifying hazards and assessing and managing risks to human health and safety.

Postgraduate Research

Six HDR scholarships – three domestic and three international were competitively awarded in 2019 with all students starting during the 2019-20 year. This brings the current cohort of QAEHS

Scholarship holders up to nine, working across six of QAEHS' eight research themes. The first QAEHS scholarship holder to near completion, Andrew Banks, is aiming to submit his thesis in the third quarter of 2020. His project focuses on the exposure of firefighters to potentially toxic combustion products.



QAEHS PhD student, Francisca Ribeiro, presenting at the 2019 3 Minute Thesis (3MT) competition (July 2019). Francisca won the People's Choice award.

Five PhD students submitted their thesis or were awarded their PhD in 2019-20:

- Assessing sources, fate, exposure and potential risks of UV filters in aquatic environments (Elissa O'Malley)
- Understanding and modelling the fate of illicit drug and pharmaceutical biomarkers in urban sewers (Jiaying Li)
- Analysis of wastewater as a tool for analysing trends in chemical exposure including consumption of different foods at a population level (Phil Choi)
- Emerging organic contaminants in wastewater treatment plants (Thi Thanh Hue Nguyen)
- Assessing early-life human exposure to chemical pollutants using urinary biomarkers (Yan Li).



Dr Phil Choi has since taken up a Postdoctoral position at QAEHS in the Emerging Environmental and Public Health Risks research group.



QAEHS students present at the 2019 World Science Week

Professional development and research workshops

Professional development activities in 2019-20 have included:

- A Statistics workshop held on 14 October 2019, delivered to 28 QH staff both in person and via teleconferencing
- A GIS workshop, involving lecturers from the School of Earth and Environmental Sciences, was planned for the first half of 2020 but has been postponed due to COVID-19
- The GIS and previously delivered and popular Literature Review workshops are currently being developed for on-line delivery. The workshops will be prerecorded so that QH staff can access them when convenient, followed by an interactive component via Zoom
- 'Meet and greet' opportunities for UQ and QH staff were facilitated through a lunch prior to the 2019 Annual Research Forum and through the SPC meetings to which all QAEHS-affiliated QH staff are invited.

Research workshops and other events organised, contributed to and/or hosted by QAEHS researchers in 2019-20 included:

 United Nations Environment Programme: Stakeholder Consultation on Securing Sustainable Conditions for the Monitoring of POPs under the Stockholm Convention: this two-day workshop was attended by QAEHS staff and 45 invited external participants including representatives of Stockholm Convention Conference of the Parties, GMP Global Coordination Group, donors, IGOs, NGOs, and experts of relevance.

- Workshop on detection and attribution for potential health impacts of anthropogenic climate change. A/Prof Linda Selvey co-hosted a workshop attended by researchers from Griffith University, QUT and UNSW. Professor Kristie Ebi presented remotely from Seattle, Washington (while in lockdown).
- Workshop on understanding the potential negative and positive effects of COVID-19 in relation to the environment. A/Prof Kelly Fielding conducted a virtual workshop attended by academics and policymakers.
- Wastewater Surveillance symposium: QAEHS Theme Leaders, researchers and students participated in a two-day event, involving government and collaborating researchers. The symposium aimed to share research findings, identify gaps and new ideas for joint research applications.



QAEHS PhD student, Rory Verhagen, deploying passive samplers at a Brisbane wastewater treatment plant



Performance - communication

Key outcomes

- QAEHS' research publication and citation rate continued on an upward trajectory into 2019-20, with the number of collaborating partners and citing countries indicating the highly collaborative nature and international significance of QAEHS' work
- 2019 Annual Research Forum was held 10 December to share research findings
- QAEHS will co-host Testing the Waters 5 the key conference in wastewater analysis in Brisbane in 2021
- The QAEHS Seminar Series has been highly successful and well attended throughout 2019-20. Technical upgrades have enabled remote attendance at seminars via video conferencing, increasing the reach of the series to a wider QH audience and beyond

Research reach

QAEHS research outcomes are primarily communicated to the wider scientific community, government and the public via peer reviewed publication in top ranking journals. Both publications and citations for the combined QAEHS research team across all themes have increased each year since 2017 and are on track to see a further increase in 2020 (Figure 3). The quality of QAEHS' publications is outlined under 'Performance – total research outputs' above.

QAEHS' work is highly collaborative and has international significance and reach. In 2019-20:

- QAEHS' work was published in collaboration with over 150 different institutions in Australia and overseas
- 56% of publications included international collaborators and 34% involved Australian colleagues outside of UQ
- QAEHS' work has been cited in 104 countries around the world.

The annual QAEHS Research Forum was successfully held on 10 December 2019. Fifteen QAEHS researchers and students presented their recent findings to an internal and external audience, including QH staff and members of the AMC.



Figure 2: Total publications and associated citations for QAEHS researchers for years 2017 to 2020 (year to date) (Scopus Aug 2020)

Conferences

Before COVID-19 travel restrictions were introduced in 2020, QAEHS staff and students attended several inter/national conferences. Of note, seven of the QAEHS wastewater team presented their work at Testing the Waters - 4th International Conference on Wastewater Analysis in Foshan, China in October 2019. At this meeting, it was voted to bring Testing the Waters 5 to Australia in September 2021, to be co-hosted by QAEHS, the University of South Australia and the Australian Criminal Intelligence Commission. The event is planned to be held at UQ Customs



House in Brisbane. We hope to encourage attendance of world leaders in wastewater-based epidemiology and bring researchers, industry and government together in one forum.



Members of the QAEHS wastewater team at Testing the Waters - 4th International Conference on Wastewater Analysis in Foshan, China in October 2019

Seminar series

The QAEHS weekly Seminar Series has been highly effective in 2019-20 having increased its reach to a wider audience through live streaming via video conferencing. This new technology has allowed the series to continue through the 2020 COVID-19 lockdown, with capabilities for questions to be taken from remote audiences. Past seminars are now also available via the QAEHS website.

In 2019-20, over forty external, internal and visiting researchers and students presented their recent research findings, including:

- Prof Chris Higgins, Colorado School of Mines, US – "Monitoring, remediation and health impacts of PFAS in the USA"
- Prof Wayne Hall, UQ "What is happening with cannabis legalisation in the Americas?"
- COVID-19 wastewater surveillance team

 "QAEHS, CSIRO and ACE present
 COVID-19 in Wastewater"

QH staff are invited to attend all seminars and have been pleased to welcome regular QH representation over the year.



Socially distant presentations to the QAEHS team at PACE during COVID-19

Website

The redesign of the QAEHS website has been continuing throughout 2019-20 and will be accelerated with the recruitment of a dedicated Centre Manager in July 2020. Initial focus was on ensuring up to date information on QAEHS staff and study options at QAEHS. News articles are now posted regularly and each month a Focus article on a staff member is written. Seminars and upcoming events are advertised on the QAEHS website, as well as being circulated by email to QH and other interested colleagues.

Media

QAEHS researchers and students have had several opportunities to engage with the media during the year to disseminate key research findings and discuss new programs that they are involved in. This has involved television and radio interviews and articles, as well as various social media outlets; including ABC, Channels 7 and 10, The Economist, and Washington Post. All media articles are posted on the QAEHS website.



QAEHS' collaborative work with Dr Warish Ahmed at CSIRO to develop approaches to detect the COVID-19 virus in wastewater has received high media interest



Appendix A Awards and honours

Kevin Thomas

- Keynote presented at Asia Pacific Network for Global Change Research (APN) on microplastics and human health, Kobe, Japan 22nd February 2020.
- Invited speaker at the 68th ASMS Conference on Mass Spectrometry and Allied Topics 2020, online webinar 'Pyrolysis-GCMS: The power of mass spectroscopy for unveiling plastic contamination in the environment'

Jochen Mueller

- ARC Laureate Fellowship 2021-2025 (awarded 2020)
- UQ Professorial Fellowship 2017-2019

Jack Ng

- Invited speaker of the ERESD 2019, China University of Mining and Technology, Crowne Plasa Hotel, Xuzhou, China, and CUMT 110th Celebration.
- Invited keynote speaker of the Belt and Road on Green Mining for Sustainable Development, Xuzhou, China. Ministry of Ecology and Environment, & China University of Mining and Technology.
- Nan Shan Distinguish Lecture Southern University of Science and Technology, Dec 2019.
- Plenary lecture The 3rd China Australia Agricultural and Food Safety Forum, Dec 2019. Yangzhou, China.
- Local Committee of Geotrop 2019 Conference, July 2019, Gold Coast, Australia.

Kelly Fielding

- Invited presenter to the Australasia Pacific Extension network.
- In response to an invitation, Kylie Morphett, Kelly Fielding, and Anne Roiko made a submission to the PFAS sub-committee of the Joint Standing Committee on Foreign Affairs, Defence and Trade about the findings of the research funded through a QAEHS seed grant.

Jianhua Guo

• PhD student Ji Lu won the Australian Water Association Queensland Student Water Prize for his research into the impact of common bathroom products on antibiotic resistance.

Gilda Carvalho

• Faculty Staff Excellence Award for Leadership 2019, Faculty of Engineering Architecture and Information Technology, UQ.

Coral Gartner

 Publons Top Reviewer Award for Social Sciences (The top 1% of reviewers in each of the 22 Essential Science Indicators (ESI) research fields. Rankings are calculated by number of verified pre-publication reviews performed and added to Publons between 1 September 2018 and September 1 2019).



Appendix B Research publications

Book chapters

- 1. Choi, P.M., **Thomas, K.V**., O'Brien, J.W. and **Mueller, J.F**., 2020. Mining Population Exposure and Community Health via Wastewater-Based Epidemiology. In A New Paradigm for Environmental Chemistry and Toxicology (pp. 99-114). Springer, Singapore.
- 2. Bingley, W.J., Greenaway, K.H. and **Fielding, K.S.**, 2019. Greening the physical environment of organizational behaviour. *Organizational Behaviour and the Physical Environment*, pp.167-184.

Peer Reviewed Journal Articles

- 3. **O'Brien**, S., E. D. Okoffo, J. W. **O'Brien**, F. Ribeiro, **X. Wang**, S. L. Wright, S. Samanipour, C. **Rauert**, T. Y. A. Toapanta, R. Albarracin, and K. V. **Thomas**. 2020. 'Airborne emissions of microplastic fibres from domestic laundry dryers', *Science of the Total Environment*, 747.
- Zheng, Q., C. Gartner, B. J. Tscharke, J. W. O'Brien, J. Gao, F. Ahmed, K. V. Thomas, J. F. Mueller, and P. K. Thai. 2020. 'Long-term trends in tobacco use assessed by wastewater-based epidemiology and its relationship with consumption of nicotine containing products', *Environmental International*, 145.
- Xiu, M., X. Wang, L. Morawska, D. Pass, A. Beecroft, J. F. Mueller, and P. Thai. 2020. 'Emissions of particulate matters, volatile organic compounds and polycyclic aromatic hydrocarbons from warm and hot asphalt mixes', *Journal of Cleaner Production*, 275.
- 6. Thomas, M. C., F. Flores, S. **Kaserzon**, R. Fisher, and A. P. Negri. 2020. 'Toxicity of ten herbicides to the tropical marine microalgae Rhodomonas salina', *Scientific Reports*, 10.
- 7. Liu, T., Z. K. Lim, H. Chen, Z. Wang, S. Hu, Z. Yuan, and J. **Guo**. 2020. 'Biogas-driven complete nitrogen removal from wastewater generated in side-stream partial nitritation', *Science of the Total Environment*, 745.
- 8. Rauert, C., S. L. Kaserzon, C. Veal, R. Y. Yeh, J. F. Mueller, and K. V. Thomas. 2020. 'The first environmental assessment of hexa(methoxymethyl)melamine and co-occurring cyclic amines in Australian waterways', *Science of the Total Environment*, 743.
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- Kim, Y. R., N. White, J. Bräunig, S. Vijayasarathy, J. F. Mueller, C. L. Knox, F. A. Harden, R. Pacella, and L. M. L. Toms. 2020. 'Per- and poly-fluoroalkyl substances (PFASs) in follicular fluid from women experiencing infertility in Australia', *Environmental Research*, 190.
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- Rauert, C., T. Harner, J. M. E. Ahad, and K. E. Percy. 2020. 'Using tree cores to evaluate historic atmospheric concentrations and trends of polycyclic aromatic compounds in the Oil Sands region of Alberta, Canada', *Science of the Total Environment*, 739.
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- 15. Li, H., H. Yao, T. Liu, B. Wang, J. Xia, and J. **Guo**. 2020. 'Achieving simultaneous nitrogen and antibiotic removal in one-stage partial nitritation-Anammox (PN/A) process', *Environment International*, 143.
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- 17. Li, Q., Y. Lan, Z. Liu, X. Wang, X. Wang, J. Hu, and H. Geng. 2020. 'Cyclic volatile methylsiloxanes (cVMSs) in the air of the wastewater treatment plants in Dalian, China Levels, emissions, and trends', *Chemosphere*, 256.
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- Ojo, A.F., Peng, C., Ng, J.C. Evaluation of the combined effects and toxicological interactions of perfluoroalkyl and polyflouroalkyl substances mixtures in HepG2 cells. Society of Environmental Toxicology and Chemistry (SETAC) North America Focused Topic Meeting: Environmental Risk Assessment of per- and poly-fluoroalkyl Substances (PFAS), 12-15 August 2019, Durham, North Carolina, USA.
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- Zheng, Q., Eaglesham, G., Tscharke, B., O'Brien, J.W., Reeks, T., Thompson, J., Thai, P. Developing a largevolume Injection method for analysis of anabasine and anatabine in wastewater by LC-MS/MS. Queensland Annual Chemistry Symposium, 29 November 2019, Brisbane, Australia.
- 23. Okoffo, E., Ribeiro, F., O'Brien, S., O'Brien, J.W., Tscharke, B., Gallen, M., Mueller, J.F., Thomas, K.V. Identification and quantification of selected plastics in biosolids by pressurized liquid extraction combined with double-shot pyrolysis gas chromatography-mass spectrometry. 4th Queensland Annual Chemistry Symposium (QACS), 29 November 2019, Brisbane, Australia.



Appendix C Community and professional activities

Kevin Thomas

- 2020 present: Editorial Board Member for Environmental Science & Technology Letters
- 2020 2023: Steering Group member EU Horizon 2020 project, Harmonization Assuring Reproducible Monitoring and Assessment of Plastic Pollution (EUROqCHARM)
- 2019 present: Member of Core Science Group, Global Panel on the Chemical Pollution of the Environment (gpcpe.org/)
- 2013 present: Associate Editor for Science of the Total Environment

Jochen Mueller

- 2006 present: Adjunct Prof, School of Public Health, Griffith University
- 2012 present: Member of SETAC (ASE joined SETAC in 2011)
- 2009 present: Member of Australian Water Authority
- 2003 present: NATA Assessor
- 2003 present: Technical Expert, International Accreditation New Zealand

Jack Ng

- 2019: Fellow of the Australasian College of Toxicology and Risk Assessment (ACTRA)
- 2019: Key member of the UNESCO Chair Program on Groundwater Arsenic
- 2019 present: Editor-in-Chief, Journal of Toxicology
- 2018 present: Associate Editor of Critical Reviews in Environmental Science and Technology
- 2018 present: International Advisor of Dundee Precious Metals, Canada
- 2018: International Scientific Committee, and Continuing Education Workshop member, Session Chair of International Congress on Arsenic (As-2018), Beijing, China
- 2017 present: Associate Editor for Frontiers in Environmental Science
- 2012 present: Committee member of the Queensland Health and Food Science Sub-Committee
- 2010 present: Member of the International Society for Groundwater Sustainable Development
- 2010 present: International Advisor of Kinross Gold Mine, Canada
- 2009 present: Editor for Journal of Toxicology
- 2006 present: Member of ACTRA
- 2005 present: Member of ISTEB
- 2004 present: Diplomat of the American Board of Toxicology
- 2004 present: Coordinating Editor for Journal of Geochemistry and Environmental Health
- 2004 2018: CRC CARE Research Program Leader
- 1977 present: Member of RACI (CChem Charter Chemist).

Kelly Fielding

- 2018 present: Deputy Director, Research Committee, School of Communication and Arts, UQ
- 2018 present: Member of HASS Faculty Low and Negligible Risk Ethics Committee, UQ
- 2018 present: Member of CSIRO Human Ethics Committee
- 2018 present: Member of the Human Dimensions working group of the Office of the Great Present: Member of the Social Scientific Expert Panel of Healthy Land and Water
- 2015 present: School of Communication and Arts (UQ) Vice Chancellor's Research and Teaching Fellow
- 2015 2018: Senior Associate Editor, Environment and Behavior

Jianhua Guo

- 2019: Organizing and Scientific Committee member, 2019 China-Australia Civil, Materials and Environment Forum, Tianjin, China.
- Member of International Water Association (IWA).
- Member of International Society of Microbial Ecology (ISME).
- Member of Australian Water Association.



• Editor of Water Science & Technology.

Gilda Carvalho

- Member of International Water Association (IWA).
- Member of the Australia Water Association.
- Member of the Australasian Association for Engineering Education.
- 2018 present: Executive Board Member for Advanced Water Management Centre (AWMC).
- 2018 present: Member of the International Development Group, Faculty of Engineering, Architecture and Information Technology, UQ.
- 2018 present: Member of the Teaching & Learning Committee, School of Chemical Engineering, UQ.

Abdullah Mamun

- Present: Editorial board member Obesity Research and Clinical Practice (ELSEVIER Publisher)
- 2015 present: NHMRC Grant Review Panel Member
- 2018 present: Part-time Lecturer, Department of Clinical Trial and Clinical Epidemiology, University of Tsukuba, Japan
- 2018 present: Senior Research Fellow, Mater Research-Mater Medical Research Institute, Mater Hospital
- 2012 present: Senior Scientist, International Centre for Diarrheal Disease Research Centre, Bangladesh, Dhaka, Bangladesh
- Present: Professional Society membership:
 - o Global Burden of Disease Network
 - o Public Health Association of Australia
 - Australia-New Zealand Obesity Society
 - o Australasian Epidemiology Association
 - National Heart Foundation
 - o QLD Epidemiology Group
 - o National Heart Foundation Think Tank Member
 - o Clinical Epidemiology and Research Synthesis methods Special Interest Group
 - o ARACY-Australian Research Alliance for Children and Youth
 - Life-course Research Network
 - Maternal and Child Health Network
 - EAGLE (The EArly Genetics and Lifecourse Epidemiology Consortium)
 - ACAORN-Australasian Child and Adolescent Obesity Research Network conferences and Heart Foundation Conferences.

Coral Gartner

- Present: Member of the Australian Academy of Health and Medical Sciences Reports Committee
- Present: Member of the Society for Research on Nicotine & Tobacco Oceania Chapter Board
- Present: Grant and Fellowship assessor for Cancer Research UK
- 2019 present: Editor, Tobacco Control
- 2019: Society for the Study of Addiction Fellowship assessor
- 2019: NHMRC Synergy Grant Review Panel
- 2012 present: Member of the NHMRC Research Translation Faculty

Linda Selvey

- 2018 present: President, Australasian Faculty of Public Health Medicine
- 2017 present: Chair, Queensland Hepatitis C elimination working group
- 2016 2018: National convenor, The Wilderness Society Ltd



Appendix D Major partners and collaborators

Kevin Thomas

- Prof Sarah Dunlop, Minderoo Foundation Flourishing Oceans
- Prof Tamara Galloway OBE, Prof Will Gaze and Dr Aimee Murray, University of Exeter
- Prof Jonathan Martin, Stockholm University
- Dr Stephanie Wright, Imperial College London
- Naomi Speers, Australian Sports Drug Testing Laboratory
- Dr Catrin Goebel, National Measurement Institute
- Dr Julianne Webster, Qld Police
- Prof Barbara Kasprzyk-Hordern, University of Bath
- Dr Emma Schymanski, University of Luxembourg
- Dr Saer Samanipour, University of Amsterdam
- Prof Erica Donner, University of South Australia

Jochen Mueller

- Shane Neilson, Australian Criminal Intelligence Commission
- Dr Warish Ahmed, CSIRO
- Dr Michael Bartkow, SE Qld Water
- Craig Barnes, Airservices Australia
- Dr Nick Crosbie, Melbourne Water
- Prof Jason White, Dr Cobus Gerber, University of South Australia
- Prof Chris Higgins, Colorado School of Mines
- Prof Michael McLachlan, University of Stockholm

Kelly Fielding

- Currently collaborating with colleagues from University of Exeter and University of Leipzig to edit a special issue on 'Collective responses to global challenges: The social psychology of proenvironmental action' for Journal of Environmental psychology.
- Founder and convenor of the UQ Network of Environmental Social Scientists (NESS). NESS holds
 regular seminars and an annual forum; the latter have attracted more than 300 attendees, many
 from government and non-government organisations.

Jianhua Guo

- Queensland Urban Utilities
- South Australia Water
- Professor Will Gaze, University of Exeter
- Dr Erica Donner, University of South Australia

Linda Selvey

- Professor Margaret Hellard, Burnet Institute
- Queensland Health Communicable Diseases Branch
- A/Professor Sharyn Burns, Curtin University
- Institute for Urban Indigenous Health Renee Brown, Richard Mills, Lyle Turner
- Professor Rebecca Guy, Kirby Institute
- Professor Basil Donovan, Kirby Institute
- Professor Kristie Ebi, University of Washington State, Seattle



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