National Priorities Research Prospectus

Version 1.0 (23rd February 2024)

Water Research AUSTRALIA

Service Delivery

Supply Optimisation

Circular Economy

Liveability

Workforce

Water Research Australia's National Priorities Research Prospectus has been shaped through extensive consultation within our Industry Members. It embraces the key concerns and opportunities that affect industry right across Australia and provides clear points where research can be taken for the greatest benefits.

We have used input from our Roadmaps to Research workshops and added insights from other sources to initiate 1–3 year research programs tailored to the national priority areas (Service Delivery, Supply Optimisation, Circular Economy, Liveability, and Workforce) outlined in the National Water Industry Research Priorities Agenda.

These research programs are designed to **complement but not replace** WaterRA's existing portfolio of research, allowing our members to see how individual research projects link together to form solutions to the national priority challenges.

The purpose of this prospectus is to help WaterRA's Industry Members understand how we plan to effectively address the national priority challenges with robust research that will help deliver both organisational and industry value.

As we identify further challenges and industry needs, our research programs will continue to evolve, grow and be updated as necessary.

Service Delivery Research Program

Ensuring affordable, fit-for-purpose water services for all

The water industry has a shared mandate to ensure safe and reliable water services that meet affordability criteria and are fit for purpose. Particularly in terms of 'Safe' water services, WaterRA and its BIG team have the opportunity to provide value by aligning with One Health goals as set down by the World Health Organisation to provide an integrated, unifying approach to sustainably balance and optimise the health of people, animals and ecosystems.

There are many potential cross-cutting research initiatives that may apply to service delivery and help to optimise the value chain for water resource management, distribution, treatment, and recovery. Looking to the future, industry members identified opportunities to address significant risks in relation to extreme and other disruptive events. In particular, it is recognised that emerging technological and digital advancements have great potential to increase the capabilities of predictive tools and enhance the capacity to respond to operational challenges and water quality incidents with greater agility.

Drivers for research in this area include:

- Advances in monitoring technology and the potential for coupling with Artificial Intelligence platforms.
- The attractiveness of Internet of Things technology to improve utilities' operational efficiencies around monitoring and control of networks and treatment technologies.
- The need for greater predictive and timely assessment capabilities to respond to and maintain safe water supplies in the face of extreme or disruptive events.

Research Program Focus Areas

Extreme Events – Prevention, Preparedness, Response and Recovery

Towards a digital utility

Research Program Focus Area	Key Priority	Activities
EXTREME EVENTS – PREVENTION, PREPAREDNESS, RESPONSE AND RECOVERY Our goal is to enhance our members' ability to maintain their business continuity in the face of disruptive and extreme events, and maintain safe and reliable supplies.	1 **Developing risk assessment guidance to increase resilience of catchments and recycled water sources to the impacts of extreme events. There is a specific need to understand the likelihood of both unknown materials and contaminants of potential and emerging concern and how best to respond to these to ensure safety of water supplies.**	Underway: #1100 – Better data-driven decision making under future climate uncertainty (Resiliwiki)
		Underway: #1145 – Bushfire Recovery for Resilience: Bushfire modelling as an enabling decision support tool
		Underway: #1152 – Improving Water Quality Analysis in Response to Extreme Events: Fires and floods
		Underway: #1155 – Emerging Contaminants Risk Priortisation: Enhancing ECHIDNA to further empower water professionals to manage contaminants of emerging concern
		Completed: #1063 – Identify and Assess the Water Quality Risks from Extreme Events
	1 **Determining social licence and the acceptance level of communities and regulators with regard to testing and treating Contaminants of Emerging Concern in water following extreme events.**	In preparation: Ozwater 24: How to Adapt and Adopt Social Licence in the Water Industry – builds on the lessons from #2060 ColoSSoS – Collaboration on Sewerage Surveillance of SARS-CoV-2
	2 **Building on the work of Project #2057 Effects-based Monitoring in Water Safety Planning to set criteria and targets applicable to specific classes of emerging contaminants in response to extreme events.**	Opportunity: ARC Effects-based monitoring and Disinfection By-Products
		Underway: #1063 – Identify and Assess the Water Quality Risks from Extreme Events
		Underway: #2057 – Effects-based Monitoring in Water Safety Planning
	3 **Application of localised climate models for understanding water security risks including water quality impacts resulting changes in rainfall patterns (catchment runoff impacts).**	Opportunity: #216 – An Integrated Approach to Water Demand Forecasting and Management in a Changing World (RFF open)

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
TOWARDS A DIGITAL UTILITY Our goal is to assist our members in utilising emerging technologies to support efficiencies in monitoring and managing operations and the performance of water assets.	1 **Developing water-industry tailored decision support tools and standards that ensure sound IoT/OT/IT operating models and data governance, and support the identification of prudent, long term digital investments.**	Opportunity: ARC IoT Water Hub - a collaboration in real-time monitoring and control
	1 **Exploring the potential of fit-for-purpose advanced analytics and the use of AI and Big Data to drive operational efficiencies and early detection and warning systems.**	Opportunity: ARC IoT Water Hub - a collaboration in real-time monitoring and control
		Underway: #1134 – State of Knowledge and Capability for Remote Sensing for Water Utilities
		Underway: #1140 – Catchment Health Metrics
	2 **Water-utility tailored and leveraged collaborative research programs utilising IoT technologies.**	Underway: #2084 – ARC Sewer Monitoring and Management in the Digital Era (ARC Batstone)
		Opportunity: ARC IoT Water Hub - a collaboration in real-time monitoring and control
	3 **Exploring and assessing advances in monitoring technologies to for water quality management (e.g., Aquawatch, sensor / drone technologies).**	Underway: #1150 – The inclusion of faecal source tracking (FST) into monitoring programmes to inform microbial risk assessments
		Underway: #1161 – Rapid Knowledge-Guided Diagnostics for Harmful Algal Bloom Management
		Underway: #4554 – Supervised & knowledge-guided machine learning approaches quantifying & identifying microorganisms in water and wastewater treatment
		Opportunity: Aquawatch Australia collaborations
		Completed: #1103 – Smart Monitoring for Microbial Risk Assessment
		Completed: #2060 – Collaboration on Sewage Surveillance of SARS-CoV-2 (ColoSSoS)
		Completed: #2064 – ColoSSoS Vic
		Completed: #2068 – ColoSSoS Asia Pacific (Mekong, Fiji)
	3 **Collaborate with researchers and technology developers to optimise energy efficiency in water processes, pumping stations, and water heating. Explore the use of Artificial Intelligence and machine learning tools for predictive maintenance and process optimisation.**	Opportunity: Future Research needs to be explored through a POD Workshop

Supply Optimisation Research Program

Making all water supply options safe and reliable

As the water industry shifts away from a reliance on rainfall dependent, surface water supplies and towards more diverse supply options, an evidence-based, research led approach is required to enable an assessment of all available and fit-for-purpose options.

The provision of adequate treatment solutions for water and wastewater is challenging in the face of ever-growing lists of contaminants of emerging or emerged concern. WaterRA and its BIG team can provide value by validating and advancing innovative treatment and delivery options to increase security of supplies.

Drivers for research in this area include:

- The need for safe, sustainable, and affordable fit-for-purpose use of different water sources and supplies.
- New developments in the water industry's social licence to operate diverse water treatment and delivery options.
- Increasing public pressure and expectation for the water industry to maintain effective control and response to addressing contaminants of potential, emerged and emerging concern.

Research Program Focus Areas

Treatment technologies and approaches

Algal innovation: Proactive management of cyanobacteria and algal blooms

Chemicals of Emerging and Emerged Concern (CECs): Balanced risk assessment and management approaches

Disinfection: Effective treatment outcomes, including management of Disinfection By-Products

Alternative Water Sources – fit-for-purpose solutions across the water portfolio

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
TREATMENT TECHNOLOGIES AND APPROACHES Our goal is to equip our members with knowledge of the most innovative management and treatment approaches to successfully respond to water security and water quality challenges.	1 **Exploring the application of nanobubbles for ferrous and manganese oxidation, for MIB and geosmin removal, aquatic health and wastewater intensification.**	Underway: #1142 – ARC - Assessing the efficiency and efficacy of nanobubble technology used in water and wastewater treatment processes
	1 **Water Validation – The primary purpose of WaterVal is to coordinate treatment process validation protocols to streamline the validation process.**	Underway: #3501 – WaterVal: Streamling Technology Validation
		Underway: #2074 – Development of a WaterVal Granular Filtration Validation Protocol
	3 **On-site generation of treatment chemicals with low environmental impacts.**	Underway: #1136 – Application of sustainable hydrogen economy based AOP for removal of emerging contaminants
	3 **Treatment options for regional lagoon-based WWTPs for water reuse and compliance outcomes.**	Opportunity: Future Research needs to be explored through a POD Workshop

Research Program Focus Area	Key Priority	Activities
ALGAL INNOVATION: PROACTIVE MANAGEMENT OF CYANOBACTERIA AND ALGAL BLOOMS Our goal is to build on decades of research to address emerging cyanobacteria issues and accelerate novel technology transfer for algal management.	1 **Algal/cyanobacterial toxins - Australian Drinking Water Guidelines Review: Inclusion of cyanotoxins and their metabolites as a secondary impact on water quality.**	Underway: #3049 – Cyanotoxin risk in recycled water used for food crop irrigation and livestock
		Opportunity: #2082 – Understanding and optimising the performance of algae co-digestion with waste activated sludge (RFF open)
		Completed: #1059 – Bad tastes, odours, and toxins in our drinking water reservoirs: Are benthic cyanobacteria the culprits?
	2 **Improving our ability to predict Blue-Green Algal events and understanding how this prediction will change with future climate variation.**	Underway: #1138 – Protocols for algal bloom management - technology performance & optimisation assessments
		Underway: #2058 – Understanding and Reducing the Spread of Antibiotic Resistance in Anaerobic Sludge Digestion
	3 **Exploring more cost-effective treatment technologies for algae and pathogens.**	Underway: #1136 – Application of sustainable hydrogen economy based AOP for removal of emerging contaminants
		Underway: #1153 – Scalable and environmentally sensitive algae management tech: H_2O_2 dosing
		Underway: #4970 – Plasma bubbles for algae control
		Underway: #4544 – Assessing granular activated carbon capacity for algal taste and odour removal: Development of a predictive tool

Research Program Focus Area	Key Priority	Activities
CHEMICALS OF EMERGED AND EMERGING CONCERN (CECs): SENSIBLE RISK ASSESSMENT AND MANAGEMENT APPROACHES The goal is to equip our members with innovative management and treatment approaches to effectively respond to contaminants of emerged and emerging concern.	1 **Emerging Contaminants Risk Priortisation: Enhancing ECHIDNA to further empower water professionals to manage contaminants of emerging concern.**	Underway: Global Water Research Coalition project "ECHIDNA international"
		Underway: #3051 SAAFE CRC
		Opportunity: #1155 – Emerging Contaminants Risk Priortisation: Enhancing ECHIDNA to further empower water professionals to manage contaminants of emerging concern (RFF open)
	1 **PFAS in water industry products (water, recycled water, sludges, biosolids, biochar): Short chain PFAS, precursors, transformation products, mass balance throughout the treatment chain.**	Underway: #3058 – ARC - Fate and riskof PAPs and short chain PFAS in biosolid amended agricultural soils
		Underway: #3052 – crcCARE - Cooperative Research Centre for Contamination Assessment and Remediation of the Environment
		Underway: #2067 – ARC ITTC Training Centre for the Transformation of Australia's Biosolids Resource
	2 **Further exploration of effects-based monitoring and/or Non-Target Analysis: Methods to contribute to safety of water supplies.**	Underway: ARC (Bid) Effects-based Monitoring for DBP in Drinking Water Application of sustainable hydrogen economy based AOP for removal of emerging contaminants
		Underway: #2057 – Effects-based Monitoring in Water Safety Planning

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
DISINFECTION: EFFECTIVE TREATMENT OUTCOMES, INCLUDING MANAGEMENT OF DBPs Our goal is to provide our members with improved foresight on innovative disinfection approaches with a focus on risks and opportunities.	1 **Disinfection By-Products assessment and management.**	Opportunity: Effects-based Monitoring for DBPs in Drinking Water - Impact of water treatment processes on Disinfection By-Product formation and toxicity (Proposed ARC project)
		Underway: #2057 – Effects-based Monitoring in Water Safety Planning
	2 **Treatment methods for DBP reduction that do not produce significant waste streams in the water treatment process and/or the reticulation network.**	Opportunity: Future Research needs to be explored through a POD Workshop
	3 **Impact of distribution system on aesthetic water quality for customers.**	Opportunity: Future Research needs to be explored through a POD Workshop
	3 **DOC removal to lower DBPs/THMs.**	Opportunity: Future Research needs to be explored through a POD Workshop
	3 ***Naegleria/Legionella*/opportunistic pathogens of concern in the distribution system.**	Opportunity: Future Research needs to be explored through a POD Workshop

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
ALTERNATIVE WATER SOURCES – FIT-FOR-PURPOSE SOLUTIONS ACROSS THE WATER PORTFOLIO Our goal is to provide adequate scientific underpinnings to enable our members to deliver safe water, balanced across technological solutions and a broader source and product portfolio.	1 **Enhanced source water monitoring and control for Purified Recycled Water.**	Opportunity: #3056 – Enhanced source water monitoring and control for Purified Recycled Water (RFF open)
	1 **Building on #3048 Review of Stormwater Quality to Support the Development of Evidence-Based Stormwater Recycling Guidlines by addressing technical and regulatory barriers and challenges for stormwater reuse schemes.**	Opportunity: Future Research needs to be explored through a POD Workshop
	2 **Business models for the decentralisation of alternative water systems (including stormwater treatment) versus large scale capital augmentation taking into consideration the One Health goals of healthy people, animals and ecosystems.**	Opportunity: Future Research needs to be explored through a POD Workshop
	3 **Management of waste streams from alternate water sources - Investigating options for brine treatment and disposal, including the beneficial uses of brine (e.g., CO2 sequestration, cement ingredients, etc) with a specific emphasis on inland towns and cities.**	Opportunity: Future Research needs to be explored through a POD Workshop

Circular Economy Research Program

Closing the loop on resource generation and use

The linear delivery model currently utilised in our economy, which consists of take-make-use-dispose, is no longer tenable given its impact on our already stressed environment. As a result, finite resources such as freshwater, nutrients and fossil fuels are depleting, affecting the environment, the economy and communities. There is, therefore, an urgent need to close the loop on resource generation and use; we need to transition to a circular economy.

The Ellen MacArthur Foundation bases the circular economy on three principles:

1. Elimination of waste and pollution
2. Circulation of products and materials
3. Regeneration of nature

WaterRA has worked with our BIG team to prepare a rigorous Circular Economy Framework that can be viewed **here**.

Drivers for research in this area include:

- A need for a strategic plan of action supported by a regulatory environment that eliminates waste and pollution.
- A need to overcome logistical challenges around supply chain and resource dependencies to enable local water and energy security.
- Building resilience through resource recovery to reduce costs, improve economic efficiencies and enable greater circulation of valuable products and materials.
- Supporting the healthy regeneration of ecosystems to meet changing societal expectations around liveability and license to operate.

Research Program Focus Areas

The Path to Net-Zero Emissions

Hydrogen Economy in the Water Industry

Realising the Full Value of our Resources

Green Supply Chains

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
THE PATH TO NET-ZERO EMISSIONS Our goal is to propel the Australian water industry towards net-zero emissions.	1 **Advance greenhouse gas emissions quantification, reduction and offset technologies and methodologies.**	Underway: #2059 – Scope 1 emissions from sewage treatment plants Underway: #2087 – Reducing direct greenhouse gas emissions from urban wastewater system Underway: #2091 – Feasible quantification of greenhouse gas emitted from wastewater treatment Opportunity: #198 – Mitigating methane emissions from water supply storages (RFF open) Opportunity: #204 – A practical guideline to monitor and quantify nitrous oxide emissions from full-scale wastewater treatment plants (GWRC)
HYDROGEN ECONOMY IN THE WATER INDUSTRY Our goal is to provide direction and a strong voice to the water industry in the hydrogen space.	2 **Optimise water sources and quality.** **Create an enabling regulatory environment.** **Close the loop to ensure green systems.** **Establish and maintain social licence.**	Underway: #1136 – Application of sustainable hydrogen economy based AOP for removal of emerging contaminants Opportunity: #215 – Treatment of Ammonia in Wastewater & production of High-Grade Hydrogen Gas Opportunity: Ozwater Panel Discussion – Developing a water responsible and circular hydrogen economy

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
REALISING THE FULL VALUE OF OUR RESOURCES Our goal is to identify untapped resources (e.g., carbon, nutrients, brine), explore opportunities for beneficial recovery and overcome barriers to resource valorisation.	1 **Improve technologies.** **Improve products.** **Ensure safe circularity.**	Underway: #2063 – Microplastic in wastewater effluent
		Underway: #2067 – ARC Training Centre for the Transformation of Australia's Biosolids Resource
		Underway: #2072 – Microplastic and the environment
		Underway: #2073 – Upcycling of biosolids into biochar as a win-win-win for environment, economy and community
		Underway: #2088 – Ammonium selective membrane to transition the water industry into circular economy
		Underway: #2090 – Biodiesel recovery from fat, oil and grease wastes
		Opportunity: #213 – Fate and identity of fluorine in biosolids pyrolysis
		Opportunity: #214 – Energy Storage CRC
		Opportunity: #217 – Enabling a climate resilient, safe and circular water industry (RFF open)
GREEN SUPPLY CHAINS Our goal is to improve supply chain sustainability and resiliency and increase recycled content in infrastructure.	3 **De-risking and improve the sustainability of supply chains.** **Improving the use of recycled content in infrastructure.**	

Liveability Research Program

Expanding the water supplier's role in public and environmental health

The water industry is pivotal to the experience and productivity of our cities, towns and neighbourhoods, because of the role it plays by providing quality water, wastewater and drainage services. These services also enhance our cities' and regions' liveable spaces, and contribute to their long term sustainability and productivity. In essence, our communities understand that water services are critical to our economic wellbeing and quality of life.

The advancement of liveability by the water industry is seen as a progression, given the extent of basic services already delivered. The benefits offered by the water industry extend to the enhancement of natural systems, disaster risk management and protection and improvement of public health. However, there remain challenges for furthering the mandate of using water utility services to improve the liveability of our spaces. Hence the need for ongoing research to unlock pathways for improving the liveability outcomes.

Drivers for research in this area include:

- Providing water and land for green infrastructure including green parks, open spaces and corridors to support active, healthy lifestyles.
- Supporting blue infrastructure including clean healthy beaches and waterways with community and ecosystem benefits.
- Supporting cool, healthy environments by using water and greening to reduce heat in the urban landscape and improving air quality.

Research Program Focus Areas

Supporting the Liveable Communities Value Proposition

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
SUPPORTING THE LIVEABLE COMMUNITIES VALUE PROPOSITION Our goal is to support our members' liveability strategies with well researched tools and approaches.	2 **Development of a nationally accepted method for valuing (both quantify and monetisation) the liveability co-benefits associated with various initiatives, such as land management actions that reduce greenhouse gases.**	Opportunity: NaturePositive research for the water industry
		Underway: #4951 – Wetland sediment, recreational activities and environmental and public health outcomes
		Underway: #4548 – Evaluating riparian buffer zones in temperate streams
		Underway: #4549 – The Living Mooraboolo: Evaluating the effects of human-driven change on River
	3 **Enable a better understanding or the science and opportunities for nutrient offsets (as a co-benefit) and how to build regulator acceptance.**	Opportunity: Future Research needs to be explored through a POD Workshop
	3 **How to implement cool parks and their role in future water requirements vs their measurable benefits.**	Opportunity: Future Research needs to be explored through a POD Workshop
	3 **Understanding the implications of making reservoirs accessible to the public, on DW treatment.**	Underway: #1124 – Understanding impacts of recreational access to drinking water catchments and storages in Australia

Workforce Research Program

Building an industry of choice

The water industry has collectively recognised that it takes a multi-pronged approach to create and retain a vibrant workforce. A focused research effort is needed to better understand how worker development, diversity, and safety impact the workplace. To gain increased knowledge about the intricacies of how operational staff remain skilled in the new and emerging tasks of a future-focused, digital utility, whilst also retaining the deep knowledge of practical experiences, remains both a formidable challenge and opportunity.

Drivers for research in this area include:

- Emerging skill gaps in the drive for digital and highly knowledgeable water supply operational experts.
- Loss of institutional knowledge in a transitional workforce.
- Regulatory pressure to ensure that incidents affecting work health and safety or water quality due to operator error are avoided.
- The need for an agile, highly trained and diverse workforce to embrace innovation thinking.
- The opportunity to retain staff in a highly competitive market by providing growth and development opportunities and positive experiences.

Research Program Focus Areas

Enabling the Future Workforce to Succeed

PRIORITY LEVEL 1 HIGH 2 MEDIUM 3 LOW

Research Program Focus Area	Key Priority	Activities
ENABLING THE FUTURE WORKFORCE TO SUCCEED Our goal is to support the water industry with 'personnel and technology – focused' research that assist in creating a vibrant and safe workforce.	1 **Assessing the value of research to ensure evidence-based decision making and realisation of research benefits to enable a positive organisational research culture.**	Underway: #1160 – Value of Research Phase 3. Driving the Value of Research principles from a useful and useable set of products to a 'used' tool
	1 **Creating standardised approaches to training a diverse and often transitional workforce.**	Underway: #1139 – Water Operations Technical Competency Benchmark & Lessons Learned from Experienced Operators
		Opportunity: #3501 – WaterVal - National Water Treatment Validation Framework: Streamlining technology validation (RFF open)