

CSIRO at Waite Campus

CSIRO at Waite Campus, South Australia

At CSIRO, we do the extraordinary every day. We innovate for tomorrow and offer solutions and technologies today – for our customers, all Australians and the world.

Our innovations contribute billions of dollars to the Australian economy every year. As the largest patent holder in the nation, our vast wealth of intellectual property has led to more than 150 spin-off companies.

With more than 5,000 experts and a burning desire to get things done, we are Australia's catalyst for innovation.

CSIRO's research at the Waite Campus provides innovation for Australia's agricultural, environment (land and water) and mineral resources sectors.

Agriculture and Food

CSIRO's agriculture research is the catalyst for agricultural innovation in Australia. Our mission is to create value for our customers through innovation that delivers economic, environmental and social impact.

Integrated agricultural systems

Researchers apply multi-disciplinary expertise to developing highly adoptable farming system solutions to improve performance of a range of crops and mixed farming. This includes increasing water and nutrient-use efficiency and improved soil function through the manipulation of soil biology. Our approach integrates microbiology, spatial analysis, agronomy, plant nutrition and soil science, weed management strategies, systems modelling, economic risk analysis, and socio-economic studies to identify opportunities to accelerate adoption and impact at a national scale (Contact: [Rick Llewellyn](#)).

Research includes:

- Mixed farming and cropping systems: Identifying and developing improved agronomy and land management practices to increase water and nutrient use efficiency in cropping and crop-livestock systems. (Contact: [Therese McBeath](#)).
- Precision viticulture and terroir: Research is focussed on understanding the drivers of terroir at the within-vineyard and -region scales, especially through the use of digital technologies, and developing tools to facilitate spatial analysis in winegrape production systems. (Contact: [Rob Bramley](#)).
- Soil ecology and biological function: Improving performance and sustainability of plant production systems through the management and manipulation of soil microbiological functions. (Contact: [Paul Harvey](#)).

Agriculture and Global Change – Adaptation and Mitigation

Systems modelling approaches to assess and manage climate risk in agriculture, livestock and mixed farming systems at short-term (3-5 days), seasonal (1-3 months) and decadal scales. This research integrates spatial and simulation modelling, climate risk assessments, bio-economic modelling and

participatory rural appraisal. The research is carried out in Australia, India, Sri Lanka and Bangladesh (Contact: [Uday Nidumolu](#)).

Research includes

- Spatio-temporal modelling of heat stress and climate change implications for dairy industry
- Investigating spatial and temporal coherence of frost risk in viticulture and broad acre farming,
- Shifting margins in a changing climate: Analysing the impact of climate change on Australian wheat belt
- Assessing climate risks in small-holder rainfed farming using farmer perceptions, crop calendars and climate analysis
- Linking climate forecasts to rural livelihoods: Mapping decisions, information networks and value chains
- Engaging farmers on climate risk through targeted integration of bioeconomic modelling and seasonal climate forecasts

Wine grapes and Horticulture

Research investigates the form and function of grapevines and selected horticultural crops from the molecular to the whole crop level to enable product differentiation based on meeting the challenges of consistent high quality, environmental production integrity and a competitive price and value proposition relative to competitors. The aim is to provide the knowledge, tools, new scion cultivars and rootstocks and better plant management techniques to equip industry to meet these challenges. (Contact: [Ian Dry](#)).

Research includes:

- Berry development: Using our understanding of grape berry development to tackle issues relating to fruit ripening, harvesting and composition that are important to the grape and wine industries in terms of improving production efficiencies and 'quality'. (Contact: [Chris Davies](#)).
- Disease resistance: World-leading research into molecular and genetic strategies to reduce the susceptibility of wine grapes to major pathogens. (Contact: [Ian Dry](#)).
- Grapevine function: Identifying key genes involved in the regulation of grape secondary metabolites and in grapevine response to water deficit, salinity and heat; for improved grape composition and greater resistance of grapevines to abiotic stresses. (Contact: [Mandy Walker](#)).
- Flavour and aroma: Working with the Australian wine industry to determine the links between grape composition and the volatile compounds and sensory attributes in the resultant wine. The team hosts a suite of powerful analytical instruments designed to quantify a range of metabolites with differing chemical properties. (Contact: [Paul Boss](#)).
- Grape genomics: Using advanced technologies to develop and identify elite grapevine selections with superior agronomic and grape and wine attributes. (Contact: [Mark Thomas](#)).
- Grapevine physiology: Developing knowledge and strategies that enable growers to manage environmental risks whilst improving quality, production and profitability. (Contact: [Everard Edwards](#)).
- Rootstock breeding and meristem function: Developing new grapevine rootstocks that are designed for Australian conditions, focusing on resistance traits to major soil borne pests. The meristem project is focused on sink relations in horticulture tree crops in relation to biennial and irregular bearing. (Contact: [Harley Smith](#)).
- Precision viticulture and terroir: Research is focussed on understanding the drivers of terroir at the within-vineyard and -region scales, especially through the use of digital technologies, and developing tools to facilitate spatial analysis in winegrape production systems. (Contact: [Rob Bramley](#)).

Genomic science for crop performance

The Waite-based contribution to this research group is through the Asexual Seed Formation Team, which is working to isolate genes regulating asexual seed formation in naturally occurring species, with the aim of deploying them in crops in a manner that would enable breeders to choose between sexual and asexual breeding cycles. The development of asexual seed formation as a breeding technology in agronomic crops, where it is absent, would preserve hybrid seed traits in all subsequent generations. (Contact: [Anna Koltunow](#)).

Soil carbon and nutrient cycling

Research focuses on quantifying the stocks, composition and transformation of organic matter in soils and sediments and how they are altered by environmental properties and applied management practices. This is contributing to the improved understanding of organic matter transformations by soil biological processes and the associated drivers, the role of organic matter in improving the productivity and sustainability of Australia's soil resource, simulation modelling of soil carbon dynamics, and Australia's national greenhouse gas inventory and carbon accounting methodologies. (Contact: [Jeff Baldock](#)).

Research includes:

- Soil Organic Matter Characterisation: Using knowledge of the composition and dynamics of soil organic matter to support efficient crop production and to inform management strategies to sustain Australia's soil resource. Research team led by [Lynne Macdonald](#).
- Soil Biogeochemistry : Research focused on deriving an improved understanding of the quantity and form of plant available N and defining drivers of N loss mechanisms including leaching and gaseous emissions, using a range of analytical techniques combined with isotopically labelled materials. Research team led by [Mark Farrell](#).

Land and Water

CSIRO's land and water research provides the science to underpin Australia's economic, social and environmental prosperity. Our research at the Waite Campus focuses on environmental resilience, environmental toxicology, managing terrestrial and aquatic ecosystems, water in the resources sector, economics, productivity and sustainability.

Contaminant biogeochemistry and environmental toxicology, research group led by [Anu Kumar](#)

Aquatic and terrestrial ecosystems are under threat worldwide from contaminants released through human activities such as mining, agriculture, and urban and industrial development. We provide expert advice and leadership on contaminant issues to national and international government agencies. Our research characterises the fate, transport and bioavailability of contaminants in landscapes and water bodies, and measures and predicts their ecotoxicological effects on biota in aquatic and terrestrial ecosystems. Our research addresses the following national issues: (1) supplying adequate water to protect and rehabilitate aquatic ecosystems; (2) ensuring that our soil and water quality is sufficient to maintain the health of our aquatic and terrestrial ecosystems while also meeting the specifications for consumptive water use; and (3) maintaining the integrity and resilience of the nation's water resources while supporting economic and social development. Our objective is to lead the incorporation of state of the art tools and world's best practices within Australia's soil and water quality management frameworks that will improve the accuracy of assessments and quality of management decisions. Research includes:

- Environmental toxicology and chemistry: Integrates aspects of environment chemistry and ecotoxicology to determine the fate and risk posed by contaminants in the environment. Research focused on contaminant speciation and bioavailability; sensor/biosensor technologies; aquatic and terrestrial ecotoxicology, mechanistic toxicology; ecogenomics; use of adverse outcome pathway approach for assessing impacts of endocrine active chemicals; mixture toxicity assessment of multiple stressors and their application in guideline framework; resilience, tipping points and recovery of ecosystem ; sustainable irrigation and reuse of wastewaters; development of national soil, sediment and water quality guidelines. The team has impact through government agencies, industry, and community; for example through embodiment of science in regulation, through the mining industries social license to operate, freedom of industry to develop innovative and emerging technologies and companies to manufacture and import/export safe products and goods. (Contact: [Jason Kirby](#)).
- Organic contaminants and risk assessment: Working to better understand and mitigate the ecological risks of emerging contaminants (e.g. nanomaterials, perfluorinated compounds, microplastics) to protect or improve environmental quality. Current research includes understanding and mitigation (through low cost technologies) of ecological risks of pesticides, pharmaceuticals, personal care products, nanomaterials, hydraulic fracturing chemicals, perfluorinated compounds (PFOAs, PFOS) and microplastics. Strong input to industry, regulatory and policy space. (Contact: [Rai Kookana](#)).

Groundwater Quality and Management

Groundwater is an important natural resource throughout much of Australia that provides a secure and highly reliable source of water for urban, rural and remote communities, industry and the environment. Protecting this valuable natural resource requires effective management of both surface and groundwaters.

Our research includes hydrogeology; groundwater resource management; coal seam gas development and evaluation, design and installation of groundwater monitoring networks; and contaminated and environmental hydrogeology.

There has been a strong emphasis on Managed Aquifer Recharge (MAR), which refers to the intentional recharge of water to aquifers for subsequent use or environmental benefit. (Contact: [Joanne Vanderzalm](#)). [Animation on managed aquifer recharge](#)

<https://research.csiro.au/mar/>

Managing water ecosystems

The Waite-based contribution to this research is through the Environmental Water Resources team. The team's research focuses on the assessment of interactions between hydrological and ecological conditions within water resource management across regional and basin scales. Research is applied to analyse and seek solutions for balancing the competing needs of water, considering the protection of ecosystems and their role in achieving broader social and economic benefits. The team has research skills in science integration, spatial analyses, remote sensing, field data collection and systems modelling. The team has been instrumental in developing spatial models of floodplain inundation, wetland connectivity, groundwater dependent ecosystems, floodplain vegetation and flood-dependent habitat distributions. Relationships between aquatic ecology and flow regimes are helping to develop targets for supplying environmental water allocations and developing water sharing plans. The Murray-Darling Basin Sustainable Futures Initiative is also being lead from the Waite Campus (Contact: [Tanya Doody](#)).

Water in the resources sector

Two Waite-based teams contribute to the water in the resources sector research:

- Environmental tracers and applications: The research team uses state-of-the-art techniques to provide advice on a range of groundwater management issues. These include recharge rates recharge mechanisms, flow velocities, flow across geological formations and discharge to water-dependent ecosystems. A current focus is increasing the capacity to measure noble gases in groundwater (helium, neon, argon, krypton, xenon) which are ideal tracers to quantify many of these processes. (Contact: [Dirk Mallants](#)).
- CSIRO's Environmental Tracer Laboratory has been developing new instrumentation and expertise that will allow for the first time in Australia to (i) measure all stable noble gases (He, Ne, Ar, Kr, Xe) in water samples, and (ii) collect and purify samples for radioactive noble gases (argon-39, krypton-81 and krypton-85) and to measure krypton -85 on purified samples. It also operates the only laboratory to measure 222Rn in water samples. (Contact: [Axel Suckow](#)).
- Regional scale groundwater analysis: Research focuses on the sustainable management of groundwater through a comprehensive understanding of regional scale groundwater dynamics and its economic, social and ecologic functions, including interactions with surface water, vegetation and anthropogenic stresses. Current research topics include the regional and continental estimation and simulation of groundwater recharge, the representation of faults and aquitards in regional groundwater models, robust uncertainty analysis of environmental simulators and integrated socio-economic simulation of groundwater use. (Contact: [Russell Crosbie](#)).

Mineral resources

CSIRO's mineral resources works closely with industry partners to deliver innovation to grow Australia's resource base, increase productivity and drive environmental performance. Our research at the Waite Campus focuses on intelligent mining and resource management.

Minesite Environmental Management

This group (including Land and Water staff from Waite Campus – Mark Raven, Sebastien Lamontagne and Anu Kumar) is increasing its engagement in SA through Social Licence to Operate and Minesite Environmental Management (SA Copper and Uranium Strategies and SA DSD/CSIRO demonstration facility for CSIRO solutions and technologies). (Contact: [Jason Kirby](#)).