Australasian Groundwater & Environmental Consultants

Geochemistry and Hydrogeochemistry

Informed decisions through hydrogeochemical investigations

Understanding the chemistry of groundwater and surface water is integral to the viability of your project, helping you predict and manage the potential for environmental harm and the risks this poses. Identifying and analysing the geochemistry in your receiving environment can help you accurately distinguish whether hydrochemical conditions are naturally occurring or caused by an activity at your site.

Hydrogeochemistry issues influencing water quality and management have far-reaching implications for your project, spanning both operational and compliance constraints from pre-feasibility to post-closure.

About us

We're Australia's groundwater specialists, providing groundwater and environmental advisory across Australasia for more than 25 years. We have a depth of experience and technical excellence borne out of more than 2,500 projects across major industries, agriculture, government and communities in Australasia and beyond.

We specialise in end-to-end groundwater and environmental services, from field work and modelling to analysis and reporting, to expert advisory and peer review.

That means we understand the commercial, environmental, government and community challenges you face when you need to determine how groundwater might be impacting your project, or how your operation might be impacting the environment in which you're working.

Our expertise

At AGE, we do not simply describe water quality characteristics, we interpret them. This is what provides valuable insight into the processes occurring in situ. Through our multidisciplinary approach, we determine the provenance of water samples based on observations of site flow dynamics and water quality. Our integrated analysis of water and soil/sediment geochemistry can also inform you about whether the system has a natural capacity to attenuate, focusing on specific water quality characteristics.

Our depth of experience and knowledge of groundwater and hydrogeochemistry means we're able to identify and quantify the real risks of impacts to your project and recommend practical management strategies for your site.

Our services

We provide support through detailed investigations and quantitative evidence for any regulatory challenges and conditions, from determining environmental impact to informing a legal challenge, or determining the source of a water seep or leak.

Mining and metals

- Water quality modeling (e.g. WRD, TSF, pit lakes)
- Mine waste material characterisation (geochemistry)
- Mine drainage or seepage modelling (physical and geochemical)
- Contaminant modelling and assessments
- Isotopic age dating and isotopic tracer studies to determine solute and water provenance, flow paths, and timelines
- Approvals (e.g. amendment applications and EIS)

Industry and energy

- Geochemical studies for approvals and waste management
- Geochemical reaction modelling (e.g. underground injection schemes)
- Solute transport modelling
- Compliance reporting and investigations (e.g. surface water or groundwater exceedance events)
- Legacy contamination characterisation and management
- Routine surface water and groundwater monitoring and reporting
- Identify risks to infrastructure from geochemical reactions, such as scaling and corrosion

Oil and gas

- Modelling water chemistry, porosity and permeability during aquifer injection
- Groundwater compliance investigations
- Seepage modelling (e.g. water storage dams)

Government

- Contaminant transport in soils and groundwater
- Design of remediation programs (passive and active)
- Third party technical review of environmental management systems.
- Contaminant source investigations
- Natural attenuation studies

Agriculture and water resource management

- Water source suitability assessments for beneficial use
- Managed aquifer recharge (water injection, storage and recovery) feasibility
- Infrastructure scaling biological fouling and corrosion risk assessments
- Design and supervise physical and chemical rehabilitation procedures for wells
- Salt balances and solute transport modelling (including saline intrusion assessment)

Our experience

Cutting edge geochemical modelling delivering key insights

We offer several approaches to solute modelling including one-dimensional (1D) transport modelling, complex aqueous modelling in PHREEQC and Geochemist's Workbench (GWB), solute transport modelling in MODFLOW, and reactive transport modelling using coupled models.

Our breadth of skills in geochemical and solute modelling enables us to recommend the right method for your problem, data or budget. We have experience in everything from predicting PFAS migration to tracking the transport of groundwater contaminant plumes and simulating the geochemical reactions of injected brine with groundwater. Our modelling is solutions-focused, and we aim to provide technically sound outputs that support your decisions, be they operational or in response to regulations.

Importantly, our geochemists and hydrogeochemists have higher degrees in their chosen fields and their specialised knowledge underpins each step of the project, from scoping to recommendations. We often design field programs to collect the data needed for geochemical or solute modelling. Once we obtain the findings from our investigations, we present the outcomes to you personally, explaining the implications of our work without all the jargon.

Engagement with regulators

We have a reputation for effective engagement with regulators through our incremental approach, managing risk as we progress. We present comprehensive data and clear evidence uncovered in our detailed investigations to ensure you and the regulator are well informed of the groundwater impacts, the implications and the appropriate solutions.

We provide expert, independent and impartial advice, detailing the potential risks clearly and in a language easily understood by your key stakeholders. We leverage our scientific expertise and existing relationships to ensure an informed decision and assist with your regulator consultations.

We support you through regulatory compliance, identify potential environmental harm, and help you focus on solutions.

Our projects

Our expertise in hydrogeochemistry has provided clients with a greater understanding of geochemical reactions occurring in their environment and the potential impacts of surface water, groundwater, and waste matters across a range of different projects. Here are some recent highlights:

Army Aviation Centre Oakey

Oakey, Queensland

Conducted contaminant transport modelling in MODFLOW USG following historical use of firefighting foams containing PFOS and PFOA at the nearby Army Aviation Centre, to understand the fate of the plume in the short and long term. Modelling was used as evidence in the Class Action against Defence (subsequently settled), with the team later engaged as expert witness in the Class Action. This involved further model development, analysis and preparation of expert reports.

Liontown Project acid drainage assessment

North Queensland

Completed Underground Water Impact Report (UWIR) for the Liontown Project and integrated geochemical characterisation into the risk assessment for a void at a metalliferous site. Assessment included development of custom methods of geochemical evaluation to understand short-term and long- term risks of acid and/or metalliferous drainage.

Kone cyanide modelling of process water

Ivory Coast, West Africa

Geochemical reaction modelling of cyanide degradation in tailings process waters incorporating the kinetics of degradation. Subsequently conducted modelling of disposal of the tailings and associated process water by simulating the mixing between it and the void lake water (sourced from groundwater discharge and rainfall runoff).

Monakoff Mine open pit geochemical stability analysis

Cloncurry, Queensland

Geochemical reaction modelling using the numerical modelling code, Geochemists' Workbench. Predicted possible concentrations of particular solutes in pore water in the void after backfilling with waste materials and assessed geochemical stability of pit fill material. Developed worst and best-case scenarios for retention of heavy metals in the backfilled pit under different redox scenarios.

Wallarah 2 Coal Project

Central Coast, New South Wales

Groundwater sampling and reporting, including dating groundwater using the radiocarbon (14C) method. Dating developed a conceptual hydrogeologic model of the groundwater system, demonstrating interactions between different groundwater-hosting layers, and limitations on inter-aquifer flow for some layers. Documented geochemical evidence of redox processes (e.g. sulfate reduction or methane oxidation).

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In my experience with AGE, we always get an excellent quality deliverable and sound advice. The benefit of this is increased by the fact that I don't need to spend a lot of time managing AGE's progress. I have been pleased with the outcomes of projects we have conducted together because they provide insights that are based on observations, site data and robust science, not just experience or inferences.

AGE responds to my input and works well collaboratively, but I also like that they don't rely solely on my opinion for conducting their work. I find they will often come up with novel methods, interesting ways of presenting data, or conclusions that we haven't considered yet, and this adds value to our projects. Ultimately, AGE are helping us discover new information about our sites, and we use that knowledge to adapt our management strategies.

Rodrigo Correa | Mount Isa Mines, Glencore

Our team

Andrew Durick

Director | Senior Principal - Groundwater Modeller

Andrew has over 25 years' experience in groundwater modelling with intimate working knowledge of MODFLOW (industry standard modelling code) and significant experience in both the public and private sectors. He specialises in conceptualisation and modelling of complex groundwater systems, implementation of complex mine plans and third- party review of models. Andrew has undertaken 3D solute transport modelling in a range of environments throughout the world and for various objectives. Amongst this experience he has simulated sulfate plume development from a tailings dam to determine the effectiveness of the pumpback system for a mine site in the Andes (Argentina). He has also simulated the movement of PFAS (PFOS, PFHxS, and PFOA) in Oakey (QLD) for the purposes of answering questions around for the class action against Department of Defence.

Dr Angela Bush

Principal Hydrogeologist

Angela specialises in integrated groundwater assessments, contaminant investigations and geochemical analyses, with more than 15 years' experience in consulting, research, and education. One of her strengths is underpinning groundwater quality and contamination assessments with an understanding of groundwater evolution mechanisms. With detailed knowledge of groundwater systems in various settings, specifically focussing on fractured rock groundwater flow systems of North Queensland, she has supported clients across metalliferous and coal mines, industrial operations, unconventional gas projects, state and federal governments, and agriculture bodies.

Dr Tariq Lattoe

Principal Hydrogeologist

Tariq has 14 years of combined industry and academic experience as a hydrogeologist specializing in groundwater modelling. His project experience is diverse comprising GDE impact assessments; resource characterization; dewatering/ injection optimisation; capture zone delineation; managed aquifer recharge operation; and seawater intrusion threat analysis across mining and agriculture sectors. Notable project work includes developing groundwater models for some of Australia's nationally recognized Major Projects including Gudai-Darri Iron Ore Mine and the Ammaroo Phosphate Project. Tariq is well versed in the applied use of use of statistical, analytical, analytical element and numerical methods in hydrogeology. This includes simulation of solute, heat and reactive transport under saturated, variably saturated and variable density conditions.

Matteo Francesconi

Principal Hydrogeologist

Matteo joined AGE in January 2023 after working for four years as a Senior Hydrogeologist / Project Manager for AECOM (Milan office, Italy). He has worked mainly in the remediation sector, dealing with a variety of tasks (hydrogeological test interpretation, conceptual modelling, groundwater flow and transport modelling, etc.) for national and international projects mainly related to large contaminated sites (Oil & gas sector, pharmaceutical sector, etc.). Along with the technical tasks his role also involved the management of small-mid size environmental projects from the proposal to the delivery/closure phase.

We empower informed water decisions that help our clients, communities and environment thrive.

If you're looking for an expert fieldwork partner to deliver the robust results you're looking for, get in touch with us.

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