



Acid and Metalliferous Drainage (AMD) Characterisation and Management

Earth Systems has specialist expertise in environmental geochemistry and is an industry leader in acid and metalliferous drainage/acid rock drainage (AMD/ARD) characterisation and the development of innovative and cost-effective AMD management and treatment strategies for mining operations in all stages of development, from planning through to closure and beyond.

From identification and characterisation through to prediction, prevention, control and treatment, Earth Systems is a global leader on AMD issues and has been providing cost-effective site-specific solutions for the mining industry for over 20 years. This expertise is recognised by Earth Systems' lead author role in the preparation of the Australian government's leading practice *Managing AMD* guide for the mining industry.

SERVICES PROVIDED

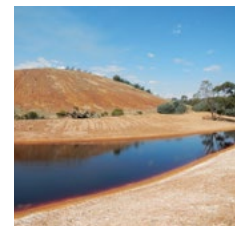
Earth Systems provides specialist expertise in all aspects of AMD management throughout the entire life cycle of a mine's development, from exploration and prefeasibility, through to development and mining, closure and rehabilitation and beyond, with an emphasis on integrating AMD management with mine planning and operations to minimise operational and post-closure AMD risk. Key and specialist AMD services include:

- AMD audits, including AMD risk assessment and management system audits throughout all phases of project development.
- AMD baseline surveys and impact assessments.
- Assessment of AMD potential and development of comprehensive site-specific management and monitoring plans that can be integrated with existing mine planning.
- Mine material characterisation: geochemical characterisation, static geochemical parameters, advanced AMD risk classification.
- Advanced, rapid kinetic geochemical testwork using Earth Systems' *OxCon* oxygen consumption test and oxygen penetration test (OPT), as well as standard column leach and humidity cell tests for the prediction of annual acidity generation rates and optimisation of waste storage strategies.
- Waste rock pile construction design and management including waste segregation, selective placement, encapsulation, blending, interlayering and cover systems.
- Water quality assessment and monitoring: sampling protocols, total acidity and acidity load assessment, analytical data assessment and calculation of treatment reagent requirements.

- Modelling and assessment of AMD potential including site water balances, acidity/contaminant load balances, pit lake modelling and geochemical equilibrium modelling.
- Mine waste management including tailings storage facility design, management and decommission planning, assessment of in-pit and mine backfill tailings disposal and storage options.
- Mine block modelling for AMD risk evaluation and scheduling of different waste rock categories.
- Site-specific AMD minimisation and treatment, both active and passive, including contract treatment for pit lakes and other water storages for risk mitigation, re-use and emergency discharge.
- Development of site rehabilitation and closure plans, incorporating long-term AMD management and prevention strategies.
- Leading-practice environmental training workshops for regulators, managers, supervisors and operators on AMD issues.

PROJECT EXPERIENCE

- Senior authors of the Leading Practice Handbook, *Managing AMD*, for the Australian Federal Government.
- Identification, characterisation, prediction, modelling, management and treatment of AMD at sites throughout Australia, China, Indonesia, Kyrgyzstan, Laos, Mali, New Zealand, Papua New Guinea, Peru, Senegal, Solomon Islands, South Africa, Tanzania, Guinea, Thailand, the United States and Vietnam, for coal, gold, silver, copper, lead, zinc, uranium, tin, iron ore, diamond, mineral sands and pyrite mines in all phases of project development – exploration, feasibility, impact assessment, construction, operations and post-closure.
- Provision of AMD characterisation and management services to various government departments and authorities to assist with the management of both decommissioned mine sites and AMD associated with acid sulfate soils.
- Development of innovative, cost-effective technologies for preventing and minimising AMD from underground mines, tailings and waste rock (eg. GaRDS, NBT, AcidBLOCK).



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