

CAPABILITY STATEMENT

MINING AND EXTRACTIVE INDUSTRIES



C&R CONSULTING PTY LTD





COMPANY BACKGROUND

C&R Consulting Pty Ltd is a Townsville-based, owned, and managed, specialist Environmental Consulting Company that has a well-earned reputation for delivering cost effective solutions to complex environmental problems. This problem solving expertise has been sought by large international and national companies, as well as by Government Agencies and Institutions and Private Industry

C&R Consulting has become renowned for its ability to assess, evaluate and interpret environmental, geochemical and mineralogical analytical data. C&R recognise that the correct advice, acquired at the preliminary stage of any project, reduces the potential for unexpected problems during both the development and operational period of a project.

Starting out as a two person business, it has expanded to over 16 staff with offices in Townsville, Perth, Emerald, and shortly in London to expressly service the oil and gas industries and to establish a Tropical Extreme Event Centre. This has enabled us to attract extremely experienced and qualified people from around Australia.

C&R Consulting skills encompass **Everything Environmental**, with our services including;

- **Geological** Field mapping & Drill logging, Structural Analysis, Petrography, Mineralogy and Rock Strength.
- **Hydrology** Flooding, Groundwater Dewatering and Contamination, Water Balance.
- **Chemical** Hydrogeology / Hydro-geochemistry, Acid Rock Drainage, Geochemical modelling of spoil, co-disposal systems, seepage.
- **Ecological** Terrestrial Ecological Surveys and Aquatic Surveys, Ecotoxicology, Macroinvertebrate Monitoring, Rehabilitation Design, Rehabilitation Monitoring.
- **Geomorphology** Landscape Analysis, River Channel Stability, River and Creek Diversions, Soil Erosion and Sediment Control, Sediment Transport Modelling.
- **Soils** Acid Sulphate, Land suitability Classification, Soil Conservation, Contamination Remediation, Rehabilitation Design Criteria.

C&R can provide a full project team or offer individual specialists depending upon client and project requirements. The majority of our staff members have managed environmental projects or have undertaken specialist investigations within the Mining and Extractive Industry Sector.

Many of these projects have been long term, spanning approval and licensing stages, through operational phases, including monitoring and compliance reporting, to rehabilitation and final closure. As such C&R understand the life of mine requirements for a wide array of resource projects. The types of Mining and extraction and processing projects that C&R Consulting has experience in resources extraction and processing include:

- **Metalliferous -** Gold, Magnetite, Nickel, Uranium, Tin, Copper, Zinc & Tungsten;
- **Coal, Oil & Gas -** Including Coal Seam Gasification;
- **Bulk Industrial -** Bauxite [Aluminium], Iron Ore [Hematite & Magnetite; Lateritic Nickel, Manganese (Groote Eylandt) & Phosphorite;
- **Industrial -** Sand, Gravel, Rock, Aggregate, Limestone & Kaolinite; and
- **Gemstone Mining**





OUR PEOPLE

<u>Staff member</u>	<u>Position</u>	<u>Specialties</u>
Directors / Principal Scientists		
Dr. Christopher Cuff	Chemical Mineralogist / Hydro-geochemist / Contaminated Site Assessor	Clay-water interactions / Spectral analyses / Hydrological and geochemical modelling / Contaminated water and soil remediation / Acid rock leaching / Groundwater movement
Dr. Cecily Rasmussen	Geomorphologist / Hydro-geomorphologist	Assessing how coastal, marine, environmental and tropical process impact geomorphology / Palaeo-geomorphology
Senior Scientists		
Dr. Iain Faichney	Geologist / Geomorphologist / GIS Specialist	Carbonate and siliclastic depositional systems analysis / GIS
Mr. Geoffrey Kavanagh	Senior Environmental Manager (Emerald Office)	Water allocation for irrigation and mining / Flood modelling and assessment / Mine compliance assessor / Groundwater and surface water monitoring
Mr. Stephen Wegner	Geologist / Petrographer	Field geology / Hydrogeology / Geochemistry / Petrography
Mr. Ben Cuff	Botanist / Soil Scientist (Pedologist) / GIS Specialist / Accredited Regional Ecosystem Assessor	Environmental systems analysis / Contaminated soils assessment / Flora and fauna assessments / Ecology / GIS
Mr. Reece Fraser	Environmental Scientist / Licensing and compliance Specialist / GIS Specialist / Fluvial Geomorphologist	Environmental management / Mine compliance assessor / Acid Sulphate Soils (ASS) assessments / River and coastal geomorphology / GIS
Mr. Matt Knott	Environmental Scientist / Aquatic Ecologist	Environmental analysis / Marine and freshwater ecology / Electrofishing / Macroinvertebrate assessment using AusRivas methodology
Mr. Jon Rasmussen	Surveyor	GRV Mapping / Surveying





Staff member

Position

Specialties

Technical Staff

Ms. Kirra Alexander

Environmental Technician

Environmental sampling and monitoring

Mr. Sam Gillespie

Environmental Modelling

Geochemical and hydrological modelling

Support Staff

**Ms. Jennifer
Rasmussen**

Executive Officer / Finance and
Marketing Manager

QA/QC / Officer management / Finance /
Marketing

Mr. Glen Deuble

Administrative Officer (Perth
Office)

Business Development / QA/QC

Ms. Alissa Oats

Administrative Officer

Reception / Administration



OUR EXPERTISE



- Due diligence investigations for environmental authorities and tenement applications
- Resource assessment investigations
- Environmental Impact Assessments (EIAs), Plan of Operations, REMPs, EM Plans, Mine Closure Plans
- River and sediment behaviour and hydraulic modelling
- Terrestrial flora investigations, Rehab monitoring
- Groundwater baseline studies including movement, contamination assessments and monitoring
- Soil investigations for Land Suitability Classification, ASS/PASS or land contamination
- Clay mineralogical dispersive and erodible clay analyses ground strength
- Aquatic ecology, both marine and freshwater including Macroinvertebrate sampling (AusRivas), fish surveys and in-stream health assessments and coral assessments
- Statistical and empirical assessment of storms, flooding, high wall stability and stockpiles
- Chemical interactions analysis for acid mine issues, (including solutions to leachate runoff), and groundwater
- Surface and groundwater quality assessments and monitoring and compliance reporting
- Reactive contaminate transport, geochemical modelling
- Stormwater and other drainage analysis
- Water balance calculations and water management
- Wastewater assessments and treatments designs
- Preparation of environmental and operational management plans and Environmental Management Systems (EMSs)
- Predictive modelling of the potential impacts of extreme weather events
- Geological and geochemical studies
- Construction materials evaluation and clay-related rock wall stability analysis
- Mapping using Geographical Information Systems (GIS) and GRV Mapping
- Provision of expert witness services in mineral/water interactions and hydro-geochemistry





MINING AND EXTRACTIVE INDUSTRY PROJECT EXAMPLES

Atlas Mine

The Atlas Mine project involved an environmental assessment of the hydrological and hydrogeochemical properties of mine waste rock dumps present on the site to provide solutions for the remediation and rehabilitation of the mine site and associated river and marine systems following severe erosion associated with an extreme rainfall event. Tailings and dam collapse caused approximately half a billion m³ of highly acidic (pH approximately 3.0) and metals-rich mine affected water to be discharged directly into the Marine Protected Area of the Tanon Straits.

Located in the Philippines, the Atlas mine (several large open pits) was one of the world's largest copper mines. During operations over 1 billion m³ of mine waste was discharged into the marine environment with another 1 billion m³ stored on the site in hundreds of small rock dumps. This mine waste material was highly acidic containing 5-10% pyrite.



The investigation included mine-pit sediment investigations and leaching experiments on rock dumps. As a result of these investigations a low cost simple technology remediation strategy using local materials to process contaminated mine waters and sediments was devised and implemented for the site. This was achieved by the construction of a clay barrier using large quantities of poor quality local bentonitic clay and limestone material.



The barrier was constructed using local labour, which provided employment for the local indigenous population who had subsequently been left unemployed after the abandonment of the copper mine.

The result was the successful treatment of the water, improving pH values from 3 prior to passage over the clay bed, to approximately pH 7.5 at exit.

The project involved liaison with local government authorities (Philippines), local industry and the community in the assessment and remediation of the Atlas Mines.

The highly successful rehabilitation solution used low cost technology, local material, and local labour.





Central Queensland Mines

C&R have been commissioned by several other mining companies throughout Central Queensland to perform a wide range of jobs. These include:

- Water Management Plans
- Environmental Management Plans
- Mine water discharge assessment
- Water dilution / flow modelling
- Aquatic fauna assessment
- Ecotoxicology assessment
- Fish and macroinvertebrate species identification
- Study of suitability of tailings dam water used for irrigation
- Regional Ecosystem assessment

Some of these companies include VALE Australia, Hancock Coal, Ensham Resources, Krucible Metals, Incitec Pivot and BHP Billiton. Further discussion on certain projects is provided below.

VALE Australia

C&R were commissioned by Vale Australia to provide expert environmental consulting advice for Carborough Downs, Broadlea and Ellensfield Coal mine sites in the following:

- Onsite expert environmental consulting advice
- Completion of a Residual Void Study
- Geochemical modelling of runoff from the walls of a co-disposal facility
- Development of Rehabilitation Success Criteria
- Creation of a Water Management Plan
- For submission to DERM, preparation of:
 - Waste Management Plan
 - Water Management Plan
 - Weed Management Plan
 - Soil Management Plan
 - Plan of Operations
 - REMP
 - Transitional Environmental Program





Hancock Coal

C&R were commissioned by Hancock Coal to determine flood mitigation measures necessary for a proposed mine site within Central Queensland. This involved high level flow modelling of both surface and ground waters for numerous tributaries closing the proposed site. The results were used by engineers to design the appropriate flood mitigation measures for road, rail and mine operations. This study included:

- Risk analysis of proposed mine sites in flood plain areas
- Interpretation of existing, current and projected rain fall & water flow
- Ground and surface water modelling
- Gap analysis from previous reports
- Technical advise on proposed pit wall locations, height, thickness and compound

Department of Environment and Resource Management

Dr Chris Cuff is a member of the Independent Scientific Panel charged with the assessment of Underground Coal Gasification burns in Queensland. As a result of this involvement, a considerable expertise has grown within C&R Consulting associated with the design of exploration and hydrological assessment programmes throughout Australia.

Ben Lomond Project - Mega Uranium

C&R performed a detailed environmental impact assessment on a uranium mine site. This investigation was part of a feasibility study to re-open the mine. C&R commenced the collation of geological, mineralogical and hydrological data and assisted the client additionally with geological exploration input. The project also included:

- Baseline ecological surveys and assessments and geological evaluations (including petrographic examinations) to determine background information of factors likely to impact on or be impacted by the development of the mine
- Aquatic ecology using electrofishing techniques, mega fauna and flora identification procedures, and frog call identification techniques
- In-field flora evaluations using line transects and targeted sampling of specific areas
- GIS mapping of all sampling locations and results.





Phosphate Hill (Incitec Pivot)

C&R Consulting are undertaking ongoing projects with Phosphate Hill Mine (North West QLD) including:

- environmentally sound disposal options for beneficiation waste;
- geochemical modelling of groundwater contamination;
- liaison with state environmental protection agencies
- district scale groundwater investigations and
- geological and mineralogical analysis of failing airstrip pavement materials



Krucible Metals

C&R Consulting Pty Ltd (C&R) was commissioned by Krucible Metals Ltd to undertake a preliminary environmental investigation for the proposed PHM South Phosphate Project, northern Queensland. The investigations have included full Vertebrate Fauna studies, Surface Water Quality sampling for baseline studies and Groundwater investigations. The study demonstrates C&R Consulting's wide range of environmental services, which include:

- A baseline investigation for flora and fauna across the site.
- A preliminary investigation into water quality / in-stream sediments currently draining the site.
- The establishment of dust monitoring sites across the area, with a preliminary evaluation of the dust particles to establish base line data prior to mine production.





Department of Natural Resources & Mines, Charters Towers

Assessment and reporting of metals mobility in a spoil site, in a development located adjacent to an environmentally sensitive RAMSAR listed wetland. This required treatment options of the effluent stream from the proposed plant to be developed to meet stringent legislative requirements. The study consisted of:

- Investigations of contaminant runoff from spoil sites
- Estimation of metal contaminants going initially to the Burdekin River and then to the Burdekin Dam
- The development of solutions, a monitoring program and pre-determined trigger levels of contaminants within the system

Olympic Dam (BHP Billiton)

Detailed chemical investigation and chemical modelling were undertaken on both the pit lake and the waste dumps at Olympic Dam Mine. Chemical modelling of the lake evolution over the next approximately 300 years were undertaken as was reaction / contaminant pull modelling of the waste dumps. Such modelling was undertaken using Geochemists Work Bench (Professional) (GWB), with the results permitting long term management strategies to be evaluated and modified.

Queensland Nickel (QNI: BHP)

C&R were commissioned to perform a gaps analysis of the company's data base prior to the development of a detailed holistic analysis, interpretation and understanding of bore field sustainability.

Assessment of the impact of large scale industrial sand and water extraction, rural residential subdivision, and natural geomorphic processes, on the ecological and environmental sustainability of the Black River bore fields. This involved determining the sustainable yield of the aquifer that services rural residential properties, Yabulu Refinery and base flow requirements of the Black River channel.

Environmental management risks were assessed and variable temporal remediation programmes indicated. Climate change impact was also evaluated and assessed.





COMPETITIVE ADVANTAGE

- Dr Chris Cuff is a member of DEEDI's Expert Panel for Underground Coal Gasification. He is also registered with DERM to sign-off on contaminated sites in Queensland.
- Ability to assess and evaluate all options, including the 'simple' low-technology, low-cost option that is so easily overlooked and may be critically important to local community involvement and acceptance, particularly in third world countries.
- C&R has a comprehensive understanding of ecosystems and their interactions, which can only be gained through many years of lecturing, researching, and working in the environment.
- Close consultation with all stakeholders so that beneficial solutions are maximised in local and regional contexts.
- Thorough understanding of environmental legislation and guidelines, leads to practical and workable solutions that are ultimately the most cost effective option.





HOW OUR PRODUCT FITS INTO THE GLOBAL MARKET

- Experience in providing solutions to environmental problems based on many years appreciation of the vagaries of the tropical climate.
- Experienced in assessing normal responses of environmental systems to frequently occurring events.
- Assessing responses as a result of extreme climatic events (e.g. cyclones and high intensity rainfall events). These, although of only short duration, may be the dominant factors in determining environmental responses.
- Understanding modifications necessary to standards in tropical areas.
- An acute awareness of how these factors may vary in global warming contexts.
- Familiarity with working in overseas countries where cultures and customs are different to those in Australia.
- Appreciation that cultural sensitivity is often a prime prerequisite for successful interaction within these areas.



CONTACT DETAILS



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