CAPABILITY STATEMENT

MINING AND EXTRACTIVE INDUSTRIES

C&R CONSULTING

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COMPANY BACKGROUND

C&R Consulting Pty Ltd is a Townsville-based, owned, and managed, specialist Environmental Consulting Company established in 2003 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 Government Agencies, NRM Groups 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.

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 and Aquatic Ecological 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. All of our senior 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 (extraction and processing) projects that C&R Consulting has experience in include:

- **Metalliferous -** Gold, Magnetite, Nickel, Uranium, Tin, Copper, Zinc & Tungsten.
- **Coal, Oil & Gas -** Open cut, underground, CSG, UCG, Offshore Oil & Shale Oil.
- **Bulk Industrial -** Bauxite [Aluminium], Iron Ore [Hematite & Magnetite; Lateritic Nickel, Manganese (Groote Eylandt) & Phosphate.
- **Industrial -** Sand, Gravel, Rock, Aggregate, Limestone & Kaolinite.
- **Gemstone Mining**

OUR PEOPLE

Staff member	Position	Specialties
Directors / Principal Scientists		
Dr. Christopher Cuff	Chemical Mineralogist / 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	Fluvial and Coastal Geomorphologist	Assessing how coastal, marine, environmental and tropical process impact geomorphology / Palaeo-geomorphology
Senior Scientists		
Dr. Jasmine Jaffres	Numerical Analyst / Modeller / Oceanographer	Modelling various physical (flooding), chemical and ecological systems / Scripting / High-end statistical analysis
Mr. Ben Cuff	Botanist / Soils	Environmental systems analysis / Contaminated soils assessment / Flora and fauna assessments / Rehabilitation inspection and design / GIS
Mr. Matt Knott	Environmental Scientist / Aquatic Ecologist	Environmental analysis / Marine and freshwater ecology / Electrofishing / Macroinvertebrate assessment using AusRivas methodology / Approvals
Ms. Sian Kennare	Mining Environmental Scientist / Groundwater hydrology	Coal mine environmental management / GIS / MODFLOW / Groundwater pumping and network design
Scientists		
Mr. Dean Buchanan	Environmental Scientist	Freshwater Ecology / Contaminated Land Investigations / Groundwater Monitoring / Water and Wastewater Treatment / Remote Sensing and Datalogging
Technicians		
Ms. Julia Routh	Environmental Technician	Field Sampling Techniques / Laboratory Management / Data Collation

OUR SERVICES

Approvals

- EA Applications and Amendments
- Transitional Environmental Programs (TEPs)
- EM Plans/Site Specific Application Documents
- Plan of Operations, Financial Assurance and Compliance Statements
- Specialist EIS Studies

Water

- Modelling water quality mixing
- Release rate calculation and amendment
- REMP development, amendment and assessment
- Water balances
- Water Management Plans
- Water quality assessment
- Groundwater pumping and sampling
- Routine water quality monitoring (environmental and potable)
- Flood assessments and reviews
- Hydraulic design
- Groundwater monitoring bore network review and design
- Groundwater contaminant modelling and plume migration
- Annual assessment/review of groundwater chemistry and level data
- Runoff quality predictions
- Irrigation and water disposal/treatment
- Forensic pit flood investigations

General Environmental Services

- Compliance audits
- Contract Environmental Officers
- Environmental database management
- General environmental sampling

Land / Geology

- Grounded and logical Rehabilitation Completion Criteria
- Rehabilitation Management Plans
- Rehabilitation Design
- Rehabilitation inspections
- Soil and Land Suitability Assessments
- Erosion susceptibility
- Erosion and Sediment Control Plans
- Soil loss modelling and measurement
- Residual Void Studies
- Mine Closure Plans
- Acid Metalliferous/Mine Drainage (AMD)
- Petrographic assessment
- Overburden and reject characterisation
- Contaminated land assessment and remediation
- Subsidence Management Plans and geomorphic assessment
- Field geological and stratigraphic expertise
- Mineralogical services (XRD/XRF interpretation)
- Clay evaluation for geotechnical concerns

Biodiversity

- Vegetation mapping and ground-truthing
- Vegetation health assessments
- Aquatic and marine ecology assessments
- Electrofishing
- Biological indicator impact assessments

Other Services

- Underground Coal Gasification (UCG) site selection and assessment
- Specialist Coal Seam Gas (CSG) advice and troubleshooting

C&R

PROJECT EXAMPLES

2008 Central Queensland Flooding Investigations

One of the highest profile projects undertaken by C&R Consulting was a forensic flooding, engineering, geological and geomorphological investigation of the 2008 flood event in Central Queensland.

C&R conducted a major investigation into the timing and magnitude of rainfall throughout the Nogoa Catchment to derive the volume, velocity, height, timing and duration of waters moving through the catchment. The investigation highlighted major flaws in the application of standard rainfall-runoff processes in determining water movement though a multiple feed catchment in the seasonally arid tropics. These flaws had major implications for the immunity of flooding to the stability of levees.

The investigation focused on the characteristics of rainfall in the seasonally arid tropics where the timing, intensity, duration and periodicity of rainfall are notoriously erratic. The investigation noted the restrictions imposed by the need to create 1 in 100 year predictions of these same parameters based on models limited to the use of 'hard' data taken from gauging stations constrained by minimal data at minimal locations.

The standard mathematical distributions recommended for use in Australia were unable to reflect the actual events of the Seasonally Arid Tropics, and produced large, unacceptable uncertainties that underestimated the magnitude and timing of stream flows following intense rainfall throughout the region.

Helicopter based Geo-Referenced Video Mapping (GRV) was used as part of this investigation only days following the peak of the flood event over the majority of the Nogoa catchment. GRV mapping is a technology developed jointly by C&R Consulting and AME Surveys which allows video footage to be located spatially. This technique proved invaluable to verify and assess readings from flood gauges.

Geological engineering and stability properties of expansive and dispersive clays of the Central Queensland were tested for periods of immersion between 7 to 10 days. In general any extended period of inundation has the potential to cause significant weakening of the common clay rich materials typical of Western Queensland.

A similar critique of current rainfall and runoff procedures in the Seasonally Arid Tropics as been noted by the Australian Rainfall and Runoff Group (AR&R) in the draft version of their 2014 Australian Rainfall and Runoff Revision. C&R have corresponded with this group relating their findings in the Seasonally Arid Tropics.

Atlas Mine (Philippines)

The Atlas Mine project involved an environmental assessment of the hydrological and geochemical 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 cubic metres 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 m^3 of mine waste was discharged into the marine environment with another 1 billion m^3 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 bentonite 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.

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:

- Contract environmental officer (part time) for 2 years
- Geochemical modelling of runoff from the walls of a tailings dam
- Development of Rehabilitation Success Criteria and subsequent Rehabilitation Inspections
- Creation of Water Management Plans and Water Balances
- Plan of Operations and Financial Assurance Calculations
- Subsidence Management Plan
- Residual Void studies (x2)
- REMPs and REMP Assessments
- Rehabilitation Inspections (numerous)
- Groundwater Investigations and Water Licence Renewals
- Vegetation Mapping and Classification
- Various water management activities (develop ratings curves, water quality assessment, release rate calculations, training)

Venus Phosphate Mine

C&R have been involved with the Venus Phosphate Mine from its inception undertaking the baseline environmental surveys required for the initial Environmental Authority application and developing the overarching Environmental Assessment Report for the Major EA Amendment as well as managing the entire application process to expand operations from a 10,000t test pit to a 600,000tpa operating mine. C&R are currently contracted to maintain all environmental compliance for the site while it is in 'Care and Maintenance', including:

- Monthly groundwater levels and dust monitoring and site inspection;
- Quarterly groundwater quality montioring;
- Development of various environmental management plans including Soil Erosion and Sediment Control Plan, Water Management Plan, Receiving Environment Monitoring Programme, Rehabilitation Management Plan, etc.; and,
- Liaison with the government regarding ongoing environmental concerns.

Hancock Coal

C&R were commissioned by Hancock Coal to evaluate flood mitigation measures necessary for a proposed mine site within Central Queensland. This involved high level flow modelling of both surface and groundwaters for numerous tributaries on 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

DEEDI Independent Scientific Panel on Underground Coal Gasification

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:

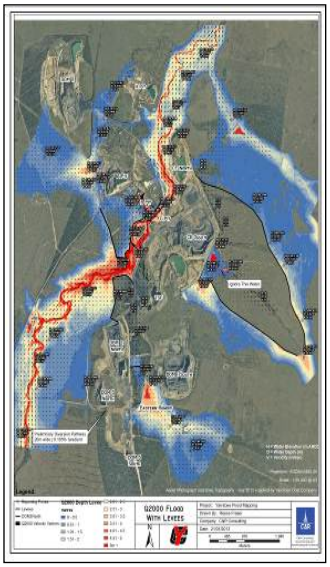
- Baseline ecological surveys and assessments and geological evaluations (including petrographic examinations) to determine background information of factors likely to impact on or be impacted by the development of the mine
- Aquatic ecology using electrofishing techniques, mega fauna and flora identification 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 have been undertaking (and continue to conduct) projects for Incitec Pivot Ltd at Phosphate Hill Mine (North West QLD) for over 7 years, including:

- environmentally sound disposal options for beneficiation waste;
- geochemical modelling of groundwater contamination;
- liaison with state environmental protection agencies;
- district scale groundwater investigations;
- quarterly groundwater monitoring;
- geological and mineralogical analysis of failing airstrip pavement materials; and
- Aquatic ecology assessments of multiple receiving environments across the site.

Yarrabee Coal Mine



C&R Consulting were initially commissioned by the Yarrabee Coal Mine to perform a pre-wet season flooding assessment to ensure that Yarrabee would be able to continue production through the 2011-2012 wet season. C&R Consulting have used their customised rainfall-runoff model for Central Queensland, knowledge of uncertainties surrounding the 100 year ARI rainfall / flood event and two-dimensional modelling (TUFLOW) to quantify the flood level as well as levels associated with uncertainty.

The success of this venture has ensured that C&R's tasks at Yarrabee have expanded to include the preparation of multiple:

- Water balance assessments and Water Management Plans
- REMPs and REMP Assessments
- Rehabilitation Inspections and the development of Rehabilitation Success Criteria

C&R are continually advising Yarrabee regarding on-site environmental issues such as water and vegetation management.

Moranbah South – Hansen Bailey (Anglo American)

C&R undertook a detailed aquatic ecology study, including surface and groundwater fauna, of the proposed coal mine site in Central Queensland. Covering 18,000ha and encompassing four major watercourses and three defined aquifers, the study had to ensure that listed aquatic species known to occur in the catchment were targeted. This involved a diverse array of methods, including:

- Electrofishing (backpack), netting and trapping targeting fish;
- Netting, trapping and visual surveys of turtles;
- Haul netting and sieving of stygofauna in the deeper bores as well as shallow alluvial aquifers;
- AusRivAS sampling of macroinvertebrates;
- Flora coverage transects;
- Water quality assessment;
- Habitat condition assessment; and
- Substrate composition.

The studies identified a diverse aquatic species assemblage occurring across the site including 61 macroinvertebrate families, 13 species of native fish, 1 species of introduced fish, 1 species of turtle, 11 species of aquatic plants and 1 species of stygofauna. This background data was used to determine the environmental values relevant to the aquatic environment within the onsite watercourses. The project was successfully completed in the allocated timeframe and within the defined budget.

Surface and Groundwater Quality Monitoring

C&R Consulting regularly undertake routine monitoring for extractive industries throughout central and northern Queensland. Currently, C&R is undertaking routine monitoring for several mining companies that includes:

- Surface waters;
- Groundwater;
- Potable waters;
- Dust monitoring; and
- Treated effluent.

As well as suitably qualified personnel to undertake the monitoring, C&R provide all the equipment necessary for monitoring watercourses and aquifers alike; including groundwater pumps, compressors, in-situ meters, etc.

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.

Rehabilitation Inspections for various mines

C&R have undertaken numerous Rehabilitation Inspections throughout Central and North Queensland. C&R specialise in providing a rehabilitation inspection method to specifically address completion criteria and provide an insight to what processes are working (and which ones are not) on rehabilitation.

Inspections have been undertaken on rehabilitated spoil dumps, drains, subsided areas above Longwall panels, streams, exploration holes and roads. C&R are adept at determining appropriate 'Success Criteria' for specific regions with the focus on returning the land to pre-mining condition.

Mine Water Management Plans – Various Clients

One of the main areas that C&R Consulting uses their hydrological expertise is the preparation of Water Management Plans & Water Management Plan Reviews for metalliferrous and coal mines.

These plans involve inspection of the site and the development of a comprehensive water balance taking catchment runoff, evaporation, groundwater seepage and pumping into consideration. These water balances are constructed in Goldsim®. Typically a water quality model (using Geochemists Workbench Professional) is also constructed for the mine site so that various water management scenarios (mixing or discharge) can be fully assessed to identify mineralogical components if required. This has been performed at several mines to determine new EA Trigger Investigation Levels based on the quantity of 'free' parameters in the water system instead of including those locked up in stable, colloidal minerals.

Once this baseline has been set up the models are varied with a variety of scenarios to provide the mine site with management scenarios to increase the efficiency of water management. Tailored applications and scenarios are created for each mine-site dependant on site specific circumstances and management objectives.