



# **STATEMENT OF QUALIFICATIONS**

## **for**

# **DECISION ANALYSIS & RISK ASSESSMENT**

## **(Multiple Accounts Analysis & Failure Modes and Effects Analysis)**

### **1.0 Introduction**

This Statement of Qualifications (SOQ) summarizes the specialized services provided by Robertson GeoConsultants Inc. (RGC) in the field of decision analysis (Multiple Accounts Analysis, or MAA) and risk assessment (Failure Modes and Effects Analysis, or FMEA). This SOQ is organized into five sections with an overview of RGC as a company, followed by a presentation of our in-house technical skills, the relevant experience of our personnel and a summary of relevant projects.

### **2.0 Robertson GeoConsultants Inc.**

Robertson GeoConsultants Inc. (<http://www.robertsongeoconsultants.com/>) is an employee-owned consulting firm specializing in geotechnical and environmental engineering for the mining industry. Our firm is based in Vancouver, B.C. and consists of a small team of specialty consultants with expert knowledge in hydrology, hydrogeology, geochemistry, geotechnical engineering and their application to mining. Since incorporation in 1995, we have worked on over 70 projects in 10 countries, including some of the largest mining projects in the world. Our experience, integrity and quality of work is widely recognized in the environmental mining community, as demonstrated by our broad client base which includes many international mining companies and other industries, real estate developers, government regulatory agencies and other consulting firms.

Our international experience has also given us recognition as leading experts in decision analysis and risk assessment. We have developed a decision making tool, tailored to the mining industry, termed the Multiple Accounts Analysis, or MAA, which has been used successfully at a number of mine sites for industry, regulators and public participants. We have also successfully utilized the risk assessment tool termed the Failure Modes and Effects Analysis, or FMEA, in association and separately from the MAA. As a result of our broad technical and global experience, our senior staff now participates in and/or facilitates a number of multi-stakeholder, multi-disciplinary technical working groups tasked with decision and risk analysis.

Robertson GeoConsultants Inc. takes an active role in the advancement of new tools and technologies applied to mining such as the MAA, through on-line course publication on EDUMINE (see the MAA course) and through technological publications and editorship of the ENVIROMINE website.

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### 3.0 Decision Analysis Services

RGC offers a broad range of consulting services related to decision analysis for mining, industrial and municipal properties, including:

- Options or alternatives development;
- Technical evaluation and impact assessment;
- Stakeholder communication and conflict resolution;
- Options or alternatives assessment and ranking through the Multiple Accounts Analysis (MAA); and,
- Cost-benefit analysis.

Robertson GeoConsultants Inc. has developed an expertise in decision analysis and provides a full suite of technical services related to multi-stakeholder, multi-disciplinary decision-making. Our staff is familiar with local and international guidelines and regulations pertaining to mining related impacts (e.g. water quality regulations), and are experienced with public hearings and stakeholder participation/consultation. We believe all stakeholders should play an active role in decision analysis and have developed the MAA such that it results in a clear and transparent evaluation. The MAA provides a platform and communication basis for technical exchange, alternative analysis that provides for the opinions of all stakeholders, and conflict resolution through engagement.

### 4.0 Risk Assessment

RGC also offers consulting services related to risk assessment for mining, industrial and municipal properties, including:

- Environmental impact assessments;
- Environmental liability assessments;
- Failure modes and effects analysis (FMEA); and,
- Risk management

Robertson GeoConsultants Inc. provides risk assessment services primarily through the utilization of the Failure Modes and Effects Analysis (FMEA). Risk assessments are often done in conjunction with decision analysis or alternatives evaluation, therefore the MAA and the FMEA are often done in association. While the MAA is used to evaluate a range of alternatives, the FMEA is utilized to perform a systematic and comprehensive evaluation of potential failure modes of any one design/plan in order to identify the potential hazards. In this manner, RGC provides services that evaluate the potential for failures of the operating or closure plan measures that could result in biological/land use impacts, regulatory impacts/censorship, public concern/image and health and safety impacts. In association with the FMEA, a risk profile is often developed for each of the concern areas identified. Once the failure modes and measures with the highest risk have been identified, RGC is able to provide guidance or assessments for consideration related to mitigation or alternative designs to reduce risks through risk management.

## 5.0 Personnel

This section summarizes our key personnel with experience in decision analysis and risk assessment. Brief descriptions of the key individuals with particular emphasis on each member's experience in these fields are provided below. Detailed resumes for the key project team members can be found on the company website (<http://www.robertsongeoconsultants.com/personnel/personnel.asp>).

Andrew MacG. Robertson, Ph.D., P.Eng.: **Dr. Robertson** has a B.Sc. in Civil Engineering, a Ph.D. in Rock Mechanics, and 30 years of experience in geotechnical and environmental engineering. He was the lead investigator and/or designer for numerous project teams for mining companies and provides review, senior evaluation, and counseling to a number of mining companies, research establishments, professional associations and provincial, state and federal agencies. Dr. Robertson has an international reputation as an environmental and geotechnical consultants and brings to the table extensive hands-on experience from all over the world.

Dr. Robertson is president of Robertson GeoConsultants Inc. He serves as lead investigator in geotechnical studies and most geochemical studies and serves in a review capacity for hydrogeological projects. He was the co-developer of the MAA tool and has utilized the MAA at a number of projects including the Zortman and Landusky mines, the Questa tailings, the Pogo project, the Grasberg mine and the Quelledveco mine.

Shannon Shaw, B.Sc. M.Sc.: **Ms. Shaw** has a B.Sc. in Chemistry and Geological Sciences, a M.Sc. in Geological Sciences and 6 years of consulting experience in geochemical related studies. Her specialization is in the assessment of the geochemical impacts of mining to the surrounding environment, (in particular to surface and groundwater resources) and the development of contaminant control strategies for impacted areas. Ms. Shaw has extensive field and modeling related experience including geochemical speciation and transport modeling for a wide range of projects and has been involved in closure planning for a number of projects. Through the closure planning work, she helped develop the MAA in order to evaluate a range of closure alternatives and has since utilized the MAA, often in association with the FMEA, for a number of projects including the Zortman and Landusky mines, the Prosperity project, the Pogo project and the Grasberg mine.

Ms. Shaw is Principal and Senior Geochemist with Robertson GeoConsultants Inc. and serves as the lead investigator in most ARD & geochemical studies, as well as MAA facilitator for those projects involving alternatives evaluation and multi-stakeholder participation. Her responsibilities include project management, all aspects of geochemical and load balance studies, facilitator and third-party review.

Christoph Wels, Ph.D., M.Sc.: **Dr. Wels** has a M.Sc. in Watershed Hydrology and a Ph.D. in Hydrogeology and has over 15 years of experience in groundwater related studies. He completed his doctorate at the University of British Columbia on the subject of numerical modeling of groundwater flow and solute transport in fractured rock. Dr. Wels has led numerous groundwater investigations and groundwater modeling studies for international and local clients. He is experienced in the use of a wide range of modeling tools ranging from specialized models to simulate contaminant migration, infiltration and percolation in unsaturated soils to simulating complex, regional aquifer systems. Dr. Wels also assists other consulting firms as an advisor and has participated on review boards and carries out peer reviews for hydrogeological projects.

Dr. Wels is Principal and Senior Hydrogeologist with Robertson GeoConsultants Inc.. He serves as lead investigator in most hydrogeological projects and has been extensively involved in both FMEA and MAA evaluations at projects such as the Questa tailings and the Grasberg mine. His responsibilities include project management, supervision of modeling studies and senior review.

In addition to the above listed personnel, Robertson GeoConsultants Inc. often works in close association with a number of specialist consultants when required for specific projects.

## 6.0 Relevant Experience

This section lists several decision and risk assessment projects, which Robertson GeoConsultants Inc. has successfully worked on in recent years. Detailed descriptions of our experience can be found on the company website at the links provided below.

- *Questa Tailings Facility, USA*  
<http://www.robertsongeoconsultants.com/projects/questatails.asp>
- *Zortman and Landusky Mines, USA*  
<http://www.robertsongeoconsultants.com/projects/zortsky.asp>
- *Pogo Project, USA*  
<http://www.robertsongeoconsultants.com/projects/pogo.asp>
- *Prosperity Gold Project, Canada*  
<http://www.robertsongeoconsultants.com/projects/prosp.asp>
- *Grasberg Mine, Indonesia*
- *Quellevaco, Chile*
- *Salar de Punta Negra, Chile*

Throughout the development of the MAA, RGC has published a number of papers and webpages describing the process and some case studies. These are available in pdf format, or on the internet at:

<a href="#">Review of the Multiple Accounts Analysis Alternatives Evaluation Process Completed for the Reclamation of the Zortman and Landusky Mine Sites</a>	2001
<a href="#">Geochemical characterization and water quality predictions for the Zortman / Landusky Reclamation Project</a>	2000
<a href="#">Material Characterization and Prioritization of Remediation Measure at the Zortman/Landusky Mine Sites</a>	2000
<a href="#">Multiple Accounts Analysis for Tailings Site Selection</a>	1999

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<a href="#">Alternatives Analysis for Mine Development and Reclamation</a> <input type="checkbox"/>	1998
<a href="#">Assessment &amp; Management of Risks Relating to Covers for Metal Leaching and ARD Mitigation</a> <input type="checkbox"/>	1998
<a href="#">Site Selection and Design Options for Uranium Mine Waste and Plant Tailings</a> <input type="checkbox"/>	1982

Additional information can be found on the ENVIROMINE website ([www.enviromine.com](http://www.enviromine.com)) and through the on-line course on EDUMINE at (<http://www.edumine.com/xedumine/toolcat.htm?category=management>).