

APPENDIX B

SENES Corporate Credentials



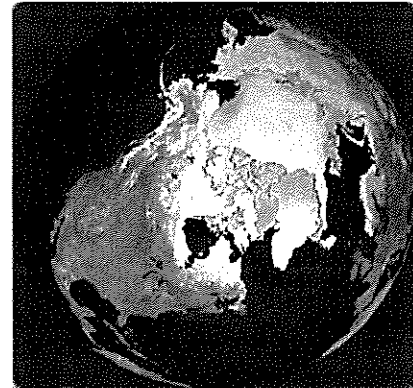
SENE Consultants Limited

NORTHERN ENVIRONMENTAL EXCELLENCE

SENE has established itself as a leader and innovator in the provision of expert environmental services across Canada and around the World. The firm has a twenty-five year track record of providing practical, state-of-the art solutions to resolve complex environmental issues. This reputation extends to the challenges that are unique to cold-weather climates. Selected highlights of our work in Canadian and International northern settings are provided below.

Northwest Territories and Nunavut

Since 1999, SENE has been actively involved in the assessment of closure issues at the Giant, Colomac and Port Radium mine sites. This work has included the development and implementation of several field programs at Port Radium; risk assessments for various closure alternatives for all three sites; development of long-term water management and treatment options for Giant and Colomac mines; geochemical, pathways and lake modelling for the Colomac and Giant mines; and development and assessments of closure options and costs. As part of DIAND's review of potential liabilities associated with northern sites, SENE carried out Screening Level Human Health and Ecological Risk Assessments in 2003 for a number of northern mine sites including the Giant, Colomac, Discovery, Port Radium, Tundra, Silver Bear, and Contact Lake mines. Other efforts undertaken in the Northwest Territories and Nunavut by SENE staff include:



- ❖ the NWT Environmental Audit (a comprehensive performance assessment of the environmental regulatory regime in the NWT);
- ❖ review of environmental permits for the Diavik Mine;
- ❖ provision of strategic environmental advice, audit, and corporate oversight on behalf of PricewaterhouseCoopers Inc. in their role as Interim Receiver for the Royal Oak properties including the Giant Mine and Colomac Mine;
- ❖ assessment and modelling of cyanide degradation of the Colomac tailings system and nitrogen species modelling in the receiving environment;
- ❖ confidential liability assessments of the Giant and Colomac mines;
- ❖ development of the closure plan for Nanisivik Mine;
- ❖ design of the tailings management system including pumps and pipelines for Nanisivik Mine;
- ❖ baseline monitoring at the proposed Thor Lake beryllium mine;
- ❖ management of all environmental aspects associated with the re-opening of the Camlaren gold mine including permitting, operation, and closure; and
- ❖ various projects for mines such as Lupin, Salmita, Polaris, Cullaton Lake, amongst others.

Yukon and Northern British Columbia

Over the years SENE staff have undertaken a range of projects in British Columbia and the Yukon that have included strategic and operational environmental oversight, development of the EA for Canada's largest coal mine, assessment of acid waste management practices and liabilities for operations in sensitive

ecological systems, due diligence and liability assessments for existing and proposed open pit and underground operations, and the application of geochemical modelling in support of a mine's position on closure liability bonding requirements. As part of DIAND's review of potential liabilities associated with northern sites, SENES carried out Screening Level Human Health and Ecological Risk Assessments in 2003 for a number of northern mine sites including the Anvil Range Mines (Faro, Grum, Vangorda), Mount Nansen Mine, Clinton Creek Mine, and United Keno Mines. Some comments on these projects are provided below.

- ❖ a review of the health risks associated with the Clinton Creek asbestos mine;
- ❖ peer review of closure plans for the Anvil Range (Faro, Grum, Vangorda) mines;
- ❖ environmental reviews and assessments of the Kemess Mine to address operational and compliance issues in support of the Interim Receiver and detailed assessment of potential non-compliance issues as related to construction of the power line right-of-way, the fisheries habitat, and the tailings bypass system;
- ❖ management and preparation of the three volume environmental impact assessment developed in support of the Quintette Coal mine and related operations;
- ❖ pre-purchase due diligence and liability assessments of the Curragh operations at the Faro, Grum and Vangorda mine sites, as well as, the San Dena Hess and the Stronsay projects for Korea Zinc and Samsung;
- ❖ due diligence and liability assessments of the Faro (Anvil Range) Mine;
- ❖ expert advice on acid mine drainage issues associated with decommissioning of the tailings facility at the Faro zinc mine;
- ❖ waste rock closure assessments of the Johnny Mountain mine;
- ❖ prediction of acid mine drainage strength and loadings from the Equity Silver mine waste rock pile and assessment of future treatment requirements and costs in support of bonding negotiations between the mine operator and B.C. government.

Northern Saskatchewan

Over the years SENES has carried out a full range of projects in support of the development of the northern Saskatchewan uranium mines as summarized below. These mines are located in sub-arctic climate conditions and many of the issues and aspects addressed by these projects are relevant to mines located further north.

- ❖ environmental impact statements for development of the Midwest, McClean Lake and Dominique Janine uranium mines;
- ❖ environmental pathways analyses and ecological and human health risk assessments for the proposed McArthur River, McClean Lake, and Cigar Lake uranium mines;
- ❖ environmental pathways analyses and risk assessments for decommissioning of the Collins Bay, Rabbit Lake and Cluff Lake uranium mines;
- ❖ closure plans and assessment of the environmental consequences of reclamation options for Beaverlodge uranium mine;
- ❖ status-of-the-environment reports on the Key Lake, Rabbit Lake and Cluff Lake mining operations;
- ❖ state-of-the-environment report on the decommissioned Beaverlodge uranium mine and ongoing advice on residual water quality issues;

- ❖ climatology and meteorology reports and air dispersion modelling at all of the aforementioned uranium mines;
- ❖ assessment of the cumulative impacts of all uranium mines in northern Saskatchewan on air quality, water quality, aquatic and terrestrial ecology and human health;
- ❖ investigation of waste rock leaching characteristics and development of waste management plans at the McClean Lake, Midwest, Cigar Lake and Rabbit Lake mines; and
- ❖ assistance to Cameco Corporation and Cogema Resources Inc. in the development of compliance and management system audit protocols for application to their respective mine operations in northern Saskatchewan, training of auditors for both companies, review of audits carried out by their auditors, and execution of independent compliance and environmental management system audits.

Quebec and Labrador

Focusing on mining operations, SENES has also conducted a variety of projects in the cold weather environments of northern Quebec and Labrador. These include:

- ❖ The assessment of tailings management and water treatment aspects and needs for INCO as part of the baseline program for the Voisey's Bay Nickel Project;
- ❖ The Peer review and subsequent re-assessment of the air quality work for Voisey's Bay as part of the EA process;
- ❖ Development of a new method of tailings reclamation for a northern Quebec tailings area with the objective of minimizing associated dust generation;
- ❖ Assistance to the Iron Ore Company of Canada (IOCC) to with a number of areas including tailings management, water management and treatment, environmental monitoring, assessment of environmental effects and closure/reclamation planning. This work focused on the Carol Lake operation, located near Labrador City, Newfoundland. The operation generates about 20 million tonnes of tailings, which are deposited in Wabush Lake. Projects efforts included:
 - participation in a multi-disciplinary team established to review tailings management alternatives in order to find an economically achievable strategy to meet future regulatory requirements and address community concerns;
 - development a set of criteria for the evaluation of tailings management strategies to meet these objectives;
 - key member of the team that developed the selected tailings management option;
 - expert advice on issues related to red water and total suspended solids (TSS) in Wabush Lake;
 - review of existing monitoring data to determine lake mixing effects, seasonal changes in TSS and relationships between key parameters such as TSS, turbidity and iron. A sampling and analysis program was developed to define the nature of the problem, as well as developing treatment options and reviewing laboratory testing programs for these treatment alternatives;
 - review of practices related to unconfined disposal of tailings in natural waterbodies. The review included a survey of mining operations currently disposing tailings in lakes, methods of disposal (e.g. spigotting on a beach, subaqueous discharge from a barge, etc.); and
 - assessment of the State of the Art of Turbidity Barriers for cold weather, year round application. This work included a worldwide search of technologies and applications, comments on conceptual barrier application approaches and costing models.

International Northern and Cold Climate Environments

In addition to the Canadian north, SENES has also undertaken projects in cold climates and in permafrost conditions in such locations as Alaska, Denmark, Greenland, Iceland, the Kyrgyz Republic, Kazakhstan, and in Siberia. These projects involved a variety of disciplines and services including scientific assessments and due diligence assessments which included all aspects of environmental operation and closure.

CONTACTS

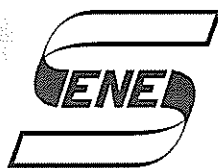
For more information, please contact:

SENES Corporate

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Dr. Donald Gorber, President
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SENES North

Yellowknife, Northwest Territories
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SENES Consultants Limited

Specialists in Energy, Nuclear and Environmental Sciences

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Environmental Excellence Worldwide



THE COMPANY

SENES Consultants Limited is a wholly Canadian-owned company that specializes in the fields of energy, nuclear, and environmental sciences with offices in Toronto and Ottawa, Ontario; Vancouver, British Columbia and Yellowknife NWT. Since its inception in 1980, the company has participated in over 3,400 projects throughout North and South America, the Caribbean, Africa, Australia, Europe, Asia, the Middle East and the Far East.

TECHNICAL SPECIALISTS

The technical resources within *SENES* include many engineering disciplines, physical and natural sciences, mathematics, statistics and computer sciences. One of our strengths is our desire to build upon the technical areas we do well, rather than attempt to provide services on all aspects of the environment. This concentrated technical effort is looked upon favourably by the legal profession who continually use our services and by other consulting firms who retain us as technical experts in specialized areas.

The strength of *SENES* is a direct reflection of the extensive knowledge and experience of our staff. The firm is committed to providing its staff with challenging opportunities and to motivating them to upgrade their professional skills on a continuing basis.

SENES has also established three other companies: *SENES Oak Ridge Inc.*, Center for Risk Analysis, Decommissioning Consulting Services Limited, and *SENES Consultants India Pvt. Ltd.* to provide additional services in selected specialized areas. Clients can take advantage of the working relationships among *SENES* and our affiliated companies to access the outstanding technical and scientific capabilities offered by each company.

EXCEPTIONAL SERVICE

The business philosophy of the firm is to provide an exceptional level of service to our clients while ensuring that our common interest in preserving the environment is enhanced. In the rapidly changing world in which we live, creative and innovative solutions are often required to resolve complex problems. We at *SENES* pride ourselves on staying in the forefront of technological advancement to allow us to continue to satisfy our clients' needs. We strongly believe that this attribute distinguishes us from our competitors.

CREDIBILITY

The resolution of complex environmental issues often requires an in-depth understanding of the movement of contaminants through environmental media and the effects on humans. Pathways analysis of contaminant migration from source to man and assessment of the uncertainties and risks of exposure, form the foundation of much of the work undertaken by the firm. Of equal importance, of course, is the knowledge our staff brings to bear on means of managing the environment to minimize risks.

At *SENES* we feel that it is important to be able to look at all sides of a problem in a professional manner. For this reason, we intentionally split our work among private sector companies, industrial associations, regulatory agencies and all levels of government, and various public interest groups. Our success is attributable, in part, to our ability to maintain credibility with all sectors.

SERVICES OFFERED

SENES provides specialty services on a broad spectrum of projects which typically involve provision of expert advice on specific environmental issues; preparation of environmental and risk assessments on proposed undertakings; environmental audits of existing facilities; site investigations; air quality assessment and air emission control; assessment of industrial and municipal water and waste treatment technologies; preparation of solid waste management master plans; development of waste management strategies; biotechnology evaluation; design and supervision of remedial action projects; and design and implementation of public participation programs. An outline of the types of services offered, in selected subject areas, is provided below.

Acid Mine Drainage

- assessment of the acid generation potential of reactive mine tailings and waste rock
- laboratory and field investigations
- modelling of acid generation processes
- evaluation and design of treatment systems
- reclamation and decommissioning strategies

Aquatic Environment

- design and implementation of monitoring for biota, sediments, surface and groundwater
- interpretation of environmental monitoring data
- modelling and analysis of contaminant movement
- watershed management studies
- assessment of river assimilation capacity and lake eutrophication status

Atmospheric Environment

- ambient monitoring for air quality, meteorology, noise, odour, greenhouse gases and dust
- field investigation of emission sources
- atmospheric dispersion modelling of environmental contaminants
- impacts of air toxics from existing and proposed developments on air quality and human health
- investigation, review and design of air emission control systems and mitigative measures

Biotechnology

- bioremediation assessments, biodegradation studies
- biochemical engineering including bio-reactors, bio-leaching and bio-filters
- biological treatment of waste water using anaerobic digestion, wetlands, etc.
- conversion of bio-mass into energy, fuels and feedstocks
- microbiological assessments and health effects
- development of policy issues on genetically modified organisms

Data Management and Statistical Analysis

- development of statistical routines and environmental pathways models
- application of statistical and database management software to analyze environmental data
- investigation of cause and effect relationships
- application of expert system programs to projects

Environmental Assessment

- collection and interpretation of environmental data
- modelling of environmental components including the dispersion and behaviour of contaminants
- site selection studies
- preparation of screening level assessments, Class EAs and individual EAs
- interpretation of, and advice on, EA processes and regulations
- expert testimony at public inquiries and hearings

Environmental Audits/Management

- assistance with ISO 14001 implementation
- assessment of facility compliance with regulations and with operating permits
- EMS audits/reviews
- site surveys to measure contaminant levels
- identification of potential liabilities
- hazard identification, quantification and alternative reduction strategies
- development of environmental management plans

Hazardous Waste Management

- site inspection of management practices and compliance with regulations for PCBs, heavy metals, asbestos and other hazardous materials
- assessment of treatment technologies
- site selection and disposal methods
- risk and accident analysis
- contingency planning for accidental releases

Low-Level Radioactive Waste Management

- site selection and evaluation studies of existing and proposed disposal facilities
- assessment of impacts from contaminated areas
- development of site clean-up criteria
- design and supervision of remedial programs
- review of management practices
- review of relevant legislation and regulations
- contingency planning for accidental releases

Mining

- collection and evaluation of environmental data
- assessment of environmental effects of mine facility releases and evaluation of mitigative measures
- tailings site selection and management studies
- design of waste water treatment systems
- identification and evaluation of close-out, decommissioning, and reclamation options
- review of relevant legislation and regulations
- assessment of workplace conditions and worker protection practices
- regulatory negotiations and expert testimony

Occupational Health

- assessment of public health and worker exposure
- inspection of facilities to identify and characterize potentially-hazardous workplace conditions and development of corrective programs
- development of codes of practice
- preparation and presentation of occupational health and safety training courses

Public Participation

- identification of stakeholder groups and key issues
- design and development of information materials including news releases, fact sheets, poster displays, public notices
- organization of and facilitating at public meetings, public information centres and workshops
- pre-submission consultation with public, government agencies, ratepayer groups and other parties
- conflict resolution

Radioactivity

- field monitoring of radon, external radiation and radionuclides in all environmental media
- pathways analysis of radionuclide transfer through the environment
- evaluation of health effects of worker and public exposure to radiation and radioactive materials
- analysis of the radiological impact of existing and proposed developments
- modelling of underground mine ventilation systems
- investigation of management alternatives for radioactively-contaminated soils and wastes

Remedial Actions and Decommissioning

- site investigations to measure contaminant levels in soil, buildings and equipment
- development of clean-up criteria for inorganic, organic and radioactive contaminants
- pathways modelling of contaminant migration through the environment to humans
- clean-up strategies and decommissioning plans
- design and supervision of remedial activities

Risk Assessment

- ecological and human health risk analysis
- identification of risk sources and risk characterization
- quantitative estimation of risk
- quantitative uncertainty analysis
- development of risk management strategies
- effective communication of risks and benefits to specific interest groups and the public

Solid Waste Management

- development of waste management master plans
- evaluation of alternative 3R's methods
- waste audits
- evaluation of material recovery, composting, incineration and landfill technologies
- site selection and evaluation studies
- EA preparation and hearing testimony
- landfill gas and leachate control

THE SPECIALISTS

SENIOR PROFESSIONAL STAFF

Donald M. Gorber, Ph.D., P.Eng.

President and Director of Environmental Assessment and Sustainability Studies

Don Gorber is involved in a wide spectrum of international multidisciplinary environmental risk and sustainability studies for all levels of government and industrial clients. He specializes in the environmental assessment process and regulatory review and approvals. He has been retained as project manager/co-ordinator on many major studies involving mining, oil refineries, petrochemical plants, solid and hazardous waste management, nuclear, gas fired and hydro generating stations and site decommissioning. He has acted as a facilitator and peer reviewer on many complex environmental problems and served as a technical liaison between public interest groups, industry and regulatory agencies.

Douglas B. Chambers, Ph.D.

Executive Vice-President and Director of Risk and Radioactivity Studies

Doug Chambers has an international reputation as expert on risk and radioactivity. His experience includes numerous risk assessments of human exposure to radiation, environmental radioactivity and hazardous chemicals. His special skills include exposure pathways analysis, air dispersion modelling, analysis of radiation and chemical risks, and environmental statistics. He serves on many international committees and has appeared as an expert witness at public inquiries, environmental hearings and court proceedings.

Bruce E. Halbert, M.Sc.

Secretary-Treasurer and Director of Aquatic Environmental Studies

Bruce Halbert directs investigations into the impact of municipal and industrial projects on the aquatic environment and on the selection of municipal waste water treatment technologies. He has extensive experience in preparing of environmental assessments, investigation and modelling of acid generation in reactive mine tailings and waste rock, modelling of contaminant movement through the environment, and application of uncertainty analysis concepts.

Gerd Wiatzka, B.A.Sc., P.Eng.

Vice President and Manager of Mining Group

Gerd Wiatzka specializes in mine site evaluations, audits, environmental assessments and strategic planning for due diligence and decommissioning of mining facilities. He has managed large mining environmental projects including engineering design, construction management, and information systems for mines throughout North America and has been active in mining projects internationally.

John F. Peters, M.Eng., P.Eng.

Vice President and Manager of Air Group and Manager of Audit Group

John Peters specializes in environmental management systems, environmental permitting, environmental auditing and facility risk assessment. Mr. Peters has an extensive and practical understanding of environmental management system requirements acquired through the development of environmental programs and his extensive auditing experience. Mr. Peters was one of the first auditors in Canada to be designated as a Certified Environmental Auditor and as an Environmental Management System Lead Auditor. Mr. Peters has prepared: corporate environmental policy and practices manuals; environmental bulletins; status of the environment reports; environmental co-ordinator training programs for a wide range of government, industrial and mining clients.

Leo M. Lowe, Ph.D.

Vice President and Manager of Environmental Radioactivity

Leo Lowe is a Senior Health and Environmental Physicist involved in investigations of radioactivity in the environment and the workplace, across Canada and internationally. He has prepared environmental impact assessments of uranium mining and refining facilities, and studies of the potential radiation hazards of industries associated with above-normal levels of naturally-occurring radioactivity. He has extensive experience in radon modelling, risk and environmental pathways analysis and dose calculations.

Murali Ganapathy, M.A.Sc, P.Eng., DEE

Vice President-India

Murali Ganapathy has over 25 years experience in process engineering, industrial technology assessment and hazardous waste management. He is a process engineer by training and has been involved with regulations and guidelines development, plant

operations and troubleshooting, energy and utilities optimization studies, safety, health and environmental studies including failure assessments, and HAZOP studies in a wide variety of industrial sectors. Mr. Ganapathy is also responsible for establishment and operations of SENES India operations.

Edward J. Norrena, M.A.Sc., P.Eng.
Manager of Ottawa Office

Ed Norrena's areas of specialization include policy development, strategic planning and environmental technology programs. Before joining SENES, he was Director General for the Environmental Technology Advancement Directorate of Environment Canada, with responsibility for national and international programs and for technology programs in biotechnology, municipal waste, climate change/cleaner air and contaminated sites. In his prior capacity as Director General for the Regulatory Affairs and Program Integration Directorate of Environment Canada, he was responsible for the review of the Canadian Environmental Protection Act and for global strategies programs.

Bohdan W. (Dan) Hrebenyk, M.Sc.
Manager of British Columbia Office

Dan Hrebenyk is a Senior Climatologist/Environmental Scientist with extensive experience in meteorological and air pollution monitoring; environmental auditing; and air dispersion modelling for industrial and mining facilities. He has managed studies on control technologies for pollution abatement, the implications of proposed new regulations for air toxics and the control of nuisance odours from landfills, sewage treatment plants, and pulp mills.

Tony Brown, M.Sc., P.Eng.
Manager of Yellowknife Office

Tony Brown has managed and conducted large multi-disciplinary projects, particularly environmental assessments and audits. Other areas in which his skills have been applied include environmental site assessments, water and air quality investigations, risk assessments, mining studies, environmental regulatory system reviews, report review and editing. In addition to his Canadian and northern experience, he has worked on numerous international assignments.

Randall A. Knapp, B.A.Sc., P.Eng.
Mining Specialist Consultant

Randy Knapp is a world recognized expert on the environmental aspects of mining. He has managed numerous mine waste site selection studies and acid mine drainage investigations, designed industrial water and waste treatment facilities, directed environmental baseline monitoring and assessment studies, and appeared as an expert witness at environmental hearings.

Mario E. Buszynski, M.Sc., M.C.I.P., R.P.P.
Manager of Environmental Assessment and Energy Studies

Mario Buszynski is Senior Planner with extensive experience in developing EA policy and conducting EA studies. He specializes in managing complex and contentious land use planning and environmental assessment undertakings, particularly in the energy sector. He has been involved with a wide range of Class EAs and complex individual EAs. Mr. Buszynski has extensive public involvement and environmental mediation experience and has acted as an expert witness before various provincial boards.

SENIOR PROFESSIONAL STAFF

The technical backgrounds of *SENES* staff include all engineering disciplines plus physical and natural sciences as well as mathematics, statistics, computer sciences and planning and economics. More than half of the company's professional staff hold postgraduate degrees. Many participate on expert and standards committees or are members of professional organizations.

Highly-qualified technical staff provide a wide range of services and often take on major roles on projects that require the installation of field monitoring equipment, collection of field measurements and samples, calibration of field instruments, liaison with analytical laboratories, and the inspection of facilities for environmental compliance.

To complement and enhance the skills of its full-time staff, *SENES* can call upon the many years of experience of a select group of internationally recognized specialists.

AFFILIATED COMPANIES

SENES Oak Ridge Inc., Centre for Risk Analysis

102 Donner Drive
Oak Ridge, Tennessee, U.S.A. 37830
Tel: (865) 483-6111 Fax: (865) 481-0060
senesor@senes.com
<http://www.senes.com>

SENES Oak Ridge has been established in association with *SENES* to provide comprehensive consulting services in relation to human health and ecological risk estimation, risk assessment and risk communication. The Center for Risk Analysis is committed to providing clients with state-of-the-art methods and practices in quantitative risk analysis and environmental assessment. One of the company's goals is to place the client beyond compliance and to do so in the most scientifically advanced and defensible position possible. Specialty services include:

- Ecological Risk Analysis
- Human Health Risk Analysis
- Land Use Planning and Sustainable Development
- Methods for Risk Estimation
- Risk Communication

Decommissioning Consulting Services Limited

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engineers@dcsltd.ca
<http://www.dcsltd.ca>

Decommissioning Consulting Services Limited (DCS) has been established in association with *SENES* to provide engineering solutions to site contaminant problems. DCS personnel are committed to providing cost-effective, achievable approaches to resolving the site and facility contamination and waste management concerns facing DCS clientele. The broad range of services offered by DCS include:

- Real Estate Environmental Audits
- Site Remediation and Decommissioning Feasibility Studies, Planning Reports, Design Specifications and Contract Documents
- Contract Administration and Quality Assurance
- Soil, Groundwater and Surface Water Assessments, Management and Planning
- Post-Remediation Monitoring and Site Sign-Off
- Hazardous Substance (e.g. Asbestos) Management and Training
- Hazardous Waste Management
- Occupational Health and Safety Services and Training

SENES Consultants India Private Limited

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SENES India provides specialty services on a broad spectrum of projects which typically involve provision of expert advice on specific environmental issues. *SENES India* has a team of multi-disciplinary specialists assisting clients from Government, municipal and industry sectors. The current areas of practice include:

- preparation of environmental, social and risk assessments on proposed undertakings;
- environmental audits of existing facilities;
- air quality assessment and air emissions control;
- preparation of solid waste management master plans; development of waste management strategies;
- design and supervision of remedial action projects; and
- design and implementation of public participation programs.

PRINCIPALS FROM AFFILIATED COMPANIES

SENES Oak Ridge Inc., Centre for Risk Analysis

F. Owen Hoffman, Ph.D.

President

Owen Hoffman has more than 25 years of experience in the evaluation of the dose to humans from the release and transport of radionuclides and chemicals in terrestrial and aquatic systems. Dr. Hoffman, who is internationally recognized for his work in quantitative uncertainty analysis, human risk assessment, and environmental risk, has authored more than 70 publications and has presented numerous workshops and lectures on quantitative methods for assessment of uncertainty in exposure, dose and risk. He is responsible for two major guidance documents in the field: NCRP Commentary No. 14, A Guide for Uncertainty Analysis in Dose and Risk Assessments Related to Environmental Contamination (1996) and IAEA Safety Series No. 100, Evaluating the Reliability of Predictions Made Using Environmental Transfer Models (1989).

SENES Consultants India Pvt. Ltd.

Rahul Dua, ACGI, MIChemE

General Manager

Mr. Dua has an undergraduate degree in Chemical Engineering and a graduate degree in Engineering with Management from Imperial College of Science

and Technology, University of London. Rahul has more than nine years of experience in the environment sector. He has worked on projects related to solid waste management, hazardous waste management, development of environmental, occupational health and safety and social management systems, training, facilitation and counselling for nearly 80 companies in India. He is a trained environmental and social auditor. He has worked on environmental performance improvement and evaluation systems mainly related to "environmental performance benchmarking" for the paint sector and "greening of supply chain management" in the automobile sector.

Decommissioning Consulting Services Limited

Richard B. German, P.Eng.

President

Rick German has experience in all aspects of the subsurface evaluation and decommissioning process through more than 25 years in industrial waste disposal facility development for the mining, metals, pulp and paper, petrochemical and manufacturing industries; in the field of contaminated dredge spoil recovery, hauling and disposal; in the disposal of toxic wastes; and, in industrial/institutional site evaluation, investigation, remediation, decommissioning and demolition. He was responsible for the first major industrial site decommissioning completed in Ontario under the provincial decommissioning guidelines.

REPRESENTATIVE CLIENTS

INDUSTRY

Agnico Eagle Mines Limited	Kidd Creek Mines Limited
Albright & Wilson Americas	King Business Centre Inc.
Alcan Ingot Alloys Canada Limited	Lac Des Iles Mines Ltd.
Alexis-Nihon Corporation	LAC Minerals Limited
AlliedSignal Inc.	Laidlaw Waste Systems Ltd.
American Motors Corporation	Les Mines Selbaie
Anachemia Chemicals Limited	Mandarin Golf Club
Armbro Enterprises Inc.	Manitoba Hydro
Atlas Alloys	Marathon Realty
Atomic Energy of Canada Limited	Marel Contractors Ltd.
Bank of Montreal	Maritime Nuclear
BASF Inmont Canada Limited	Markborough Properties Limited
Benjamin Moore & Co. Ltd.	Midwest Joint Venture
Bramalea Limited	Minnova Inc.
Bristol-Myers Products Canada	Mitsui and Company (Canada) Limited
CAMBIOR Inc.	MWI Industries
Cameco Corporation (Eldorado Resources Limited*)	Nacan Products Limited
Campbell Red Lake Mines	Nanisivik Mines
Canada Metal Limited	Neptune Meters Limited
Canada Tungsten	Neptune Resources
Canada Wire Limited	New Brunswick Electric Power Commission
Canadian Lencourt Mines Limited	Northern Telecom
Canadian Occidental Petroleum Limited	Norton Advanced Ceramics of Canada Inc.
Cigar Lake Mining Corporation	Ontario Hydro
Citadel Gold Mines	Placer Dome Inc.
Chrysler Canada	PNC Exploration (Canada) Co. Ltd.
Cluff Mining	Quintette Coal Limited
COGEMA Canada Ltd. (AMOK Limited*)	Rahn Metals Plastics Limited
Colgate Palmolive Limited	Ralston Purina Canada Inc.
Consumers Gas	Rio Algom Limited
Corona Corporation	Rogers Telecommunications Limited
Corundal Re-Refiners	ROXUL Inc.
Cyprus Minerals	Saskatchewan Mining Development Corp.
Denison Mines Limited	Shell Canada Limited
Detour Lake Mine	Skyline Gold Corporation
East Kemptville Tin Corporation	Slough Estates Canada Limited
East Woodbridge Development Inc.	Steetley Quarry Products Inc.
Emerald Lake Resources	Strathcona Mineral Services Limited
ENTERAC Property Corporation	Taikisha Canada Inc.
Equity Silver Mines	Teck Corporation
Esso Petroleum Canada Limited	Texaco Canada Limited
Esso Resources Canada Limited	Topliss & Harding Canada Limited
F&P Manufacturing Inc.	Toronto Refiners and Smelters
Falconbridge Limited	Total Minatco Limited (Minatco Limited*)
Fiberglas Canada Inc.	TransCanada PipeLines Limited
General Motors Limited	Tricil Limited
Grand & Toy Limited	Union Carbide Canada Ltd.
Hecla Mining Company	Uranium Saskatchewan
John T. Hepburn Limited	Victoria Woods Development Corp.
Honda Canada Inc.	Viscase Canada Limited
ICI Canada (C-I-L Inc.*)	Walker Brothers Quarry Ltd.
Imperial Tobacco	Westfield Minerals Limited
INCO Limited	Westminer Canada Limited
Intermetco Limited	Wingold Properties Limited
Interprovincial Pipeline Limited	WMI Waste Management of Canada Inc.
Johnson Controls Battery Division	York Hanover Development Limited
Kerr Addison Mines Limited	

(* predecessor company also a client)

GOVERNMENT

Atomic Energy Control Board
B.C. Energy Mines and Petroleum Resources
B.C. Environmental Roundtable
Canadian Council of Ministers of the Environment
Canadian International Development Agency
Carleton Roman Catholic School Board
City of Nanticoke, Ontario
City of North York, Ontario
City of Oshawa, Ontario
City of Scarborough, Ontario
City of Toronto, Ontario
City of Victoria, British Columbia
City of Windsor, Ontario
County of Essex, Ontario
Dufferin Peel Separate School Board
Energy, Mines and Resources Canada
Environment Canada
Etobicoke Public School Board
Health and Welfare Canada
Indian and Northern Affairs Canada
Interim Waste Authority
Low-Level Radioactive Waste Management Office
Municipality of Metropolitan Toronto
Northwest Territories Chamber of Mines
Ontario Ministry of the Environment and Energy
Ontario Ministry of Health
Ontario Ministry of Housing
Ontario Ministry of Government Services
Ontario Ministry of Natural Resources
Public Works Canada
Regional Municipality of Halton
Regional Municipality of Hamilton-Wentworth
Regional Municipality of Niagara
Regional Municipality of Peel
Saskatchewan Environment
Siting Task Force on Low-Level Radioactive Waste
Town of Lindsay, Ontario
Town of Markham, Ontario
Town of Vaughan, Ontario
Township of Charlottenburg, Ontario
Township of Georgian Bay, Ontario
Township of West Lincoln, Ontario

INDUSTRIAL ASSOCIATIONS

Aggregate Producers' Association of Ontario
Canadian Automatic Sprinkler Association
Canadian Nuclear Association
Ontario Restaurant Association
Petroleum Association for Conservation of the Canadian Environment

PUBLIC GROUPS

Catchacoma Cottagers Association
Coalition to Maintain the Environment
Group of Eight
Pollution Probe
Rawson Academy
Save the Valley
Toxic Waste Research Coalition

INTERNATIONAL

United States

American Brands, Inc.
American Mining Congress
Anaconda Minerals Company
Bethlehem Steel Corporation
City of Omaha, Nebraska
Commonwealth of Virginia
Cyprus Anvil Mining Corporation
Freeport McMoran
Kerr-McGee Chemical Corporation
McKesson Corporation
Mobil Mining & Minerals Company
Monsanto Chemical Company
Placer Pacific
Ridgeway Mining Corporation
Scranton Medical Society, Pennsylvania
Sequoyah Fuels Corporation
State of Michigan, Low-Level Radioactive Waste Authority
State of Washington, Department of Ecology and Air Programs
The Fertilizer Institute
United States Environmental Protection Agency
University of Cincinnati, Institute of Environmental Health

Others

Asian Development Bank Uzbekistan
Council of Nuclear Safety, South Africa
Department of Science, Technology and Environment, Vietnam
Direction Régionale de l'Industrie de la Recherche et de l'Environnement, France
European Bank for Reconstruction and Development Kazakhstan
German Federal Ministry of Environment
India Ministry of Environment and Forests
Instituto Nacional de Ecología, Mexico
International Atomic Energy Agency, Vienna
Ministry of Health Government of Montserrat
Ministry of Planning and Development, Trinidad and Tobago
National Environmental Commission (CONAMA), Chile
Royal Netherlands Embassy Tanzania
Russian Project Finance Bank Kazakhstan
Solid Waste Corporation Government of St. Kitts and Nevis
United Nations Development Program (UNDP)
United Nations Industrial Development Organization (UNIDO)
World Bank India, Nepal, Mexico, Turkey, Colombia, Ghana
World Health Organization

THE SENES GROUP

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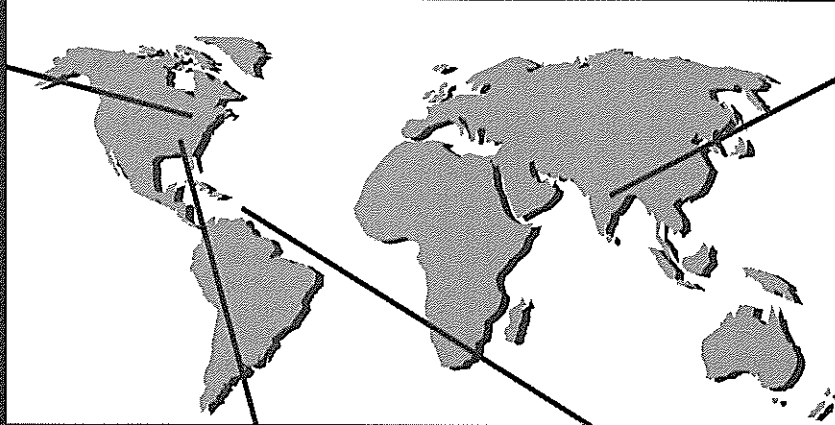
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MINING

SENES Consultants Limited provides expertise on various aspects of environmental assessment and waste management to mining companies, mining associations, research organizations and government agencies. The following pages provide a partial listing of organizations that SENES has assisted and describe the contributions that SENES has made on mining projects in the areas of: environmental monitoring, modelling and assessment; tailings management; wastewater treatment; close-out, decommissioning and reclamation; occupational health and safety; hearings and inquiries; and legislation reviews.

MINING COMPANIES AND ORGANIZATIONS

Aggregate Producers Association	International Minerals and Chemical Corp. Ltd.
Agnew Lake Mines Limited	Kerr Addison Mines Limited
Agnico-Eagle Mines Limited	Kerr-McGee Chemical Corporation
American Mining Congress	Key Lake Board of Inquiry
AMOK Ltée	Kidd Creek Mines Limited
Anaconda Minerals Company	LAC Minerals Limited
Aquitaine Company of Canada Inc.	Low Level Radioactive Waste Management Office,
Atomic Energy Control Board	AECL
AUR Resources Inc.	Midwest Joint Venture
B.C. Energy, Mines and Petroleum Resources	Minatco Limited
B.P. Selco Limited	Mines Pollution Control Branch (Sask.)
Cambior Inc.	Mobil Mining and Minerals Company
Cameco Corp.	Nanisivik Mines Ltd.
Campbell Red Lake Mines Limited	National Uranium Tailings Program
Canada Wide Mines Limited	Neptune Resources Corporation
Canadian Industries Limited	Noramco Explorations Inc.
Canadian Lencourt Mines Ltd.	Noranda Mines Limited
Canadian Occidental Petroleum Limited	Norcen Energy Resources Limited
CANMET	Northgate Exploration Limited
Citadel Gold Mines Inc.	Northwest Territories Chamber of Mines
Cigar Lake Mining Corporation	Nuinsco Resources Limited
Commonwealth of Virginia	Outokumpu Mines Ltd.
Cyprus Anvil Mining Corporation	Placer Development Limited
Denison Mines Limited	Placer Dome Inc.
Denmark Ministry of Energy	PNC Exploration (Canada) Co. Ltd.
Dentherm Resources Limited	Quintette Coal Limited
East Kemptville Mines Limited	Redpath Limited, J.S.
Eastmaque Gold Mines Limited	Ridgeway Mining Corporation
Echo Bay Mines Limited	Rio Algom Limited
ELDOR Mines Limited	Rosario Dominicana
Eldorado Resources Limited	Rössing Uranium Limited
Emerald Lake Resources Inc.	Sandy K Mines Limited
Energy and Resources Limited	Saskatchewan Environment
Energy, Mines and Resources Canada	Saskatchewan Mining Association
Environment Canada	Saskatchewan Mining Development Corp.
Equity Silver Mines Limited	Shell Canada Resources Limited
ERCO Industries Limited	Somincor Inc.
Esso Resources Canada Limited	Strathcona Mineral Services Limited
Falconbridge Limited	Teck Corporation
Fertilizer Institute, The	Urangasellshaft Canada Limited
Foundation for Aggregate Studies	Uranium Saskatchewan Association Inc.
Freeport McMoRan Inc.	Walker Brothers Quarries Limited
Golden Sunlight Mines Ltd.	Watts Griffiths and McQuat Limited
Hecla Mining Company Limited	Western Quebec Mines Inc.
Highland Crow Gold Mines Limited	Westfield Minerals Limited
Homestake Mining Company Limited	Westminer Canada Limited
INCO Metals Company Limited	

Environmental Monitoring

- data collection and analysis for a potential uranium mine in northern Saskatchewan (*Canadian Occidental Petroleum Limited and INCO Metals Company Limited*);
- baseline data collection for a uranium property in Nova Scotia (*Kidd Creek Mines Limited, formerly Aquitaine Company of Canada Limited*);
- data collection and analysis at a coal property in northeastern British Columbia (*Quintette Coal Limited*);
- monitoring, assessment, and modelling of acid generation sources in Quirke Lake on the Serpent River Basin in northern Ontario (*Denison Mines Limited and Rio Algom Limited*);
- baseline data collection for the proposed Lakeshore gold mine tailings remilling process in northern Ontario (*LAC Minerals Limited*);
- baseline data collection for a 6000 t/d gold mine near Hemlo in northern Ontario (*LAC Minerals Limited*);
- collection of meteorological data and baseline monitoring of contaminant levels in air, water, soil, sediment, aquatic biota and terrestrial biota at the site of the uranium refinery in Blind River, Ontario (*Eldorado Resources Limited*);
- environmental monitoring at the closed-out Willroy Mine in Manitouwadge, Ontario (*LAC Minerals Limited*);
- environmental data collection and interpretation at a coal property in Alberta (*Dentherm Resources Limited*);
- baseline environmental monitoring at a gold mine property in northern Ontario (*Northgate Exploration Limited*);
- environmental monitoring at potential gold mine developments in northern Ontario (*Emerald Lake Resources Inc., Highland Crow Gold Mines Limited, Noramco Exploration Inc.*);
- radon and meteorological monitoring at several uranium tailings areas near Elliot Lake, Ontario (*National Uranium Tailings Program, CANMET*);
- benthos, sediment and surface water monitoring for radionuclides in the Serpent River Basin in northern Ontario and the Wollaston Lake area of northern Saskatchewan (*National Uranium Tailings Program, CANMET*);
- development of environmental monitoring programs for several active gold mining operations in Ontario and Quebec (*LAC Minerals Limited*);
- environmental data collection and interpretation at the site of the Midwest Lake uranium project in northern Saskatchewan (*Midwest Joint Venture*);
- environmental and radiological monitoring at a potential rare earth and beryllium mining prospect near Yellowknife, NWT (*Hecla Mining Company Limited*);
- collection of water quality data at selected aggregate operations as part of the Municipal Industrial Abatement Strategy (MISA) preregulation monitoring program (*Aggregate Producers Association*);
- environmental data collection at a natural uranium outcrop in Newfoundland (*National Uranium Tailings Program, CANMET*);

- air quality, radon and meteorological data collection at the Lacnor tailings area near Elliot Lake, Ontario (*National Uranium Tailings Program, CANMET*); and
- development of environmental monitoring program, including surface and groundwater quality, air quality, gamma survey, aquatic and terrestrial vegetation and wildlife, for the Quirke and Panel Mines during decommissioning (*Rio Algom Limited*).

Environmental Modelling

- evaluation of radon data for the Ambrosia Lake area of New Mexico and estimation of background levels via statistical analysis (*American Mining Congress*);
 - development, verification and application of the Reactive Acid Tailings Program (RATAP) to model acid generation from low sulphide bearing tailings and utilization of the model as a tool for assessment of reclamation options and their effects on the rate of acid generation in pyritic tailings and waste rock dumps (*National Uranium Tailings Program, CANMET and Rio Algom Limited*);
 - development of source and dispersion models for air and water pathways as input to an environmental pathways analysis for decommissioning the Beaverlodge uranium mine in Northern Saskatchewan (*Eldorado Resources Limited*) and the Agnew Lake uranium mine in northern Ontario (*Agnew Lake Mines Limited*);
 - modification and calibration of the Reactive Acid Tailings Assessment Program to model acid generation from high sulphide bearing, base metal tailings (*CANMET, Energy Mines and Resources Canada*);
 - air quality modelling, involving source and dispersion characterization in complex terrain, for use in impact assessment and air emission control specifications for the Quintette Coal project in British Columbia (*Quintette Coal Limited*);
 - radioactivity pathways analyses, involving source, dispersion and impact modelling, for a number of proposed or expanding uranium properties (*American Mining Congress, Canada Wide Mines Limited, Cigar Lake Mining Corporation, Denison Mines Limited, LAC Minerals Limited, Norcen Energy Resources Limited, Rio Algom Limited*);
 - development of the Uranium Tailings Assessment Program (UTAP), a probabilistic model for assessing the behaviour of radionuclides in the environment that have been released from active, or inactive, uranium tailings areas and application of the code to the Lacnor tailings area in Elliot Lake, Ontario (*National Uranium Tailings Program, CANMET*);
 - development and adaptation of mine ventilation models used to predict radon and radon daughter levels in underground mine environments (*Atomic Energy Control Board, Canada Wide Mines Limited, Canadian Occidental Petroleum Limited, Cigar Lake Mining Corporation, Eldorado Resources Limited*) and surface mines (*Canada Wide Mines Limited, Kidd Creek Mines Limited, Norcen Energy Resources Limited*);
 - calculation of occupational exposures from the handling, transportation, storage and management of radioactive materials (*Canada Wide Mines Limited, C.E. Superheater, Eldorado Resources Limited, Low Level Radioactive Waste Management Office, Toplis and Harding Canada Inc.*);
 - evaluation of the suitability of existing computer models to predict acid generation and metals leaching from tailings and waste rock dumps (*American Mining Congress*);
 - development and verification of a screening model to assess the potential application of natural degradation for cyanide removal from gold mill tailings effluents (*Citadel Gold Mines Inc. and LAC Minerals Limited*);
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- development of a water quality and contaminant transport model to assess potential reclamation measures for several mine waste disposal sites in the Link Lake watershed at the Rabbit Lake uranium mine site in northern Saskatchewan (*ELDOR Mines Limited*);
- development of comprehensive models to predict the geochemical behaviour of arsenic and thorium in uranium mine tailings (*National Uranium Tailings Program, CANMET*);
- development of fugitive dust emission inventories and calculation of the impact on local air quality of the expansion of a quarry (*Walker Brothers Quarries Ltd.*); and
- acid generation modelling and predictions to aid in formulating waste rock management plan for waste rock dumps (*Equity Silver Mines Limited*).

Environmental Assessment

- preparation of all environmental documentation and the Environmental Impact Statement for a uranium mine in northern Saskatchewan (*Minatco Ltd.*) and for the expansion to a uranium mine in northern Saskatchewan (*Amok Limited*);
- preparation of the Initial Environmental Evaluation (IEE) for the Colomac Gold Mine prospect in the Northwest Territories (*Neptune Resources Corp.*);
- preparation of the Stage 2 environmental impact assessment for the Quintette Coal mining operation in northeastern British Columbia (*Quintette Coal Limited*);
- assistance in preparation of the project description for the Thor Lake beryllium and rare earth project in the Northwest Territories (*Hecla Mining Company Limited*);
- assistance in preparation of an assessment report on the effects of subsurface seepages on fresh water receptors at the Stanleigh and Quirke Mines in the Elliot Lake area of northern Ontario (*Rio Algom Limited*);
- assistance in preparation of an environmental impact statement for a uranium mine in northern Saskatchewan (*Canada Wide Mines Limited*);
- assistance in preparation of a radiological assessment report for a proposed molybdenum mine in Atlin, British Columbia (*Placer Development Limited*);
- contributions to the air quality and water quality aspects of the environmental impact assessment for the Coalspur coal property in the foothills of southern Alberta (*Dentherm Resources Limited*);
- provision of advice and assistance on a wide range of environmental matters for several active gold mining properties in Ontario and Quebec (*LAC Minerals Limited*);
- review of environmental constraints for a proposed tailings remilling project near Timmins (*Energy and Resources Limited*);
- assessment of risk from uranium mining in Virginia (*Commonwealth of Virginia*);
- environmental assessment of several gold mine developments (*Citadel Gold Mines Limited, Echo Bay Mines Limited, Emerald Lake Resources Inc., Northgate Explorations Limited*);
- preparation of all environmental documentation, the Environmental Impact Statement and the safety report for the Midwest Uranium Project in northern Saskatchewan (*Midwest Joint Venture*);

- assessment of radon releases from phosphogypsum stacks (*The Fertilizer Institute*);
- assessment of the impact of the Willroy Mine's Dam E seepage on the Rabbitskin Creek watershed (*LAC Minerals Limited*);
- environmental assessment studies for the development of McClean Lake uranium deposit (*Canadian Occidental Petroleum Limited and INCO Limited*);
- evaluation of expected environmental effects of processing oil shales in Ontario, part of an oil shale mining feasibility study (*Watts, Griffiths and McQuat*);
- design of a pre-operational environmental monitoring program for a uranium refinery site at Blind River, Ontario to meet with the approval of the Inter-Agency Review Committee (*Eldorado Resources Limited*);
- preparation of an environmental assessment for the decommissioning and reclamation of the Beaverlodge uranium mine in northern Saskatchewan (*Eldorado Resources Limited*);
- preparation of an environmental impact assessment for a proposed underground, high-grade uranium mine in Saskatchewan where a test mine was to be used to evaluate sub-surface conditions and mining technologies (*Midwest Joint Venture*);
- environmental studies undertaken at the Millet Brook uranium deposit site in Nova Scotia (*Kidd Creek Mines Limited*); and
- decommissioning plans for uranium mines in northern Ontario, screened using Federal Environmental Assessment Review Office (FEARO) guidelines (*Rio Algom Limited*).

Tailings Management

- assistance in preparation of environmental monitoring protocol and tailings management manuals (*National Uranium Tailings Program, CANMET*);
- in-depth investigation of the factors affecting the bacterial oxidation of sulphide minerals in mine tailings and definition of concepts for controlling the rate of acid generation (*National Uranium Tailings Program, CANMET*);
- design of laboratory leaching experiments to assess the acid generation potential and/or leachability of metals from various tailings and waste rock types (*Cyprus Anvil Mining Corporation, Denison Mines Limited, Denmark Ministry of Energy, Eldorado Resources Limited, Hecla Mining Company Limited, Rio Algom Limited*);
- field and laboratory investigations of tailings acid generation at a lead/zinc mining operation in the Yukon and assistance in development of an appropriate waste management scheme (*Cyprus Anvil Mining Corporation*);
- review of design reports relating to the Stanleigh and Quirke tailings areas in Elliot Lake, Ontario (*Rio Algom Limited*);
- investigation of a deep water tailings disposal scheme in Quirke Lake on the Serpent River System in northern Ontario (*Denison Mines Limited and Rio Algom Limited*);
- assessment of potential radiological exposure from a closed out phosphogypsum stack (*Canadian Industries Limited*);

- assistance in preparation of waste management applications for approval of six gold mine operations in northern Ontario (*Citadel Gold Mines Limited, Echo Bay Mines Limited, LAC Minerals Limited, Westfield Minerals Limited*);
- assistance in preparation of numerous site selection reports for tailings repositories, including: a tin mine in Nova Scotia (*Rio Algom Limited*); three uranium mines in Elliot Lake (*Rio Algom Limited* and *Denison Mines Limited*); a gold mine near Hemlo (*LAC Minerals Limited*); tailings remilling projects in Kirkland Lake (*LAC Minerals Limited*) and Timmins (*Energy and Resources Limited*); and a gold mine in the Dominican Republic (*Rosario Dominicana*); and a gold mine near Kenora (*Echo Bay Mines Limited*);
- assistance in preparation of Quebec Regulation 19 Mining Permit Applications (*Agnico-Eagle Mines Limited, AUR Resources Limited, Cambior Inc., LAC Minerals Limited, Western Quebec Mines Inc.*);
- advice on tailings management practices at Canadian gold mine operations (*Ridgeway Mining Corporation*);
- assistance in preparation of application for Certificate of Approval to construct, own and operate an industrial tailings management facility to treat 1,000 t/d of tailings from a group of claims near Gowganda, Ontario (*Canadian Lencourt Mines Ltd.*);
- assistance in the selection of a treatment process for the final effluent from a tailings pond (*Campbell Red Lake Mines Ltd.*);
- assistance in a study to develop corrective measures and improvements for a gold mine tailings pond near Joutel, Quebec to conform with MENVIQ directives (*Agnico-Eagle Mines Limited*); and
- assessment and design of processes for treating acid mine drainage from tailings piles and waste rock dumps for the Neves Corvos mine in Portugal (*Somincor Inc.*), the decommissioned Willroy base metal mine at Manitouwadge in northern Ontario (*LAC Minerals Limited*), several uranium mines in the Elliot Lake area (*Rio Algom Limited*) and the Strathcona nickel copper mine near Onaping, Ontario (*Falconbridge Limited*).

Wastewater Treatment

- conceptual design of a lime treatment system for the Fecunis Lake tailings discharge from base metal mine/mill facilities near Levack in northern Ontario (*Falconbridge Limited*);
- conceptual design of an SO₂/air cyanide removal system for the Pueblo Viejo Mine in the Dominican Republic (*Rosario Dominicana*);
- conceptual design of a two-stage arsenic, antimony, cyanide removal system for a gold mine development (*LAC Minerals Limited*);
- conceptual design of a biological thiosalt oxidation system in combination with an acid mine water treatment system for the Neves Corvos Mine in Portugal (*Somincor Inc.*);
- conceptual design of a batch lime feed system for managing acid runoff from the decommissioned Willroy Mine (a copper, lead, zinc mine) at Manitouwadge in northern Ontario (*LAC Minerals Limited*);
- design of effluent treatment modifications for the Quirke, Pronto and Nordic Mines in the Elliot Lake area (*Rio Algom Limited*);
- design of an experimental program and development of treatment concepts for a novel system for combined removal of uranium, nickel, molybdenum, radium and arsenic from a proposed uranium mine in northern Saskatchewan (*Canadian Occidental Petroleum Limited and INCO Metals Company Limited*);

- design of an R & D study for cyanide degradation in gold mine wastewaters including the testing of alkaline chlorination, stripping, natural degradation, SO₂/air, activated carbon and biological removal (*LAC Minerals Limited*);
- design and management of a series of large-scale tests of promising radium removal technologies and preparation of conceptual designs for the Panel Mine treatment system and the proposed expansion of the Quirke Mine treatment system (*Rio Algom Limited*);
- technical review of and development of recommendations for the design basis and operating procedures for waste water management and treatment at the East Malartic operations (*LAC Minerals Limited*);
- review of treatment strategies and proposed changes for the Detour Lake effluent treatment plant (*Placer Dome Inc.*); and
- technical review of the characteristics of sulphidic mine waters and mine water treatment requirements for an application for a Certificate of Approval to construct and operate a mine water treatment system for La Mine Bousquet No. 2 in Quebec (*LAC Minerals Limited*).

Close Out, Decommissioning, And Reclamation

- case history study of decommissioning options for uranium mine open pits (*Eldorado Resources Limited*);
- preparation of a conceptual reclamation plan and engineering feasibility study and preparation of an environmental and radiological pathways analysis for the close-out options of the Beaverlodge uranium mine in northern Saskatchewan (*Eldorado Resources Limited*);
- development and finalization of conceptual plans and planning budgets for the closure plan for the mine/mill facilities and waste management area at Elliot Lake in northern Ontario (*Denison Mines Limited*);
- radioactivity pathways analysis for the close-out of a uranium mining property in northern Ontario (*Agnew Lake Mines Limited*);
- critical review of the environmental impact statement on the decommissioning of an open pit uranium mine in New Mexico (*Anaconda Minerals Company*);
- evaluation of decommissioning plans proposed for the disposal of leach residue from a high grade uranium mine (*Saskatchewan Environment*);
- development of decommissioning and reclamation plans for the Rio Algom uranium mining operations (Panel, Quirke, Stanleigh, Lacnor, Nordic, Pronto and Spanish American Mines) in the Elliot Lake area (*Rio Algom Limited*);
- development of close-out plans for the Nanisivik lead zinc mine on Baffin Island (*Strathcona Minerals Services Limited*);
- evaluation of major environmental concerns and development of operational practices to minimize closure costs for a conceptual closure plan for a copper/tin mine in Portugal (*Somincor/Rio Tinto Corporation*);
- development of guidelines to aid site and facility managers in preparing decommissioning plans in compliance with the requirements of Bill 71 (new Ontario Mining Act and Regulations) (*INCO Limited*);
- assessment of acid generation potential of tailings and/or waste rock and evaluation of potential concerns, mitigative measures and closure options and costs for the Detour Lake Gold Mine (*Placer Dome Inc.*), La Mine

Doyon (*LAC Minerals Ltd.*), the Owl Creek Gold Mine waste rock dumps (*Falconbridge Gold Corporation*) and Stanrock waste management area (*Denison Mines Limited*);

- development of the closure plan for the East Kemptville tin mine in Nova Scotia (*Rio Algom Ltd.*);
- assistance to Equity Silver in the development of their proposed reclamation plan for high sulphide-bearing waste rock piles (*Equity Silver Mines Limited*);
- heading a team of Canadian Consultants to advise the German Environment Ministry on the decommissioning of Wismut's uranium mining facilities in Saxony and Thüringea (*German Environment Ministry*);
- site assessment and technical advice relating to environmental impacts, tailings management, remedial investigation and cleanup requirements for the failure of the 150,000 m³ tailings area and subsequent effluent discharge from the Matachewan Gold mine (*Matachewan Consolidated Mines Limited*);
- advice on closure plan options and costs for La Mine Selbaie operations (BP Selco and Billiton Metals Canada Inc.) and the Willroy lead/zinc mine (*LAC Minerals*);
- assessment of long term acid generation problems and environmental benefits of various decommissioning options for Les Mines East Malartic and Terrain in northern Quebec (*LAC Minerals Ltd.*);
- identification and documentation of environmental and occupational regulatory requirements at the federal and Ontario levels relevant to all aspects of uranium mining and milling (*Rio Algom Limited*);
- provision of advice on various concerns regarding more than ten inactive mine sites owned by LAC Minerals Ltd. (*LAC Minerals Ltd.*);
- assessment of the impact of a waste rock pile and open pit on water quality for Rabbit Lake Uranium Mine through the design and evaluation of laboratory scale leaching studies. Potential benefits of reclamation alternatives were examined through use of a water quality model (*Cameco Corporation*); and
- development of, under contracts to the National Uranium Tailings Program administered by CANMET, Energy, Mines and Resources Canada, a probabilistic computer model for predicting the long-term effects of sulphidic uranium mill tailings close-out options (*CANMET, EMR*).

Occupational Health and Safety

- scientific assessment of the adequacy of U.S. federal limitations on exposure of underground miners to radon daughter exposure and gamma radiation in the workplace (*American Mining Congress*);
- reconstruction of radiation doses for the period from 1954 to 1966 for the Beaverlodge uranium mine/mill facility (*Eldorado Resources Limited*);
- occupational health evaluation for an open pit uranium mine in northern Saskatchewan (*Canada Wide Mines Limited*);
- evaluation of radiological and worker health considerations for engineering feasibility studies of high grade underground uranium deposits in Canada (*Canadian Occidental Petroleum Limited and INCO Metals Company Limited, Cigar Lake Mining Corporation, ELDOR Mines Limited, Midwest Joint Venture, Urangasellshaft Canada Limited*) and for the Kayelekara Uranium Project in Malawi, Africa (*Wright Engineers Limited*);
- preparation of an introductory course in radiation and related worker safety (*Aquitaine Company of Canada Limited*);

- measurement of radiation levels in the underground workings at the Cluff Lake mine and application to a mine ventilation/radiation prediction model (*Atomic Energy Control Board*);
- a study of co-carcinogens in the uranium mining environment (*Saskatchewan Mining Development Corporation and the Atomic Energy Control Board*);
- a study of uncertainty in radon daughter exposure estimates and the effect of uncertainty on the estimation of risk (*Atomic Energy Control Board*);
- evaluation of estimated workplace radon daughter levels and potential radiation exposures to mine workers as well as recommendations for radiation protection and monitoring for the Eagle Point mining development (*Eldorado/Cameco Corp.*); and
- review of occupational hygiene and environmental control practices at a uranium mine in Namibia in the context of international practice (*Rössing Uranium Limited*).

Hearings and Inquiries

- assistance in preparation and presentations at a public meeting on a tailings area expansion in Elliot Lake, Ontario (*Rio Algom Limited*);
- assistance to the Board at an environmental assessment hearing into uranium mining in northern Saskatchewan (*Key Lake Board of Inquiry*);
- assistance at public meetings on a proposed molybdenum mine development in northern British Columbia (*Placer Development Limited*);
- documentation and presentations to the Select Committee on Ontario Hydro Affairs (*Denison Mines Limited and Rio Algom Limited*);
- advice on environmental aspects of uranium mining development in the Northwest Territories (*Northwest Territories Chamber of Mines*);
- public presentations in Nova Scotia of the environmental aspects of uranium tailings management (*Shell Canada Resources Limited*);
- presentations to a Senate sub-committee on the proposed development of a uranium mine (*Commonwealth of Virginia*);
- review of British Columbia uranium exploration guidelines (*B.C. Energy, Mines and Petroleum Resources*);
- presentations to the McLeave inquiry in Nova Scotia regarding the environmental, worker and public health aspects of uranium exploration, mining, milling and waste management (*Kidd Creek Mines Limited*);
- assistance at numerous public meetings to review mine development proposals in Ontario (*Citadel Gold Mines Limited, Denison Mines Limited, LAC Minerals Limited, Rio Algom Limited*); and
- expert testimony before the Ontario Municipal Board regarding the air quality and noise impacts of a gravel extraction operation (*Foundation for Aggregate Studies*).

Legislation Review

- review and comments on AECB Draft Interim Closeout Criteria for Uranium Mines (*Denison Mines Limited, Eldorado Resources Limited, Rio Algom Limited*);
- review and comments on fourth draft of Saskatchewan Uranium Mining Regulations (*Saskatchewan Mining Association*);
- review of U.S. and Canadian uranium legislation to assist Virginia in developing uranium mining regulations (*Commonwealth of Virginia*);
- critique of Mine Safety Health Administration (MSHA) proposed standards and a scientific assessment of the basis for U.S. Uranium Miner Regulations (*American Mining Congress*);
- evaluation of mining effluent quality standards in the Province of Newfoundland (*B.P. Selco Limited*);
- summary of legislation applicable to mining exploration and development in Canada (*PNC Exploration (Canada) Co. Ltd.*);
- review of the radon assessment methodology proposed by U.S. EPA in the Clean Air Act and presentation to the EPA Science Advisory Board (*American Mining Congress and The Fertilizer Institute*);
- review of the scientific basis of the sum rule proposed in AECB regulation C-83 (*Denison Mines Limited and Rio Algom Limited*);
- review and comments on the U.S. EPA's 18 July 1992 Notice of Proposed Rulemaking for the National Primary Drinking Water Regulations for Radionuclides: U, Ra, Rn-222 (*American Mining Congress*);
- evaluation of radiological exposures of uranium mine and mill worker in light of the new proposed ICRP and AECB dose limited for uranium mines in Saskatchewan (Uranium Saskatchewan Association Inc.) and for Rio Algom's Stanleigh Mine in particular (*Rio Algom Limited*);
- review and update of regulatory framework (federal and Saskatchewan) for uranium developments in Saskatchewan (*PNC Exploration (Canada) Co. Ltd.*);
- extensive review and compilation of all applicable federal and provincial legislation, both existing and proposed, in support of a compliance audit of a uranium mine (*Rio Algom*); and
- development of recommendations for environmental control legislation appropriate to Namibia (*Rössing Uranium Limited*).

Environmental Audits

- preparation of a compliance audit of the mining, milling and tailings operations of a major uranium producer, including the identification and documentation of those processes, procedures or situations which had the potential for exceedence of regulatory criteria, guidelines or policies (*Rio Algom*);
- an audit to identify areas or facilities of actual or potential environmental significance in support of the formation of a joint venture for an existing uranium mine and milling operation (*Confidential Client*);
- a compliance audit of an Ontario gold mine in support of the company's policy to conduct routine environmental inspection of facilities; including a review of hazards, an evaluation of procedures, assessment of compliance, identification of potential liabilities and preparation of recommended potential solutions (*Confidential Client*);

- review of five salt mining and production facilities on behalf of a potential bidder in the acquisition of salt production assets in order to confirm environmental audit findings provided by the vendor and to solicit further information with respect to the environmental controls, performance and regulatory status of the facilities (*Confidential Client*);
- a screening level audit, including inspection of mine and processing plants, completion of a compliance review, and evaluation of waste management practices, as a condition of sale of a talc mine (*U.S. Borax Inc.*);
- development of a company audit policy and preparation of audits of more than ten mine and mill properties (*LAC Minerals Limited*);
- due diligence audit of Rabbit Lake operations (*Cameco Corporation*); and
- audits of a yttrium plant (*Denison Mines Limited*), the Gibraltar and Endako Resources mining properties (*Stikeman, Elliot and Newmont*).

MINE DECOMMISSIONING AND CLOSURE

SENES Consultants Limited (SENES) offers a broad spectrum of skills and experience related to mining projects in the areas of environmental monitoring, modelling and assessment; tailings management; waste rock management; waste water treatment; acid mine drainage assessment; close-out, decommissioning and reclamation; occupational health and safety; hearings and inquiries; and legislative reviews.

Legislation has only recently been enacted in several provinces to set standards for the closure of mines and the rehabilitation of land used for mining activities. In some provinces, closure plans are now mandatory for all new and existing mines, and although each plan will be unique, basic information requirements are standard in every closure plan. These include a before/after site assessment, an explanation of the intended work on the site, a description of the rehabilitation measures to be carried out during operation and closure, as well as identification of any long-term management needs.

For many years federal jurisdictions, such as the Atomic Energy Control Board, have required closure plans and decommissioning strategies to be approved prior to close-out of a mine. SENES has been involved in many mining projects involving federal agencies and has extensive experience in both the development and implementation of closure plans. Specific examples of mining projects undertaken by SENES involving decommissioning and closure are summarized below.

BASE METAL MINES

Copper Cliff Tailings Area

SENES evaluated long-term disposal and closure alternatives for the Copper Cliff tailings in 1993, and updated the evaluation in 1996. The 1993 study evaluated seven primary options which included a base case (which was the plan in effect at that time), dam raising utilizing low sulphur tailings, construction of dams with an impervious core, changes to the physical area to be used for tailings disposal, the use of cut-off walls and clay caps, the use of a thickened tailings cone, and the application of an oxygen barrier cap. The 1996 update evaluated the 1993 closure plan based on how the tailings area had been developed over the three intervening years, the implications of new laboratory and field research, production testing of low sulphur tailings, and emerging acid mine drainage control technologies. (*INCO Limited*) - 31331

East Kemptville Tin Mine

SENES was the prime consultant for preparation of the mine's Closure Plan. In the absence of specific closure guidelines in Nova Scotia, the overall plan under development has been structured to meet Ontario mine closure guidelines. The closure plan must address acid generation concerns and the associated releases of contaminated runoff and seepage. The closure plan addresses all components of the mine including mill facilities, fuel storage, miscellaneous buildings, hazardous waste management, refuse, demolition debris, open pit mines, ancillary facilities, low grade ore, waste rock and tailings.

The plan evaluated reclamation options from end cost and environmental perspectives and has recommended a closure proposal which minimizes cost while meeting Rio Algom's environmental policies. (*Rio Algom Limited*) - 31072

Kam Kotia Mine Property

In 2000, SENES Consultants Limited was the successful bidder for the Phase 1 Kam Kotia Mine Site Rehabilitation Study undertaken on behalf of the Ontario Ministry of Northern Development and Mines. The Kam Kotia copper-zinc mine operated intermittently between the 1940s and 1967. Sulphidic tailings and waste rock disposed in many areas across the mine property generated acid drainage that adversely impacted the receiving environment. An expert team led by SENES was given the task to develop a rehabilitation plan that includes practical and cost-effective strategies to address the immediate environmental concerns at the site which relate to impacts to receiving waters and fish habitat; and allows for the progressive rehabilitation of the site by the Province. The Kam Kotia site includes three extensive tailings areas, waste rock piles, two mine plant sites, the former mill site, old power line, crown pillar, and areas impacted by acid drainage. (*Ontario Ministry of Northern Development and Mines*) - 32800

Kidd Creek Zinc Mine

A closure plan for Kidd Creek's 1015 ha thickened tailings management area was prepared and submitted to the Ontario Ministry of Development and Mines in 1997, in accordance with Ontario regulations. The closure plan describes the history of the site and its current condition, and then presents the preferred

rehabilitation plan for the site, which is designed to inhibit the production of acid drainage. The closure plan addresses the long-term physical and chemical stability of the tailings management area, and the requirements for long-term collection and treatment, care and maintenance, and monitoring. (*Falconbridge Limited*) – 32016, 32201

LAC Minerals Inactive Mine Sites

SENES provides ongoing advice regarding more than ten inactive mine sites owned by LAC Minerals. The services rendered include periodic site visits, evaluation of environmental data collected from ongoing monitoring program and investigation of specific concerns as they arise. (*LAC Minerals Ltd.*)

Levack/Onaping Area Nickel-Copper Mines

This project involved development of closure plans for ten underground nickel-copper mines located near Sudbury, Ontario. One closure plan was developed for all ten mines since the mines are located so closely together that the closure plans cannot be made in isolation. Closure strategies for the entire area were developed and evaluated, and the preferred closure methods were then documented in a report submitted to the Ontario Ministry of Northern Development and Mines, in accordance with Ontario regulations. Issues addressed included management of waste rock and tailings, long-term physical and chemical stability, and requirements for long-term treatment, care and maintenance, and monitoring. (*Falconbridge Limited and INCO Limited*) – 32088, 32089, 32090

Nanisivik Base Metal Mine

SENES provided advice and guidance to Nanisivik Mines regarding the closure of the lead/zinc mine located on the northern tip of Baffin Island. SENES' role has been to review data, recommend appropriate studies, provide expertise and written submissions for components of the closure plan and to support the company as necessary in public meetings. (*Nanisivik Mines Limited*) – 30403, 31152

Neves Corvo Base Metal Mine

SENES was a member of a team which developed the conceptual closure plan for the Somincor/Rio Tinto copper tin mine in Portugal. The closure plan has been recently completed although current reserves should extend operations for another 15 years. SENES' role was to evaluate the major environmental concerns such as acid mine drainage and hazard waste management, and develop operational practices to minimize closure costs. In this regard, several operational changes have

been implemented at minimal cost and will save several million dollars at closure. (*Somincor/Rio Tinto Corporation*) – 31061

North Coldstream 'Copper Mine Tailings Management Areas, Ontario

SENES Consultants Limited had key roles in the development, implementation and post-closure monitoring of two tailing management areas at the historic North Coldstream Copper Mine located northwest of Thunder Bay, Ontario. The work conducted by SENES included: an extensive two year long field investigation program aimed at better understanding the characteristics of the tailings, hydrological and hydrological conditions, and assessing impacts to the receiving environment; development of the closure strategy; preparation of detailed 'For Construction' Engineering Drawings; audits of the closure construction activities to ensure that the works were carried out in compliance with the closure plan. TMA – 1 was decommissioned using an engineered dry cover with a capillary break layer. An extensive search was undertaken by SENES to identify and characterize suitable cover materials. The tailings containment dam was reprofiled and bolstered. TMA – 2 was decommissioned by dredging the tailings beach and relocating the material to deeper parts of the pond. (*Alberta Energy Corporation*) – 32666, 32711

Selbaie Base Metal Mine

SENES has provided advice and guidance to both BP Selco and Billiton Metals regarding closure plan options and costs for La Mine Selbaie operation. (*Billiton Metals Canada Inc.*) – 30662

Willroy Base Metal Mine

On this project, SENES assisted LAC Minerals in developing a closure plan for the Willroy lead/zinc mine. SENES' role was to assess current environmental effects, address remedial actions and provide input on environmental aspects of the closure plan. (*LAC Minerals Ltd.*) – 30106, 30838, 30984

Winston Lake Zinc Mine, Ontario

SENES participated in the development of decommissioning plans for Winston Lake mine in the early 1990's and has continued to provide ongoing advice on environmental matters throughout the mine closure and reclamation process. SENES designed and supervised the operation of experimental columns which were used to demonstrate the effectiveness of water cover as a reclamation option for the tailings basin. A detailed assessment of the potential for AMD

formation in the mine workings demonstrated that flooding the workings was advisable to prevent groundwater and surface water contamination problems. To accelerate recovery of water quality and aquatic biota in the Whitesand River immediately downstream of the tailings pond discharge, diversion of the effluent to flood the mine was recommended and implemented. Work on rehabilitation of a meromictic lake, which was affected by the tailings pond discharge, continues. (*Inmet Mining Corporation*) - 31162, 31685, 32489, 32594, 32621, 32663, 32740, 32758

COAL MINES

Coal Ash Usage, Germany

SENES prepared a literature review which examined research studies and field applications on the use of coal ash as an alkaline amendment for amelioration of acidic drainage from waste rock, and for treatment of acidic mine water. SENES subsequently performed geochemical modelling of the flooding of an historic mining region, to assess the effects of alkaline coal ash on mine water quality which had been used as sealant material in the underground drifts and as an alkaline backfill within caved zones throughout the mines. The assessment included evaluation of data on the geochemical characteristics of coal ash and the simulation of mine water quality in a vast area of mine workings affected by AMD. (*Federal Ministry of the Environment, Germany*) - 31691

Coal Mining, North America

SENES completed a comprehensive study in 1996 on the North American practices associated with coal mine waste management. The study included both state-of-the-art literature searches and direct correspondence with mining industry sources. (*Confidential Client*) - 31691

Coal Mining, Nova Scotia

SENES conducted a strategic management workshop for the Cape Breton Development Corporation, Nova Scotia - a coal mining company - titled "Strategic Planning Session for the Environment". The objective of the workshop was to help the top management of the company identify, prioritize and draw up an action plans for effective environmental management of the company's operations including potential closure liabilities. (*Cape Breton Development Corporation*) - 32243

Coal Mining, Poland

SENES has recently been retained by Industry Canada

to develop an environmental joint industry/government workshop to be held in Poland to address the environmental issues related to coal mining operations, rehabilitation, decommissioning and closure. (*Industrial Canada*) - 32210

Coal Discard Dumps, South Africa

In association with Pulles Howard and DeLange (PHD), SENES completed a geochemical modelling assessment of decommissioning options for three large coal discard piles in South Africa. The modelling performed by SENES included: physical modelling of the transport of heat and air in the piles; geochemical modelling of the generation of acid and the production of contaminated seepage from the piles over the short-term and long-term, for several pile rehabilitation options; and, hydrological modelling of an ideal engineered soil cover that was proposed for remediation of the piles. (*PHD*) - 32264, 32406, 32697

Coal Refuse Piles, North America

SENES performed a geochemical modelling study of the effects of various treatment options (e.g. compaction, alkali addition, bactericide) on the generation of acidic drainage from coal refuse piles. This study included simulation of several small coal refuse test piles, as well as a large acid-generating pile, and comparison of the model predictions to monitoring data collected from the site.

Coalspur Project, Alberta

SENES provided expertise for the assessment of the environmental effects of developing an open pit coal mining operation in the Albertan foothills. Tasks undertaken included the development of estimates of air and water emissions to evaluate the potential atmospheric and aquatic impacts. (*Dentherm Resources Limited*) - 30057

Quintette Coal Mine, British Columbia

SENES was lead consultant on the preparation of a comprehensive environmental impact assessment for the largest coal mine in Canada - Quintette Coal. The assessment involved all aspects of the environment, including: air quality, water quality, land use, and biological studies. The environmental permit applications were completed under the direction of SENES and following extensive regulatory review, the necessary approvals were received. (*Quintette Coal Limited*) - 30054

PRECIOUS METAL MINES

Detour Lake Gold Mine - Canada

SENES undertook an overall assessment of the acid generation potential of tailings, waste rock, the open pit and low grade ore dumps at the Detour Lake mine in northeastern Ontario. The assessment included an evaluation of potential concerns and development of recommendations to mitigate future concerns. The report also reviewed potential closure options and costs. (*Placer Dome Inc.*) - 30805

Doyon Gold Mine - Canada

SENES has undertaken several assessments for LAC Minerals at La Mine Doyon. These studies include: modelling of the acid generation potential of sulphidic waste rock and tailings; a research investigation into cyanide degradation in the tailings pond; investigation of alternative water supply and water management; a research investigation into cover material alternatives for capping acid generating waste rock; a technical review of the mine water treatment system operation, including recommendations for upgrading the system and for sludge management; identification of long-term closure concerns; and, providing advice on appropriate management and mitigative measures to address decommissioning of the site. (*LAC Minerals Ltd.*) - 30060, 30188, 30391, 30402

ERG North Basin, Ontario

This project involved the development of closure options and recommendation of a plan of action for the remediation of the ERG North tailings basin. The study involved site reconnaissance; a downstream biological survey; sampling and analysis of tailings solids, pore water and pond water; ABA testing; and geotechnical input regarding dam stability. (*Ministry of Northern Development and Mines*) - 31396

Equity Silver Mine - Canada

SENES provided technical support to Equity Silver in the development of their reclamation proposal for high sulphide bearing waste rock piles. The Equity plan for closure of acid waste piles involved covering the piles with clay and treatment of residual runoff for as long a period as required. SENES developed a predictive, screening level model to assess acid generation rates with and without cover as well as for various types of cover material. The suitability of local materials was tested in the laboratory. The model results were used to

support Equity's position that the current bonding cost provisions were adequate. (*Equity Silver Mines Limited*) - 32180

Les Mines Est Malartic Ltée and Les Terrains Aurifères Malartic Ltée, Quebec

SENES was retained by Lac Minerals to undertake an assessment of long term acid generation problems at two operating mines, Les Mines Est Malartic and Les Terrains Aurifères in northern Quebec. This work included modelling, cost analysis and assessment of the environmental benefits of various decommissioning options. In addition, SENES undertook an evaluation of water quality data collected at the sites and provided technical guidance on waste water treatment system operation. (*LAC Minerals Ltd.*) - 30060, 30747, 30913, 31638

Matachewan Gold Mine - Canada

SENES was retained as MCML's private consultant to provide site assessment and technical advice relating to environmental impacts, tailings management, remedial investigations and cleanup requirements for the failure of a 150,000 m³ tailings area and subsequent effluent discharge into Davidson Creek and the Montreal River near Matachewan, Ontario. SENES' responsibilities included developing the necessary programs to address the requirements of Orders issued by the MOE and MNR and participating in Environmental Appeal Board Hearings relating to appeal of the Orders. The assignment involved reviewing all of the investigation, evaluation, design and construction activities undertaken by the Regulatory authorities both during and after the failure. (*Matachewan Consolidated Mines Limited*) - 31780

Owl Creek Gold Mine Waste Rock Dump

SENES was part of a team which evaluated closure options for the Owl Creek gold mine in northern Ontario. The major concern was acid generation from the waste rock dump. SENES undertook an assessment of the acid generation and long-term nature of the acid problem and evaluated the environmental effects of several closure options. The data was integral in the mine's selection of pit disposal for resolution of a major environmental liability. (*Falconbridge Gold Corporation*) - 30855

URANIUM MINES

Agnew Lake Uranium Mine

Assistance was provided to Agnew Lake Mines in the receipt of approval to allow the Atomic Energy Control Board (AECB) decommissioning license to lapse. SENES completed a pathways analysis for the site and coordinated and submitted the final monitoring summary report for the five year transition monitoring phase. SENES also provided testimony before a hearing with the AECB in support of Agnew Lakes application which was approved. Ownership of the property now resides with the Province of Ontario. (*Kerr Addison Mines Limited*) - 30544

Atlas Tailings Pile Reclamation

SENES undertook a comparative screening level risk assessment of the proposed on-site reclamation plan and an alternative off-site reclamation option for this 10.5 million ton uranium tailings pile situated near Moab, Utah. The project included review of planned activities and assessments of associated radiological and non-radiological risks to the environment, public, and reclamation workers along with a comparison to the "no action" base case. In NRC's EIS assessment, staff concurred with the results of the SENES risk analysis. In addition to the risk analysis, SENES performed a review of the NRC regulatory and decision making framework, a review of Title I and Title II reclamation precedents and costs, carried out probabilistic cost estimate sensitivity analyses, and assisted Atlas and national counsel in development and presentation of public information and in producing comprehensive responses to NRC's DEIS and DTER. (*Atlas*) - 31601

Beaverlodge Uranium Mine

An engineering feasibility study was undertaken by SENES to assess the engineering requirements and the environmental and cost implications of several potential reclamation concepts for the ultimate close-out of the Beaverlodge uranium mine/mill facility in northern Saskatchewan. Reclamation concepts were developed for each component of the mine/mill facility including the tailings areas, tailings spills, waste rock piles, mine water sludges, mines, mill and ancillary facilities. Detailed pathways analyses were subsequently undertaken for selected reclamation options. Site-specific radiation measures, an evaluation of eating habits specific to the area, and a literature search of critical pathways parameters (e.g. water to fish transfer factors) were used to estimate the potential radiation exposures resulting from several reclamation options. A water quality model was developed mainly to simulate

uranium and radium-226 levels over an extended timeframe for input to the pathways analysis.

The mine was successfully decommissioned and reclaimed. The Province of Saskatchewan and Eldorado Resources (now Cameco) have jointly participated in monitoring the transition years. The facility has largely performed as expected and negotiations are ongoing for transfer of the property back to the Crown. (*Eldorado Resources Limited*) - 30104, 30048, 30099

Chemical Reaction Modelling in Reactive Tailings

The primary objective of this work was to provide a model for predicting the long-term potential of acid generation in sulphidic tailings and for evaluating the effects on acid generation of alternative closeout concepts. The initial version of the model framework, known as the Reactive Acid Tailings Assessment Program (RATAP), was developed over the course of several projects under contract to the Canada Centre for Mineral and Energy Technology. The initial version of the model was designed to predict, on a long-term basis, the rate and the extent of acid generation and concomitant major geochemical events brought about by the chemical and microbial oxidation of pyrite in uranium tailings. This model was subsequently adapted to base metal tailings (RATAP.BMT) by including other sulphide ores such as arsenopyrite, galena, pyrrhotite and sphalerite. It consists of eight modules: initial inventory, soil temperature, oxidation kinetics, oxygen transport, sulphide oxidation, solute transport, aqueous speciation, and trace metal chemistry. The program can be run in a probabilistic or a deterministic manner. The original version of the model (RATAP) has been calibrated and validated extensively on pyritic uranium tailings. Partial validation of the modified computer model (RATAP. BMT) has been performed using field study data on the high sulphide tailings at Waite-Amulet in northeastern Quebec, some relevant data from pyritic uranium tailings investigations in the Elliot Lake area of northern Ontario, and laboratory observations. (*Energy, Mines and Resources Canada; now Natural Resources Canada*) - 30470, 30947

Collins Bay Uranium Mine

To assess the impact of a waste rock pile and open pit, laboratory scale leaching studies were designed and evaluated to determine the acid generation potential and the leachability of metals and radionuclides from the mine wastes. The project involved the development of a water quality model to assess reclamation strategies for the B Zone open pit and waste rock pile developed adjacent to Collins Bay on Wollaston Lake. The model

simulated metal and radionuclide leaching from waste rock, mineralized waste and exposed ore and evaluated the potential benefits of reclamation alternatives. Pathways analyses to estimate the radiation exposure of local residents in the Wollaston Lake area of northern Saskatchewan were also prepared. (*Cameco Corporation*) – 30457, 30575, 30931, 31303, 31522

Denison Uranium Mine

SENES was a member of a team which developed and finalized the closure plan for the Denison mine/mill facilities and waste management area at Elliot Lake in northern Ontario. SENES' role is to complete all environmental components of the study, address acid generation controls and determine long-term environmental impacts, including modelling of the long-term dose to local inhabitants. The project also entailed the assessment of environmental and human health risks of accidental events and failures. (*Denison Mines Limited*) – 31403, 31430, 31433, 31803, 31804

Germany Uranium Mines

The re-unification of east and west Germany has provided an unparalleled challenge related to the publicly acceptable and cost effective environmental decommissioning of the former East German uranium mining and processing industry.

Since 1991 SENES has been advising the West German Federal and State Ministry's of the Environment on the complex environmental and scientific needs associated with decommissioning and rehabilitating lands and surrounding areas affected by the former East German uranium industry.

The decommissioning challenges related to this program are equal to or greater than any such task previously faced by the western mining industry. Key issues that need to be addressed include, among many:

- rehabilitation of more than 500 million m³ of waste rock;
- restoration of background natural waters which have been altered by more than 40 years of mining;
- cleanup and release of more than 8,800 acres of surface lands;
- stabilization and decommissioning of large scale settling basins containing chemical and radioactive contaminants.

In addition to the scientific and engineering needs, all of the above works must be addressed in a cost effective and timely manner within the complex infrastructure resulting from reunification of the two Germany's. Additionally, the work is complicated through the close proximity of large populations that will be affected by all actions.

Based on our recognized leadership in the area of radiological and environmental sciences, and a proven record of practical and effective application of these sciences and management practices, SENES Consultants Limited has played a key role in the assessment of the above issues and the development of strategies addressing the need for a long term integrated decommissioning plan that will meet with government and public acceptance. (*Germany Environment Ministry*) – 30915, 30915-3

Lacnor, Nordic, Pronto and Spanish American Uranium Mines

SENES completed an overview of closure options and costs for five inactive sites currently under long term care and maintenance in the Elliot Lake area of northern Ontario. The principal concerns at these properties pertained to long-term acid production from the sulphidic tailings and the ongoing operation of effluent treatment plants. (*Rio Algom Limited*) - 32339

Quirke and Panel Uranium Mines

SENES has participated in several investigations over the years aimed at the development of decommissioning plans for the Quirke and Panel uranium mines, mills, and associated waste management areas located in the Elliot Lake region of northern Ontario. This work has progressed through a review of options, preparation of an environmental and radiological pathways analysis, presentation of the decommissioning proposals to the Atomic Energy Control Board (AECB) and preparation of six environmental screening reports for submission to the AECB in accordance with the EARP process. All decommissioning activities and their attendant environmental impacts were identified; specific ameliorative and mitigative actions were recommended as required.

The decommissioning plan proposed for the Quirke tailings area involved the construction of an elaborate dam and dyke system to facilitate the flooding of the tailings management area, the institution of an interim mine dewatering program, and the implementation of radiological protection and decontamination methodologies. At Panel, the closure plan

recommended for the tailings area entailed raising the perimeter dams to flood the tailings and thus control acid production and long-term contaminant migration of the receiving environment. (*Rio Algom Limited*) – 30541, 31249, 31353, 31772, 31803, 31804, 31110, 31123, 31124, 32495

Rabbit Lake Uranium Mine, Saskatchewan

SENES recently conducted a field program at the Rabbit Lake minesite followed by a laboratory program in order to characterize waste rock and mineralized waste, and to monitor the leachability of these materials. The program involved rock sampling, which included documentation of sample characteristics, field paste pH and conductivity measurements, and seepage water sampling. The laboratory program involved geochemical analyses and static tests (acid base accounting) followed by dynamic testwork (humidity cells and saturated columns) as well as leach tests and buffering tests. The interpretation of the results included evaluation of acid generation and leaching potential. The information from this assessment was subsequently used in geochemical modeling of the waste rock piles and in an environmental pathways analysis. (*Cameco Corporation*) – 32473

Stanleigh Uranium Mine

SENES prepared a conceptual closure plan in 1990 for the Stanleigh mine and mill facilities and waste management area. The closure plan was required as a condition of the Atomic Energy Control Board regulatory guide. The plan is presently under revision and being updated to reflect current developments from Rio Algom's Quirke and Panel closure plan studies. (*Rio Algom Limited*) – 30799, 31106, 31158, 31677, 31960

Stanrock Waste Management Area

The tailings in the Stanrock Waste Management Area (WMA) at Elliot Lake, Ontario, pose the usual acid mine drainage (AMD) problems associated with sulphidic mine wastes. Treatment of runoff and seepage from the WMA has been practised for two decades for neutralization of acidity, precipitation of heavy metals and removal of radionuclides. Faced with the prospect of continuing to treat the AMD for tens of years into the future, an investigation was undertaken to assess the costs and benefits of moving the tailings to a new facility or constructing new impermeable structures around the existing WMA, versus leaving the tailings in place and continuing to treat the AMD and handle the chemical sludge produced during treatment. The long-term acid generation potential of the tailings was modelled to assess how long into the future acid will continue to be produced from oxidation of the iron

sulphide minerals. The investigation showed that the costs associated with all potentially viable options were high, although the benefits varied widely. (*Denison Mines Limited*) – 31405, 31430, 31433, 32222

Uranium Tailings Assessment Program Development

SENES developed, under contracts to the National Uranium Tailings Program administered by CANMET, Energy Mines and Resources Canada, a probabilistic computer model for predicting the long-term effects of sulphidic uranium mill tailings close-out options. The project involved: evaluation of three potential computer codes for carrying out a probabilistic assessment; delineation of the principal characteristics of a typical reference tailings site; selection of key pathways of radionuclide exposure of reference receptors; development of source term, environmental compartment, transfer, and dose models; assessment of the probability distributions and main attributes of the input parameters; evaluation of sensitivity and uncertainty analysis techniques for application to the output results; and execution of preliminary probabilistic assessments for selected tailings close-out options. The principal focus of the project was on the development of a flexible but user-friendly probabilistic assessment code. In addition to the concepts outlined above, the Uranium Tailings Assessment Program (UTAP) handles time dependency, spatial dependency, variable site characteristics, and numerous radioactive and non-radioactive contaminants. (*Energy Mines and Resources Canada*) - 30206

REGULATORY REQUIREMENTS

Decommissioning Guidelines

SENES was retained by INCO to develop guidelines to aid the site and facility managers in preparing decommissioning plans in response to the requirements of Bill 71 (new Mining Act and Regulations) which came into force in Ontario in June 1991.

The guidelines present an approach for determining and evaluating site closure and rehabilitation requirements and include a compendium of issues which must be addressed. The guidelines and several case studies previously undertaken by SENES were presented at a workshop for a group of INCO's facility managers. (*INCO Limited*) – 30944

Environmental and Occupational Regulatory Requirements

The objective of the review was to identify and document environmental and occupational regulatory requirements at the federal and Ontario levels relevant to all aspects of uranium mining and milling. The scope of the study included both current and pending acts, regulations, criteria, guidelines and objectives that apply to emissions to air and water, noise, waste management, transportation, decommissioning, occupational environment, WHMIS (Work Place Hazardous Materials Information System) and occupational health and safety. *(Rio Algom Limited)*

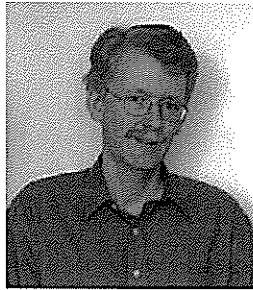
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APPENDIX C

SRK Curricula Vitae

Daryl Hockley

Principal



Profession Civil/Environmental Engineer

Education M.Eng., Civil Engineering, McMaster University, 1989
B.A.Sc., Civil Engineering, University of British Columbia, 1986

**Registrations/
Affiliations** P.Eng., Association of Professional Engineers and Geoscientists of B.C.
P.Eng., Association of Professional Engineers, Geologists and Geophysicists of NWT

Specialisation Mine closure, Waste characterization and management, Mine water management, Contaminant hydrogeochemistry

Expertise Daryl is a Principal in the GeoEnvironmental Engineering Division of SRK Canada. He is a civil engineer with a Master's degree in environmental engineering.

Daryl has taken a lead role in SRK's contribution to many northern mine closure projects with DIAND and PWGSC over the last ten years. He has been SRK's Project Principal on the Giant Mine, Colomac, and Faro projects, and has made technical contributions to the Arctic Gold & Silver, Venus, Discovery, Rayrock and Port Radium projects. In that role he has directed workshops to identify possible closure methods and critical investigation needs, directed and reviewed the results of investigation programs, and authored reports ranging from study reviews to complete Remediation Plans. He also worked directly with CSP Headquarters on program development projects, including the original PP&A forms, and development and implementation of the risk management system. Daryl has also been SRK's Project Principal on several mine closure projects for industry in Canada, USA, South America and Asia. Northern examples include developing a closure plan for Red Dog Mine in Alaska, inspecting closure measures and estimating the remaining liabilities at the Brewery Creek Mine in the Yukon, and developing closure cost estimates for the Lupin, Nanisivik and Jericho mines in Nunavut.

Daryl has also directed applied research projects in his areas of interest, including reviews on mathematical modeling of acidic drainage and on measures to delay the onset of acidic drainage. He has authored or co-authored over forty technical papers, and has presented short courses on his areas of expertise to industry and regulators.

Daryl Hockley

Principal

Employment Record

1998 to present	SRK Consulting (Canada) Inc., Principal
1994-1998	Steffen, Robertson and Kirsten (Canada) Inc., Division Head, GeoEnvironmental Engineering
1992-1994	Steffen, Robertson and Kirsten (Canada) Inc., Senior Engineer and Project Manager
1990-1992	AJBL Consultants Limited, The Netherlands, President and Engineer
1988-1990	Netherlands Energy Research Foundation, The Netherlands, Visiting Engineer
1986-1988	Wastewater Technology Centre, Environment Canada, Hamilton, Ontario, Contract Engineer

Publications	First author of 22 papers and conference proceedings. Co-author on 20 papers and conference proceedings.
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Languages	English
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Daryl Hockley

Principal

Publications and Seminar Presentations

1. Hockley D.E., M.M. Noel, E.M. Rykaart, S. Jahn and M. Paul (*July 2003*). "Testing of Soil Covers for Waste Rock in the Ronneburg WISMUT Mine Closure". Sixth International Conference on Acid Rock Drainage, Cairns, Australia.
2. Chapman J., D.E. Hockley, K. Sexsmith, B. Arthur and S. Donohue (*July 2003*). "Testing Acid Generation in Cemented Paste Backfill". Sixth International Conference on Acid Rock Drainage, Cairns, Australia.
3. Chapman J., B. Williams, K. Ramsey, D.E. Hockley, M. Noel, and M. Rykaart (*July 2003*). "Design and Installation of Large Scale Lysimeters to Assess Cover Performance at the Normandy Mt. Leyshon Mine, Queensland". Sixth International Conference on Acid Rock Drainage, Cairns, Australia.
4. Sexsmith K., D.E. Hockley, J. Chapman, N. McKay, G. Sevic and K. Black (*February 2002*). *Mineralogical Examination of Carbonates in the Crandon Ore and Tailings*. SME 2002 Annual Meeting, Phoenix AZ.
5. Lefebvre R., D.E. Hockley, J. Smolensky and P. Gélinas (*2001*). "Multiphase Transfer Processes in Waste Rock Piles Producing Acid Mine Drainage, (1) Conceptual Model and System Characterization". Journal of Contaminant Hydrology, Special Number on Coupled Process Models in Subsurface Environments, Motomu Ibaraki and Rene Therrien, Eds.
6. Lefebvre R., D.E. Hockley, J. Smolensky and A. Lamontagne (*2001*). "Multiphase Transfer Processes in Waste Rock Piles Producing Acid Mine Drainage, (2) Applications of Numerical Simulation". Journal of Contaminant Hydrology, Special Number on Coupled Process Models in Subsurface Environments, Motomu Ibaraki and Rene Therrien, Eds.
7. Hockley D.E., S. Schultz and M. Nahir (*July 2001*). "Analysis and Selection of Closure Measures for Northern Canadian Mines". Skelleftea, Sweden.
8. Hockley D.E., J. Smolensky S. Jahn and M. Paul (*June 2000*). "Geochemical Investigations and Gas Monitoring of an Acidic Waste Rock Pile". Fourth International Conference on Acid Rock Drainage, Denver.
9. Hockley D.E., S. Day, R. Howell and J. Cowan (*September 2000*). "Environmental Geochemistry of Uranium Mining: Implications for Groundwater Protection". Seventh International Mine Water Association Congress, Ustron, Poland, 11-15, pp. 384-397.
10. Hockley D.E. (*November 1999*). "A Bird's Eye View of ARD Issues". Presented at Copper Hydromet 99, Vancouver, B.C.
11. Smolensky J., D.E. Hockley, R. Lefebvre and M. Paul (*September 1999*). "Oxygen Transport Processes in the Nordhalde of the Ronneburg Mining District, Germany". Mining and the Environment II, Sudbury, Ontario.
12. Smolensky J., D.E. Hockley, R. Lefebvre and M. Paul (*September 1999*). "Oxygen Transport Processes in the Nordhalde of the Ronneburg Mining District, Germany". Mining and the Environment II, Sudbury, Ontario.

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13. Lefebvre R., J. Smolensky and D.E. Hockley (*February 1998*). "Modelling of Acid Mine Drainage Physical Process in the Nordhalde of the Ronneburg Mining District, Germany". TOUGH Workshop, Lawrence Livermore National Laboratory.
14. Hockley D.E., J. Chapman, G. Sevick and D. Moe (*January 1998*). "Estimating Contaminant Concentrations in a Re-Flooded Underground Mine". Tailings and Mine Waste, Denver, Colorado.
15. Delaney T.A., D.E. Hockley, J.T. Chapman and N. Holl (*January 1998*). "Geochemical Characterization of Tailings from the McArthur River Mine, Saskatchewan". Tailings and Mine Waste, Denver, Colorado.
16. Chapman John, Daryl Hockley, Jerry Sevick, Richard Dakel and Michael Paul (*January 1998*). "Pit Backfilling on Two Continents, Comparison of Recent Experience in the Wismut and Flambeau Projects". Tailings and Mine Waste, Denver, Colorado.
17. Sevick G.W., N. Paruvakat, K.P. Black and D.E. Hockley (*January 1998*). "Engineered Upland Sulfide Tailings Management Facility". Tailings and Mine Waste, Denver, Colorado.
18. Delaney T.A., D.E. Hockley and D.D. Sollner (*June 1997*). "Review of Methods for Delaying the Onset of Acid Mine Drainage". Fourth International Conference on Acid Rock Drainage, Vancouver, B.C.
19. Hockley D.E., M. Paul, J. Chapman, S. Jahn and W. Weise (*June 1997*). "Relocation of Waste Rock to the Lichtenberg Pit near Ronneburg Germany". Fourth International Conference on Acid Rock Drainage, Vancouver, B.C.
20. Delaney T.A., D.E. Hockley and D.D. Sollner (*June 1997*). "Review of Methods for Delaying the Onset of Acid Mine Drainage". Fourth International Conference on Acid Rock Drainage, Vancouver, B.C.
21. Hockley D.E. and J.T. Chapman (*November 1996*). "Waste Rock Remediation Activities in the Ronneburg Mining District". Fourth Annual B.C. ARD Symposium, Vancouver, B.C.
22. Hockley D.E., T. Delaney and J. Smolensky (*November 1996*). "Modeling Acidic Drainage from Waste Rock Piles". Fourth Annual B.C. ARD Symposium, Vancouver, B.C.
23. Hockley D.E. and N. Holl (*1995*). "Investigations of Waste Rock at the Key Lake Mine". Environmental Remediation of Waste Rock Piles, Chemnitz, Germany.
24. Hockley D.E., H.J. Borch and T. Sackmann (*1994*). "Risk Assessment and Risk Management of Contaminated Soil at Signal Hill, CFB Esquimalt". First DND Symposium/Workshop on Risk Evaluation and Assessment, Kingston, Ontario.
25. Hockley D.E. (*1994*). "Mathematical and Physical Models of Acid Rock Drainage". Acid Rock Drainage and Rapid Bio-Assessment Seminar, Boise, Idaho.
26. Hockley D.E., J.L. West, E.L. Livingstone and G. Savei (*January 1994*). "Short Course in Contaminant Hydrogeology". Sponsored by the Technical University of Nova Scotia.
27. van der Sloot H.A., D.E. Hockley, J. Wijkstra and J.A. Stegemann (*1993*). "Self-forming and self-repairing liners for waste isolation". GeoConfine 93, Montpelier, France.

Daryl Hockley

Principal

28. Hockley D.E., H.A. van der Sloot and J. Wijkstra (1993). "Processes at the interface between waste and soil". GeoConfine 93, Montpellier, France.
29. Hockley D.E., H.A. van der Sloot and J. Wijkstra (1992). "Waste-Soil Interfaces". Final Report for NOVEM, the Netherlands Agency for Energy and the Environment, Petten, Netherlands.
30. Hockley D.E., H.A. van der Sloot and J. Wijkstra (1992). "Application of the Self-forming and Self-repairing Seals as Heap Leaching Pond Liners". Final report for Billiton Metals B.V., Petten, Netherlands.
31. Hockley D.E., H.A. van der Sloot and J. Wijkstra (1992). "Criteria for the Design and Implementation of Self-forming and Self-repairing Seals". Interim report for NOVEM, the Netherlands Agency for Energy and the Environment, Petten, Netherlands.
32. Hockley D.E. and H.A. van der Sloot (1991). "Long term processes in a stabilized coal-waste block exposed to seawater". Environ. Sci. Technol., 25 (8) pp 1408-1414.
33. Hockley D.E. and H.A. van der Sloot (1991). "Modelling of interactions at waste - soil interfaces". In WASCON '91: Proceedings of an International Conference on Environmental Implications of Construction with Waste Materials, Elsevier Science, Amsterdam.
34. H.A. van der Sloot, P.M.J. Woodhead, D.E. Hockley and F.J. Roethel (1991). "The long-term behaviour of stabilized coal ash in the sea". In Proceedings of the Ninth Coal Ash Symposium, Electric Power Research Institute, Palo Alto, California.
35. Hockley D.E., J. Wijkstra and H.A. van der Sloot (1991). "Afdichtingen voor deponie en hergebruik van kolenreststoffen: Opsluiten van afval binnen 'natuurlijke' barrières" (Seals for disposal and reuse of coal wastes: surrounding waste with 'natural' barriers.). Energie Spectrum, vol. 15, no.2, pp. 50-55.
36. van der Sloot H.A. and D.E. Hockley (1991). "Milieu-implicaties van reststoffen in de bouw - Conferentie verslag van WASCON '91". (Environmental implications of waste reuse in construction - Conference Summary from WASCON '91.) Energie Spectrum, vol. 15, no.12, pp. 319-320.
37. van der Sloot H.A., D.E. Hockley and J. Wijkstra (1991). "Zelf-vormende en zelf-herstellende afdichtingen: Concept, modellering, en laboratoriumresultaten" (Self-forming and self-repairing seals: concept, modelling and laboratory results). Energie & Milieu Technol., vol 1/2, pp. 27-31.
38. Comans R.N.J. and D.E. Hockley (1991). "Kinetics of cesium sorption on illite". Geochim. Cosmochim. Acta.
39. Hockley D.E. and W.J. Snodgrass (1989). "Effects of methanol cosolvent on 2-methyl naphthalene sorption". In Preprint Extended Abstracts Presented before the Division of Environmental Chemistry, Miami Beach Florida, Sept 10-15, 1989, American Chemical Society, Ann Arbor, Michigan.
40. Hockley D.E. and W.J. Snodgrass (1988). "Mass transfer from petroleum refinery sludges". Presented at Ontario Ministry of the Environment Technology Transfer Conference, Toronto, Ontario.
41. Bulman T.L., K.R. Hosler, B. Ibbotson, D. Hockley and M.J. Riddle (1988). "Development of a model to set clean-up criteria for contaminated soil at decommissioned industrial sites". In Contaminated Soil '88, K. Wolf, W.J. van den Brink, & F.J. Colon, Eds., Kluwer Academic Publishers, Amsterdam.

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42. Hockley D.E., T.L. Bulman and W.J. Snodgrass (1988). "Mass transfer limitations in petroleum refinery land treatment sites". Poster presented at R.S. Kerr Environmental Research Laboratory Annual Meeting, Oklahoma City.
43. Bulman T.L., K.R. Hosler, M.J. Riddle and D.E. Hockley (1988). "Field evaluation of the regulatory and investigative treatment zone (RITZ) model for predicting fate of organic contaminants in soil at closed industrial sites". Paper presented at R.S. Kerr Environmental Research Laboratory Annual Meeting, Oklahoma City.

Daryl Hockley

Principal

Key Experience: SRK Project Experience

ARCO Remediation (California)

- Senior Reviewer, remedial investigations and closure plan for the Leviathan Mine, an abandoned open-pit and underground copper and sulphur mine near the California-Nevada border

Aurora Gold (Indonesia)

- Senior Engineer, closure plan and closure cost estimates for Mt. Muro gold mine, central Borneo

B.C. Ministry of Environment

- Project Engineer, development of water treatment and discharge criteria to replace B.C. Pollution Control Objectives for Mining, Smelting, and Related Industries

BHPBilliton Base Metals (B.C., Arizona)

- Senior Engineer, review of closure plan for Island Copper Mine
- Senior Engineer, risk assessment and closure planning for San Manuel Mine

BHPBilliton Diamonds (NWT)

- Senior Engineer, investigation and thermal modeling of waste rock and permafrost at Ekati Mine

Boliden Westmin Ltd. (B.C.)

- Senior Engineer, development of closure cost estimates for the Gibraltar open pit copper porphyry mine

Brenda Mine (B.C.)

- Project Engineer, modelling of water flow patterns and effects of flow channeling on molybdenum release from waste rock piles

CAMECO Corporation (Saskatchewan)

- Project Principal, review of contaminant loadings from above ground tailings at Key Lake Mine
- Project Principal, prediction of contaminant loadings from waste rock at Rabbit Lake Mine
- Senior Engineer, review of contaminant loads from waste rock at Key Lake Mine
- Senior Engineer, tailings characterization and review of raffinate neutralization processes for Cigar Lake project
- Senior Engineer, tailings characterization and review hearings for McArthur River Mine
- Senior Engineer, prediction of contaminant fluxes from waste rock piles at the Key Lake and Rabbit Lake uranium mines
- Senior Engineer, laboratory investigations and mathematical modelling to estimate uranium, radium, lead, nickel and arsenic release from Key Lake and McArthur River tailings
- Senior Reviewer, design of re-grading and covers for Gaertner Waste Pile, Key Lake Mine

CH2M Gore & Storrie, Ontario Ministry of Environment (Ontario)

- Senior Engineer, remediation of tailings and mine areas at the Deloro Mine site, an abandoned gold mine, cobalt smelter, and arsenic production facility

Confidential Clients (Canada, Mexico, Argentina)

- Senior Engineer, closure and environmental costing for mine valuations

Daryl Hockley

Principal

Cominco Alaska Inc. (Alaska)

- Senior Engineer, development of closure plan for Red Dog Mine
- Senior Engineer, review of proposed closure measures and closure plan for Red Dog Mine
- Senior Engineer, development of water and contaminant load balance for Red Dog Mine

Compania Minera del Sur S.A. (Bolivia)

- Senior Reviewer, evaluation of potential impacts and remediation related to a dam failure and tailings discharge at the Porco Mine

Cyprus Climax Limited (B.C.)

- Senior Engineer, waste rock characterization and development of decommissioning plan for the Kitsault molybdenum mine

Department of Indian Affairs and Northern Development (NWT)

- Project Principal, feasibility study and public consultation on methods to remediate 270,000 tons of arsenic trioxide dust stored underground in Giant Mine
- Senior Engineer, development of abandonment and restoration plan for surface facilities at Giant Mine
- Project Principal, development of remediation plan for Colomac Mine
- Senior Engineer, development of risk assessment and risk management methods for northern mines
- Senior Engineer, review of closure plans and prioritization of budget requirements for management of abandoned mines in NWT and Yukon

Deloitte & Touche Inc. and Type II Mines Office (Yukon)

- Project Principal, closure and decommissioning of Faro, Vangorda and Grum Mines
- Senior Reviewer, risk assessment of Faro Freshwater Supply Dam and design of breach

Equity Silver Mine Ltd. (B.C.)

- Senior Engineer, independent review of environmental liabilities and geological resource at the Equity Silver Mine, on behalf of the Independent Committee of Minority Shareholders

Exploraciones Eldorado S.A (Mexico)

- Senior Engineer, development of a plan and critical path schedule for permitting of expansion of the La Colorada Mine expansion, Mexico

Foth and Van Dyke (Wisconsin)

- Senior Engineer, characterization of depyritized tailings and pyritic paste backfill at the proposed Crandon massive sulphide copper-zinc mine
- Senior Engineer, characterization of sulphidic tailings and modelling of oxygen entry, tailings oxidation, and solute release from the tailings impoundment at the proposed Crandon mine
- Senior Engineer, prediction of solute release from rock and tailings backfill at the proposed Crandon Mine
- Senior Engineer, characterization of waste rock, oxygen transport and alkalinity requirements, and development of procedures for backfilling the Flambeau Mine open pit with limestone amended waste rock

International Skyline Gold (B.C.)

- Senior Engineer, water quality predictions for proposed Bronson Slopes Mine

Daryl Hockley

Principal

Lac Minerals (Ontario)

- Senior Engineer, review of Canadian environmental legislation relevant to the mining industry, as part of development of international code of practice

Lytton Minerals Ltd. (Nunavut)

- Project Manager, environmental studies and permitting of Jericho Project, a diamond deposit located in Nunavut, formerly Northwest Territories

MEND and B.C. Acid Mine Drainage Task Force

- Senior Engineer, review of measures to delay onset of acid generation
- Senior Engineer, review of mathematical models for predicting acid rock drainage from waste rock piles

MINATCO Ltd. (Saskatchewan)

- Senior Engineer, prediction of contaminant release from McLean Lake and Cigar Lake tailings

Minera Escondida Limitada (Chile)

- Senior Reviewer, conceptual decommissioning plan for the Escondida Mine and related facilities
- Senior Engineer, development of conceptual waste management plans for Escondida Mine and Planta Coloso refinery

Minorco Lisheen (Ireland)

- Senior Engineer, assistance with permitting of a 60 ha tailings management facility, to be constructed on a peat bog, for the Lisheen zinc-lead mine
- Senior Engineer, characterization of compacted peat as a low permeability liner, and investigation of geochemical behaviour of tailings (Lisheen Mine as Chevron Ivernia Inc.)

Noranda Mines (B.C.)

- Project Engineer, studies of sulphide oxidation and copper release from waste rock at Granisle Mine

North American Metals (B.C.)

- Senior Reviewer, waste rock characterization and preliminary water quality assessments for the Golden Bear mine and heap leach facility

Pan American Silver Corporation (Peru)

- Senior Engineer, review of acidity control and tailings closure measures for the Quiruvilca Mine

Public Works and Government Services Canada (Yukon and Northwest Territories)

- Senior Engineer, assessment of water management measures and treatment requirements and development of Remediation Plan for Colomac Site
- Senior Engineer, remediation of two mines in the Northwest Territories (Rayrock and Discovery) and two mines in the Yukon Territory (Arctic Gold & Silver and Venus)
- Reviewer, assessment of potential for acid rock drainage at fifteen abandoned mine sites in the Yukon
- Principal, development of specifications for Discovery Mine remediation contract

Reclamation Management of Canada Ltd. (Ontario)

- Site Engineer, environmental and geotechnical supervision of demolition activities at Panel, Quirke, and Quirke II uranium mines

Daryl Hockley

Principal

TVX Gold (Russia)

- Reviewer, ARD and geochemical testing of waste rock from the proposed Asacha Mine

Viceroy Minerals and Loki Gold Corporation (Yukon)

- Senior engineer, preparation of closure plan for Brewery Creek mine and heap leach
- Reviewer, environmental baseline and environmental management documents for permitting of gold mine and heap leach

Wheaton River Minerals Inc. (Yukon)

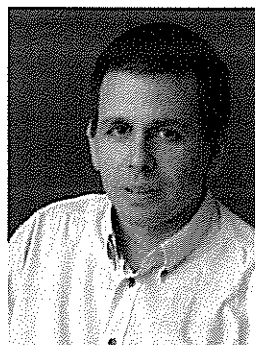
- Project Manager, assessment of risks associated with failure of the tailings pond at the Ketza River Mine
- Senior Reviewer, geochemical investigation of Ketza River tailings and tailings pond closure plan

WISMUT GmbH, (former East Germany)

- Senior Engineer, study of covers over waste rock backfill in the Lichtenberg Pit
- Senior Engineer, review of waste rock neutralization potential and predictive modeling of acid generation
- Senior Engineer, audit of 1996-1998 waste rock relocation program
- Project Manager, cost estimates and assessment of remediation alternatives for Nordhalde waste rock pile
- Project Manager, installation of oxygen monitoring equipment in waste rock, and review of data to predict future trends in water quality
- Project Manager, review and testing of *in situ* remediation measures for acidic waste rock
- Senior Reviewer, block modelling of waste rock piles
- Project Engineer, development of laboratory and field protocols for evaluation of waste rock, and control of waste rock backfilling operations
- Project Engineer, assessment of physical barriers and geochemical remediation methods for the Ronneburg uranium mine complex

Michel Noël

Senior Engineer

**Profession**

Civil and Geotechnical Engineer

Education

B.Eng. Civil, University of Sherbrooke, Canada, 1984
M.A.Sc. Geotechnical, École Polytechnique of Montréal, Canada, 1990

**Registrations/
Affiliations**

Association of Professional Engineers and Geoscientists of British Columbia (APEGBC)
Ordre des ingénieurs du Québec (OIQ)
Association of Professional Engineers, Geologists and Geophysicists of the NWT and Nunavut (NAPEGG)
Canadian Geotechnical Society (CGS)

Specialisation

Michel Noël, M.A.Sc., P.Eng., is a senior geotechnical engineer with the GeoEnvironmental Engineering Division of SRK Canada. He has a degree in civil engineering and a graduate degree in geotechnical engineering. His background includes twenty years of experience in consulting and research, primarily on mine related projects. His experience also includes acid mine drainage, permafrost engineering, numerical modelling, programming, construction supervision and a position as an environmental engineer at a base metal mine. Michel Noël joined SRK's Vancouver office after spending four years with the research team on acid mine drainage at the Australian Nuclear Science and Technology Organisation in Sydney, Australia.

Employment Record

2002- Present	SRK Consulting (Canada) Inc., Vancouver, BC, Canada Senior Engineer
1997-2002	Australian Nuclear Science & Technology Organisation. (ANSTO), Sydney, NSW, Australia, Manager – Computational Services (Business Unit), Researcher (Research Project on Acid Mine Drainage)
1996-1997	Noranda Mining & Exploration Inc., Heath Steele Mines, NB, Canada Environmental Engineer
1992-1995	ADI Group (ADI Nolan Davis), Fredericton, NB, Canada Project Engineer
1988-1992	SNC-Lavalin Inc. (Geocon), Fredericton, NB, Canada Project Engineer
1986-1988	CASTOR Project, École Polytechnique of Montréal, QC, Canada Computer Programmer (part-time)
1985-1988	Héneault et Gosselin Inc., Montréal, QC, Canada Manager and Project Engineer

Publications

See attached

Languages

English and French

Michel Noël

Senior Engineer

Publications

1. Rykaart, M., D. Hockley, M. Noël and M. Paul (2006) "Findings Of International Review Of Soil Cover Design And Construction Practices For Mine Waste Closure". Submitted to the 7th International Conference on Acid Rock Drainage (ICARD), St. Louis, MO. USA.
2. Noël M. and D.E. Hockley (2004). "Thermal analysis of an experimental thermosyphon installed at the Giant Mine in Yellowknife, NT, Canada". Submitted to the 57th Canadian Geotechnical Conference, Quebec, QC, Canada (*in press*).
3. Noël M. and E.M. Rykaart (2003). "Comparative study of surface flux boundary models to design soil covers for mine waste facilities." Submitted to the 6th International Conference on Acid Rock Drainage (ICARD), Australia.
4. Hockley D.E., M. Noël, E.M. Rykaart, S. Jahn and M. Paul (2003). "Testing of Soil Covers for Waste Rock in the Ronneburg WISMUT Mine Closure." Submitted to the 6th International Conference on Acid Rock Drainage (ICARD), Australia.
5. Chapman J., B. Williams, K. Ramsey, D.E. Hockley, M. Noël, and M. Rykaart (July 2003). "Design and Installation of Large Scale Lysimeters to Assess Cover Performance at the Normandy Mt. Leyshon Mine, Queensland". Sixth International Conference on Acid Rock Drainage, Cairns, Australia.
6. Noël M., D.E. Hockley, J.M. Konrad and M. Fredlund (2003). "Literature reviews and thermal modelling to assess in situ freezing of arsenic trioxide dust (As_2O_3) at the Giant Mine in Yellowknife, NWT, Canada." Submitted to the Assessment and Remediation of Contaminated Sites in Arctic and Cold Climates 2003, Canada.
7. Noël M., E.Y. Kuo and A.M. Garvie (2000). "Gaseous oxygen transport and the design of soil covers for waste rock dumps". 53rd Canadian Geotechnical Society Conference, Montréal, QC, Canada, pp. 527-534.
8. Noël M., 2000. "Report on 'Mine, Water & Environment, (1999), International Mine Water Association (IMWA) Congress, Seville, Spain'". Australian Centre for Mining and the Environment Research Workshop 2000, Townsville, Queensland, Australia, pp. 75-80.
9. Noël M. and A.I.M. Ritchie, (1999). "Some physical properties of water transport in waste rock material". 14th annual Symposium International Mine Water Association (IMWA). Seville, Spain, pp. 449-454.
10. Bennett J.W., A.M. Garvie, G. Pantelis, A.I.M. Ritchie, A.V. Bell and M. Noël, (1996). "Comparison of measured and predicted transport processes controlling oxidation in the waste rock piles at the Heath Steele Mines site". Mine and the Environment Sudbury 1996, Sudbury, ON, Canada, pp. 1017-1026.
11. ADI Nolan Davis Inc. (co-author), (1996). "Final Report - Acid Waste Rock Study, Heath Steele Mines". Mine Environmental Neutral Drainage (MEND) Program, Newcastle, NB, Canada, 216 pages.

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Senior Engineer

12. ADI Nolan Davis Inc. (co-author), (1996). "Demonstration Soil Remediation Techniques (DESRT) Project: An Assessment of Air Flow Characteristics of Fractured Sandstone Bedrock and Application of Air Sparging at a Petroleum Contaminated Site". New Brunswick Department of the Environment, Fredericton, NB, Canada, 56 pages.
13. Noël M., L. Stewart and P. Rose, (1995). "An Assessment of Air Flow Characteristics of Fractured Sandstone Bedrock and Application of Air Sparging at a Petroleum Contaminated Site". 4th annual Symposium on Groundwater and Soil Remediation, Calgary, AB, Canada.
14. ADI Nolan Davis Inc. (co-author), (1995). "Engineering Design and Construction, Phase IV - Composite Soil Cover; Acid Waste Rock Study, Heath Steele Mines". Mine Environmental Neutral Drainage (MEND) Program, Newcastle, NB, Canada, 142 pages.
15. ADI Nolan Davis Inc. in association with ANSTO (co-author), (1994). "Assessment of Gas Transfer - ANSTO Model at Heath Steele Mines". Mine Environmental Neutral Drainage (MEND) Program, Ottawa, ON, Canada, 190 pages.
16. Sego D., K. Biggar and M. Noël, (1993). "Laboratory and Field Performance of High Alumina Cement Based Grout for Piling in Permafrost". Canadian Journal of Civil Engineering, Volume 20, pp. 100-106.
17. Holubec I. and M. Noël, (1992). "Pile Load Testing of Grouted Pile across Western Canadian Arctic". 45th Canadian Geotechnical Conference, Toronto, ON, Canada.
18. Sego D., K. Biggar and M. Noël, (1991). "Laboratory and Field Performance of High Alumina Cement Based Grout for Piling in Permafrost". 44th Canadian Geotechnical Conference, Calgary, AB, Canada, Vol. 1, pp. 42.1-42.9.
19. Noël M., (1990). "Étude Paramétrique de l'essai au perméamètre aléteur par la méthode des éléments finis [Parametric study on the reaming permeameter using the finite elements method]". Thesis - Master in Applied Science, École Polytechnique de Montréal, Montréal, QC, Canada, 159 pages.
20. Lafleur J., M. Noël, M. Soulié and D. Desaulniers, (1988). "Influence of Storage Coefficient on the Permeability Testing of Weathered Clay Crust". 41st Canadian Geotechnical Conference, Kitchener, ON, Canada, pp. 174-182.

Michel Noël

Senior Engineer

Key Experience: Permafrost and Ground Freezing

Colomac Mine, NWT, Canada, Department of Indian and Northern Affairs Canada

- Permafrost assessment, thermal modelling and cost estimating for closure work of a tailings impoundment.
- Preparation of construction specifications.
- Construction management for cover placement on tailings.

Giant Mine, NWT, Canada, Department of Indian and Northern Affairs Canada

- Preliminary design of a large scale ground freezing to isolate 237 000 tonnes of arsenic stored underground. Design involves more than 900 freeze pipes over more than 60 km of pipe.
- Characterisation and assessment of the tailings in discontinuous permafrost in preparation for cover design.

Jericho Mine, NWT, Canada, Tahera Corporation

- Preliminary designs of three frozen core dams. Tasks included subsurface investigation, instrumentation, thermal modelling.

Red Dog Mine, Alaska, USA, Teck Cominco Alaska

- Cost estimating of closure work.

Meadowbank Gold Project, NT, Canada, SG Mining Finance, SG House

- Preliminary assessment of the thermal conditions and closure options.

Discovery Mine, NWT, Canada, Department of Indian and Northern Affairs Canada

- Management of field personnel supervising the closure work.
- Preparation of construction specifications.

Gahcho Kue Project, NT, Canada, De Beers Canada

- Permafrost assessment and modelling for deep groundwater monitoring.

Victor Mine, ON, De Beers Canada

- Preliminary thermal model to assess the feasibility of using ground freezing to stabilise soft soils for the proposed open pit.
- Preliminary assessment on the feasibility of using ground freezing to control infiltration into the proposed open pit.

Kumtor Project, Kyrgyz Republic, Centerra Gold Inc.

- Conceptual design of a tunnel through permafrost.

Doris North Project, NT, Canada, Miramar Mining Corporation

- Preliminary designs of two frozen core dams, including field work supervision, instrumentation, thermal modelling and design reports.

Ekati Diamond Mine, NWT, Canada, BHP Billiton

- Assessment of evolution and processes of waste rock oxidation from temperature and oxygen measurements.

Michel Noël

Senior Engineer

Key Experience: Permafrost and Ground Freezing (continued)

Diavik Mine, NWT, Canada, Diavik Diamond Mines Inc.

- Modelling to assess the thermal behaviour of a soil cover in cold climate.

Key Experience: Mine Closure

Magistral Project, Peru, Inca Pacific Resources Inc.

- Cost estimating for constructing a large rock fill dam.

Faro Mine, Yukon, Canada, Deloitte & Touche

- Cost estimating of closure work.

Flin Flon, Man, Canada, Hudson Bay Mining and Smelting Co., Limited

- Cost estimating of closure work.

Les Mines Selbaie, QC, BHP Billiton

- Review of the implementation the closure plan that included a flooded open pit, and soil covers on waste rock and tailings.

Key Experience: Modelling & Computing

Holden Mine, WA, USA

- Modelling of water infiltration in tailings for a water balance for water quality predictions at a base metal mine in WA, USA.

Marigold Mine, Nevada, Glamis Gold Ltd

- Modelling to review the proposed design of soil covers for heap leach pads and waste rock dumps.

Island Copper, BC, BHP Billiton

- Development of a model to predict water quality of released from a flooded deep open-pit.

Mount Leyshon, Australia, Normandy Mining Ltd

- Water transport modelling using SoilCover and SWIM to reproduce the performance of a covers over waste rock and tailings that are instrumented and have lysimeters.

Kaltim Prima Coal (KPC) Mine, Indonesia

- Independent review of proposed cover design over acid generating waste rock. Review based on modelling of water and gas transport, and the oxidation process of the sulphidic waste rock.

Kestrel Mine, Qld, Australia, Rio Tinto

- Independent review of proposed cover design, made recommendations towards more efficient cover design.

Michel Noël

Senior Engineer

Key Experience: Modelling & Computing (continued)

Acid Mine Drainage Research, Australian Nuclear Science Technology Organisation (ANSTO), Australia

- Modelling to assess the oxidation of sulphidic material.
- Unsaturated and saturated hydraulic properties of waste rock.
- Development of numerical models related to cover design and acid mine drainage.

Murrawombie Mine (formerly the Girilambone Copper Mine), Australia, Straits Resources

- Numerical predictive modelling of soil covers for the reassessment of the cover aspects in the original Environmental Impact Statement.

Glamis MariGold, USA

- Modelling comparison of a designed cover using HYDRUS-2D to fulfil regulatory requirements.

WISMUT GmbH, (former East Germany)

- Calibration and extensive predictive modelling of instrumented cover trials as part of the Wismut rehabilitation project in Germany. Modelling work included water and oxygen transport.

Heath Steele Mines, Canada

- Modelling and performance monitoring of a soil cover placed on top of sulphidic waste rock material. Project carried out for the Canadian MEND program.
- Modelling of gas transfer and acid drainage in the oxidation processes of acid waste rock.

Cape Breton Development Corporation, Canada

- Modelling of gas transfer and acid drainage in the oxidation processes of acid waste rock.

Major industrial landfill site, USA, confidential client

- Groundwater and contaminant modelling using MODFLOW.

Proposed coal mine, NS, Canada, confidential client

- Noise and air quality modelling for environmental impact assessments for proposed industrial and mining facilities.
- Reserve estimation.

CASTOR Project, École Polytechnique of Montréal, QC, Canada

- Programming and validation of a geotechnical database system (Oracle) as part of a major project to develop computational tools for the design of hydroelectric infrastructures.

Michel Noël

Senior Engineer

Key Experience: Mine Operations

Heath Steele Mines, NB, Canada, Noranda Mining & Exploration Inc.

- Environmental guidelines for the daily mine operations with respect to emission quality (airborne, surface water, groundwater and acid mine drainage).
- Management and inspection of the tailings deposition facilities.
- Grouting of bedrock as part of the construction of a water retention dam.
- Maintenance, calibration, data collection and interpretation of surface water gauge stations.
- Slope stability and seepage analysis for tailings dams.
- On-site full-scale water balance seepage test.

Key Experience: Civil Works

Stone Consolidated , NB, Canada

- Repair work and upgrading of an earth dam at a pulp & paper mill. Included seepage analysis, slope stability, sheet piling design, hydrology and supervision of construction.

Short Range Radar Sites, NWT, Canada, Department of National Defence

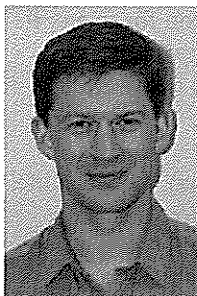
- Field supervision of QA/QC for the construction of foundations in permafrost for ten military radar sites in the Canadian Arctic. Installation of over 2100 piles and load testing of more than 100 piles.

Héneault et Gosselin Inc., QC, Canada

- Management, design, sale and scheduling of specialised foundation projects such as under-pinning, special foundations and transportation of buildings.

Michael D. Royle

Senior Hydrogeologist



Profession Hydrogeologist (Geology)

Education M.App.Sc., Hydrogeology and Geopollution Management,
University of New South Wales, Australia (1992)
B.Sc., Geology, University of British Columbia, Canada (1987)

**Registrations/
Affiliations** Registered Professional Geoscientist (B.C and N.T.)
Member, International Mine Water Association (Journal
Editorial Board member), International Association of
Hydrogeologists (BC Executive Representative)

Specialisation Mining Hydrogeology, Groundwater Instrumentation, Hydraulic Packer Testing,
Ground Water Resources, Drill Program Design and Supervision, Contaminant
Hydrogeology, and Unsaturated Flow Modelling.

Expertise Mining Related Hydrogeology and Groundwater Resource Evaluation.

Employment Record

1995 – Present SRK Consulting Inc., Vancouver, BC
Senior Hydrogeologist

1993 – 1995 Golder Associates Ltd., Vancouver, BC
Hydrogeologist

1989 - 1991 Westbay Instruments Inc., Vancouver, BC
Hydrogeological/ Technical Representative

1988 Teuton Resources Corp., Vancouver, BC
Contract Geologist

Languages English

Project Management

Michael Royle has worked in geological exploration, instrumentation, and mining consulting for over 15 years. His geological experience and knowledge have been used to guide the planning and investigation of groundwater projects in both mining and groundwater resource evaluation. Recent project management experience (within five years) has included running multidisciplinary programs in both Canada and internationally. The work has also been carried out under difficult operating and logistical conditions in Africa, Turkey and northern Canada in the winter.

Recent project experience includes:

- Project manager for the integrated reclamation program at the Giant Mine, NWT. Closure of the mine site entails ensuring long term encapsulation of 270,000 tonnes of soluble arsenic trioxide mill waste currently stored in underground stopes and chambers. Final closure option chosen will consist of a frozen block encapsulation to isolate the dust from the local environment when the mine is reflooded to surface. Individual contribution focussed on predictions of groundwater inflow during and after reflooding and planning for contaminant control and capture from the 600 m deep reflooded mine

Michael D. Royle

Senior Hydrogeologist

- De Beers, Victor Project, Ontario. Preliminary hydrogeological dewatering investigation for open pit mine design. Design and implementation of multilevel monitoring systems in both deep overburden (125m) and bedrock (325m) as part of open pit mine inflow studies. Work was carried out in January to March under arctic conditions
- Groundwater Department Manager. Port Elizabeth Groundwater Department (6 months). Responsible for running department. Most projects related to municipal and rural water supply in Western Cape region, South Africa
- Project manager. Joint venture with CH2M Gore & Storrie to remediate the Deloro mine site. Client: Ontario Ministry of Environment and Energy

Mining Hydrogeology Experience

As part of SRK Vancouver's mine design and planning work, Mr. Royle has been involved in several projects to delineate the hydraulic characteristics of the bedrock within the mine hydrogeological system. Many of the programs have involved deep diamond core drilling programs and testing and instrumentation at depths exceeded 200m. Recent project experience includes:

- Hydraulic packer testing and multiple level instrumentation (Westbay MP System) installation in 900m deep cored drillholes at the Kazan Project, Turkey as part of a mine feasibility study for Rio Tinto (RioTur)
- Hydraulic packer testing and instrumentation installation (grouted thermistors and vibrating wire piezometers) in 325m deep cored drillholes at the Victor Project, Ontario as part of a mine prefeasibility study for De Beers Canada. All work carried out under winter conditions
- Design and implementation of a 150m deep groundwater monitoring system in fractured rock to provide background data and input for remediation of an underground mine system as part of remediation/closure. Work carried out at Giant Mine, NWT during winter
- Qualified installer for Westbay Instruments MP System™ multiple level groundwater monitoring equipment. Worked on several US Department of Energy nuclear research site helping design and install deep level monitoring systems.

Numerical Modelling Experience

Groundwater modelling projects have involved both saturated and unsaturated modelling for assessing closure options on the sites. Recent project experience includes:

- Directed the groundwater modelling program at Giant Mine. Modelling was carried out using the finite element code FEFLOW in order to integrate open tunnel flow in the complex mine workings following reflood to assess final closure options at the site. Publication in process
- Sat/Unsat modelling of the underground Giant Mine system, both in current dewatered state, and for future reflood scenarios as part of arsenic remediation project. Code used is FEFLOW. Ongoing
- Unsaturated flow modelling of seepage systems, tailings drainage predictions as part of water quality prediction, and cover design for tailings and waste rock impoundments using 1D and 2D numerical codes (SEEP/W, Hydrus 2D, SOILCOVER, SWMS)

Michael D. Royle

Senior Hydrogeologist

Mining – Reclamation and Investigation

The main focus of M. Royle's work with the SRK Vancouver Geoenvironmental department has been investigation and reclamation of abandoned mines in the Canadian north. Recent project experience includes:

- Investigation of groundwater conditions at the currently dewatered Giant Mine in order to predict reflooding behaviour under various remediation options as part of the arsenic trioxide remediation program
- Investigation of abandoned mine sites in the Yukon and NWT for environmental monitoring and remediation planning
- Investigation of potential heap leach effluent infiltration system for mine development plan
- Siting investigation, hydrogeological modelling, and monitoring of tailings facility and waste rock piles for mine development and closure/remediation plans

Water Resource Experience

Groundwater resource evaluation is an area of specific interest. Recent project experience includes:

- Regional exploration drilling project in Namibia - supervision of air rotary drilling operations and testing of completed wells for Namibian government rural water supply program
- Community water supply drilling and evaluation in Gauteng Province South Africa and rural water supply drillhole siting and drilling supervision in Kwazulu - Natal, SA.
- Community water system remediation and evaluation. Three month volunteer position with the regional water district training local engineers and NGO (WaterAid) workers. Dodoma, Tanzania
- Drilling and evaluation of community water supply systems in BC, Canada for municipal and rural developments, First Nations communities, and private industry

Environmental Experience

Recent project experience includes:

- Design, installation and operation of groundwater monitoring systems at several large mine sites, both active and abandoned

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| Publications | <ol style="list-style-type: none">1. Royle, M., D.Mackie (2004) "Assessing Groundwater Conditions in Preparation for Post Closure Reflood of the Giant Mine, Canada Using a 3-D Numerical Model: Idealized vs. Reality" Presented at IWMA, 2004 (Newcastle upon Tyne).2. Wels, C., Shaw, S., and Royle, M. (2000) "A Case of Intrinsic Remediation of Reactive Tailings Seepage for Questa Mine" Paper presented at the ICARD 2000 Conference, Proceedings Volume 1, pp. 441-458, May 2000, Denver, Colorado.3. Nahir, M., Scott, C., Royle, M., and Palmer, M. (2000) "Case Study: Development of a Rehabilitation Plan for the Abandoned Arctic Gold and Silver Mine Site" Proceedings of the 24th Annual British Columbia Mine Reclamation Symposium, June 2000. |
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STEPHEN R. SCHULTZ*Senior Consultant***EDUCATION**

*B.Eng. (Hons), Mineral Process Engineering,
Camborne School of Mines, United Kingdom (1988)*

EXPERIENCE*Jan 2000 to present*

***Project Engineer / Senior Consultant, SRK Consulting (Canada) Inc.,
Yellowknife, Northwest Territories***

- *Manager for ongoing multi-disciplinary project to develop and implement a remediation plan for the Colomac Mine, NT. Major project focus is management of 10 million cubic metres of contaminated water stored on-site.
Client: Public Works and Government Services Canada*
- *Development and verification of a water balance model for the tailings storage basin and open pit at the Colomac Mine.*
- *Project Engineer and Local Coordinator for ongoing multi-disciplinary project to develop a remediation plan for the Giant Mine, Yellowknife, NT. Major project focus is management of 240,000 tonnes of arsenic trioxide baghouse dust stored underground, and 14 million tonnes of tailings stored in surface impoundments.
Client: Indian & Northern Affairs Canada*
- *Development of a conceptual long-term water management plan for the Giant Mine.*
- *Hydrogeochemical sampling at the Giant Mine, including underground mine water and mine materials, and groundwater sampling using the Westbay well system.*

1997 to 1999

***Superintendent of Environmental Services, Royal Oak Mines Inc.,
Yellowknife, Northwest Territories***

Reporting to the General Managers at the Giant and Colomac gold mines, with responsibility for environmental management at both operations, including:

- *Supervision and training of site environmental technicians*
- *Compliance monitoring and reporting*
- *Investigation and reporting of spills of hazardous materials
Coordination of containment and remediation measures*
- *Tailings dam inspections (with geotechnical consultant) and implementation of monitoring and maintenance recommendations*
- *Renewal of operating water licences at both the Giant and Colomac Mines*
- *Coordination of studies and development of numerous plans, with consultants and in-house expertise, including: Abandonment & Restoration Plans, Tailings Management Plans, Contingency Plans, Soil Contamination Assessments, Compliance Monitoring QA/QC Plan*
- *Installation of Continuous Emissions Monitoring System (CEMS) to measure sulphur dioxide emissions from Giant Mine roaster*
- *Planning and supervision of small reclamation projects*
- *Regular consultation with First Nations stakeholder groups*

- 1995 to 1997* **Mill Metallurgist, Royal Oak Mines Inc.**
Colomac Mine, Northwest Territories
- *Supervision of junior metallurgical engineer and technician*
 - *Planning and implementation of process efficiency studies*
 - *Installation of new process equipment and implementation of improved operating procedures to achieve increased throughput and consistent metallurgical performance*
- 1994 to 1995* **Laboratory Technician, Chemex Labs Ltd.**
Mississauga, Ontario
- *Analysis of gold concentrations in rock samples*
- 1989 to 1991* **Development Engineer / Engineer-in-Training, Cominco Ltd.**
Polaris Mine, Northwest Territories
- *Planning and implementation of grinding circuit efficiency studies*
 - *Design of improved reagent handling and delivery systems*
 - *Environmental field monitoring*
- 1988 to 1989* **Process Engineer, McFinley Red Lake Mines Ltd.**
Red Lake, Ontario
- *Development of mill maintenance computer database*
 - *Calculation of metallurgical balances*
- 1987 (work term)* **Metallurgical Technician, P.T. Preussag**
Kelapa Kampit Mine, Belitung, Indonesia
- 1986 (work term)* **Pilot Plant Technician, Preussag AG Metall**
Rammelsberg Mine, Goslar, Germany

Kelly S. Sexsmith

Senior Environmental Geochemist

**Profession**

Geologist

Education

B.Sc. Geological Sciences, University of British Columbia, 1990.

MS, Environmental Science and Engineering, Colorado School of Mines, 1996.

Registrations/ Affiliations

Association of Professional Engineers and Geoscientists of British Columbia.

Specialization

Mine Permitting, Environmental Geochemistry, Acid Rock Drainage, Water Quality Monitoring.

Employment Record**1997-Present****Senior Environmental Geochemist, SRK Consulting.**

As part of the GeoEnvironmental Division, involved in monitoring and prediction of acid rock drainage and metal leaching for various new, developed, and closed mining properties. Experience includes design and supervision of geochemical test programs, development of conceptual waste management plans, and prediction of water quality from mine components. Other responsibilities include managing environmental studies and permitting for new mine developments.

1996 - 1997**Independent Consultant.**

Established small consulting practice in Kamloops, B.C., primarily providing specialty services to other independent mining consultants in British Columbia.

1994 - 1996**Graduate Research Assistant, Colorado School of Mines.**

Research Supervisors: Dr. Bruce Honeyman, Dr. Eileen Poeter. Masters research study on the occurrence of radon in groundwater. Project involved extensive field and laboratory testing; statistical analysis, including multivariate analysis, geostatistics, and non-parametric methods. Geochemical and surface complexation modelling was applied to understand the enrichment of parent nuclides (i.e. uranium and radium) in this granitic system.

1990 - 1994**Environmental Geologist, Steffen Robertson and Kirsten (Canada) Inc.**

Acid rock drainage prediction; interpretation of laboratory testing programs; water quality monitoring; and site assessments. Also involved with site characterization work for sites with contaminated soil and/or groundwater. Previous SRK experience in soils testwork, construction control and blast vibration monitoring.

1988 - 1990**Summer Field Geologist, Various Employers.**

Westland Resource Group and Denny Maynard: Surficial mapping projects related to terrain and slope stability analysis in the Vancouver forest region. Minnova Exploration: Responsible for the field mapping of three large mineral claims in the Kamloops area of British Columbia. Geological Survey of Canada: assisted with a regional mapping project in the Bowser Basin of Northern B.C.

1990**Field Assistant, Parks Canada**

Volunteer assistant, participated in a study on the interactions between wolf and their prey in Banff National Park.

Publications

See attached

Languages

English, limited Spanish

Kelly S. Sexsmith

Senior Environmental Geochemist

Publications:

1. Chapman, J., D. Hockley, K. Sexsmith, B. Arthur, S. Donohue, 2003. Testing Acid Generation in Cemented Paste Backfill. Submitted to ICARD 2003, Cairns Australia.
2. Day, Stephen., Kelly Sexsmith and Jim Millard, 2003. Acidic Drainage from Calcareous Coarse Kimberlite Reject, Ekati Diamond MineTM, Northwest Territories, Canada. Submitted to ICARD 2003, Cairns Australia.
3. Sexsmith, K., D. Hockley, J. Chapman, N. McKay, G. Sevic, and K. Black, 2002. Mineralogical Examination of Carbonates in the Crandon Tailings. In: Pre-Prints of the 2002 SME Annual Meeting, February 25-27, 2002. Phoenix, Arizona.
4. Mehling, Peri., Stephen Day, and Kelly Sexsmith. 1997. Blending and Layering Waste Rock to Delay, Mitigate or Prevent Acid Generation: A Case Study Review. In: Proceedings of the Fourth International Conference on Acid Rock Drainage, Vancouver, B.C., May 31 to June 6, 1997.
5. Sexsmith, Kelly S., 1996. A detailed examination of the chemical, hydrological and geological properties influencing the mobility of ²²²radon and parent radionuclides in groundwater. MS Thesis, Colorado School of Mines.

Kelly S. Sexsmith

Senior Environmental Geochemist

Key Experience: Projects:

Site Evaluations

2002 - Selbaie Mine, Quebec – BHP Billiton

- Site Evaluation and Review of Closure Planning

1999 - Con Mine, NWT – DIAND

- Site Evaluation and Review of Closure Plan for Water Licence Renewal

1999 - Abandoned Mine Site Assessments, Yukon – Public Works

- Characterized Potential for ARD and Metal Leaching for Five Abandoned Mine or Mine Exploration Sites in the Yukon

1997 - MEND Blending and Layering Project – Mehling Environmental Management (for MEND).

- Compiled and evaluated data from case studies where acid generating and acid consuming waste rock was blended or layered to delay, mitigate or prevent acid rock drainage and metal leaching

1992-2002 - Confidential Projects (Various Locations)

- Assisted with environmental liability audits of mines in Canada and the United States

Monitoring

2002 - 2005 Red Mountain Project, BC – Seabridge Gold

- Water Quality Assessment for Reclamation Planning
- Ongoing management of monitoring and reclamation programs

2002 - Questa Mine, New Mexico – Molycorp

- Design and implementation of an underground flow and water quality monitoring program

2001-2003 - Giant Mine, Northwest Territories (Canada) – DIAND

- Sampling and analysis of underground mine water, including isotope analyses
- Geochemical characterization of backfilled tailings and waste rock
- Characterization of background loading in Baker Creek
- Tracer study of groundwater movement
- Contributions to Project Description Report

2001-2002 - Ekati Diamond Mine™, Northwest Territories (Canada) – BHP-Billiton Diamonds Inc.

- Monitoring and reporting of seepage and waste rock geochemistry
- Geochemical characterization of waste rock from new pipes

2002 - 2003 - Anvil Range (Faro) Mine, Yukon – Deloitte and Touche

- Seepage surveys
- Geochemical characterization of waste rock

2000 - Discovery Mine, NWT – Public Works

- Developed seep survey protocols and advised site personnel on sampling approach and methodology

Kelly S. Sexsmith

Senior Environmental Geochemist

Key Experience: Projects (Cont'd)

Geochemical Characterization/Water Quality Predictions

1993-2005 - Key Lake and B-Zone Mines, Saskatchewan - Cameco Corporation

- Design and supervision of laboratory testing programs to characterize mine rock and tailings
- Geochemical modelling to evaluate long-term water quality.

2004-2005 – Trend Coal Project, British Columbia – NEMI Northern Energy and Mining

- Geochemical characterization of waste rock, coal, coarse coal rejects, tailings and road cut samples.
- Regulatory consultation and general support of permitting activities.

2001-2005 - Victor Project, Ontario – DeBeers

- Geochemical characterization of sedimentary country rock and processing residues
- Ongoing support of the permitting process.

2003-2004 – Marlin Project, Guatemala – Marlin Engineering and Consulting

- Geochemical characterization and water quality estimates for tailings and waste rock

2004 – Los Filos Project, Mexico – Wheaton River Minerals

- Review of existing geochemical data and supplemental testing in support of the environmental assessment process.

2001-2005 - Britannia Mine, BC - BCWLAP

- Test flooding of mine workings to evaluate effects of seasonal flooding on water quality as an input to the treatment plant
- Ongoing management and interpretation of water quality monitoring data

2000-2001 - Highmont Tailings, British Columbia (Canada) - Highland Valley Copper

- Sampling and testing to characterize and predict long-term molybdenum concentrations in the tailings
- Geochemical modelling of secondary molybdenum minerals

2000 - Vangorda Project, Yukon Territory (Canada) - Deloitte and Touche

- Collected and characterized water and rock samples from the Vangorda mine pit
- Evaluated current and future water quality in the pit under various remediation scenarios

1999-2000 - Cigar Lake Project, Saskatchewan (Canada) - Cameco Corporation

- Managed and directed testing program to evaluate tailings geochemistry
- Geochemical modelling, including developing a comprehensive database on arsenate minerals

1998-1999 - Crandon Project, Wisconsin - Foth and Van Dyke/Nicolet Minerals

- Assisted with geochemical and mineralogical characterization of depyritized tailings, pyrite concentrate and pyritic paste backfill
- Completed MINTEQA2 modelling to predict water quality from the tailings management facility
- Assisted with preparation of technical reports
- Overall management of SRK's project team (6 professionals in two offices) and budget

Kelly S. Sexsmith

Senior Environmental Geochemist

Key Experience: Projects (Cont'd)

1998-1999 - Bellavista Project, Costa Rica - Wheaton River Minerals

- Geochemical testing and characterization of waste rock and pit walls
- Developed conceptual waste rock management plan
- Prepared a dilution model to estimate downstream water quality

1993-1994 - Lisheen Mine, Ireland – Chevron Mineral Corporation and Ivernia West

- Geochemical characterization of tailings and tailings porewater
- Assisted with interpretation of batch and column testing to determine sorption of metals to peat liner

1993-1994 - Noailhac - St. Salvy Mine, France - Metaleurop S.A.

- Carried out testing program to evaluate tailings geochemistry and metal leaching
- Developed model to predict tailings pore water quality in 3 zones of the impoundment (beach area, advancing beach, and saturated pond)
- MINTEQ Modelling to determine limits on metal transport from the tailings area

1992-1994 - Granisle Mine, B.C. - Noranda

- Completed seep surveys to evaluate water quality
- Sampling and geochemical characterization of mine and pit wall rock
- Developed 3D model of geochemically distinct rock units in original pit for use in modelling geochemical composition of waste rock piles

Permitting

2004 -2005 – Red Dog Mine, Alaska – TeckCominco Alaska

- Currently preparing an Environmental Information Document for the mining of the Aqqaluk deposit.

1997 - 2005 - Jericho Project, Nunavut - Tahera Corporation (Formerly Lytton Mineral Ltd)

- Managed environmental studies and permitting of Jericho Project(1998-1999)
- Geochemical characterization of waste rock and heap leach residues
- Water Quality Estimates
- Ongoing support of permitting process, including impact review and water licencing stages.
- Tahera has now received final approval and licences required to proceed with the project.

2001 - Izok Project, Nunavut – Inmet Mining Corporation

- Coordinated multidisciplinary review of earlier baseline studies to identify additional activities to reinstate permitting

1997 - Prosperity Project, B.C. – Watermark Consultants (for Taseko Mines Ltd.)

- Compiled and set-up EQWin Database of water quality data
- Assisted with statistical evaluation of static testing program

1993-1994 - Brewery Creek Project, Yukon - Loki Gold Corporation (now Viceroy Resource Corporation)

- Compiled and assessed water quality data, prepared metal load balance
- Design, supervision and interpretation of laboratory testing to characterize mine rock and heap leach residue
- Assisted with preparation of permitting documents

APPENDIX D

SENES Curricula Vitae

TONY BROWN, M.Sc., P.ENG.

SENES Yellowknife Office Manager

EDUCATION

B.Sc., Civil Engineering, 1994, Queen's University
Aga Khan International Development Management
Fellow, 1996

M.Sc., Civil-Env, 1997, Queen's University (Award
of Excellence in Research and Technology
Development, Ontario Ministry of the
Environment)

PROFESSIONAL AFFILIATIONS

Professional Engineers of Ontario

EXPERIENCE

1999 to date - SENES Consultants Limited

Manager of SENES Yellowknife beginning January 2005. Responsibilities include design of field programs, logistics planning, quality assurance and management of field personnel and programs.

Environmental engineer focussing on environmental assessments, sustainability issues, emissions inventories, risk assessment, permitting, site assessments, project management and business development.

Regional Environmental Audit - Local manager for the implementation of the NWT Environmental Audit. Components of the assignment include an evaluation of the effectiveness of the environmental regulatory regime in the NWT, preparation of a comprehensive State of the Environment evaluation and determination of the extent to which current cumulative effects monitoring systems are performing. All environmental media and regulations are being addressed in the assignment.

Environmental Assessment - Project Manager and author of a Federal EA (CEAA) on a proposed low-level radioactive waste storage facility for Ontario Power Generation. Responsibilities included overseeing technical disciplines, liaising with regulators, integration of findings and preparing EA documentation.

Author of a Cumulative Effects Assessment for a proposed co-generation facility on First Nation's lands in Thunder Bay, Ontario.

Environmental Sustainability - Project Manager and primary investigator for the Toronto Waterfront Scan and Environmental Improvements Strategy Study. This comprehensive project involved

assessing and minimizing the potential environmental effects from a \$17 Billion future development for approximately 70,000 people. Focussing on sustainable development, a broad variety of subjects were investigated during this multi-year project, including: energy infrastructure (co-generation, district energy, energy efficiency, wind and solar), transportation, transit, air quality, water quality, soil contamination and solid waste management. Overall environmental management of the waterfront was assessed and appropriate mitigation strategies were developed.

SENES Project Manager for an "Integrated, Long Term, Sustainable Wastewater Management Strategy" prepared for the Greater Moncton Sewerage Commission. The multi-disciplinary assignment addressed treatment processes, combined sewer overflows, biosolids management and cumulative effects in an effort to identify a sustainable approach to the management of wastewater over a 20-year period.

Emissions Inventories - Project Manager responsible for a World Bank funded project to develop a comprehensive city-wide air emissions inventory, software and database for the City of Buenos Aires, Argentina. The web-based software and database are being used as models for the development of similar inventories throughout Latin America. All communication for this assignment was performed in Spanish.

Prepared a site-wide inventory of non-radiological emissions for Pickering Nuclear Generating Station. Project components included program design, site reconnaissance to identify emissions sources, review of source performance, quantification of emissions (based on engineering calculations, manufacturer's specifications and emissions factors) and reporting.

Risk Assessment - Participated in the assessment of risks associated with transporting uranium slurry by road in northern Saskatchewan. Work performed involved identification of failure modes, exposure pathways, and assessment of event probabilities and consequences. Accident statistics were extrapolated from several transportation studies and linked to statistics on spill probabilities. Spill quantities from a theoretical tank fracture were modelled and the likelihood of a release occurring to an aqueous environment was determined.

Environmental Permitting - Participated in the preparation of a consolidated Certificate of Approval

(Air) for a major automotive manufacturer. Reviewed all existing certificates, prepared an inventory of emissions and conducted air dispersion modelling for the facility.

Environmental Site Assessments - Responsible for performing environmental site assessments on numerous properties including light and heavy industry, commercial operations, residential and recreational areas, vacant land and green-field properties.

Decontamination Programs - Provided field engineering support and supervision for several decontamination projects. Work has included management of field staff, assessing the adequacy of decontamination and identifying subsequent remedial measures.

Water Quality Assessment - Conducted water quality assessments for two automobile manufacturing facilities. The work addressed process, domestic supply and sewer water quality and investigated plant performance with respect to the relevant water quality regulations.

1998-1999 – International Rescue Committee Sudan

Responsible for the co-ordination and redesign of a basic water and sanitation infrastructure program being implemented in the war zone of southern Sudan. Projects were carried out over a broad geographic area, and under physically and socially demanding environments, requiring complex logistics and creative programming (all field sites were accessible by air only). Responsible for overseeing six local engineers working in indigenous communities. Project design and execution were performed closely with UN agencies, foreign donors and other implementing agencies (UNICEF, WFP, UNDP).

1997-1998 – Dowell Schlumberger Venezuela

Engineer involved in the design, implementation and post-execution analysis of treatments performed to enhance the productivity of Venezuela's oil wells. Projects included high temperature and pressure deep-well applications with the potential to cause significant damage to sensitive land and off-shore environments. The position also required the development of an environmental management plan for the company's field activities. All work was performed in Spanish.

1994-1996 – Queen's Project on International Development

Executive Director - Management of a Canadian non-governmental organization conducting environmental and micro-infrastructure projects in Guyana, Peru, Bolivia and Canadian indigenous communities (Moose River and Moosonee, Ontario). The position involved supervising the organization's Executive board, project selection and design, logistics, solicitation of partner organizations, proposal and report writing, recruitment and public relations.

Environmental Assessment Manager, Tarija, Bolivia - Carried out baseline studies in support of a biological and chemical assessment of the potential impact to the aquatic environment in the inundation zone of a proposed hydro-electric dam located on an indigenous land claim. This position involved project design and execution, including sampling, analysis and data synthesis. Other responsibilities included personnel management, field logistics and community relations activities. Performed in a remote jungle location, the working language for this project was Spanish.

Audit Member, Potosi, Bolivia - Responsible for the quantification of extensive aquatic chemical contamination related to mining practices in a mining region of Bolivia. In addition to assessing the levels of chemical contamination, an epidemiological study was also conducted to indicate health impacts.

Research

Research for M.Sc. thesis involved the development of a bio-leaching technique to remediate heavy-metal contaminated aquatic sediments. Acidophylic bacteria were utilized to lower the pH of sediment slurries, resulting in solubilization of target metals. The technology was applied in bench-scale, continuous bio-reactors and has proven to be a feasible option for decontamination of sediments.

Language Capabilities

Fluent in English and Spanish.

Technical Papers

Biological leaching of trace metals from stormwater sediments: influential variables and continuous reactor operation Water Science and Technology, 38(10): 73-81, 1998 (with B.C., Anderson, W.E. Watt and J. Marsalek).

Examination of influential variables on biological leaching of trace metals from storm-water detention pond sediments. M.Sc. thesis, Queen's University, 1997.

D. Grant Feasby, M.Sc.

Senior Project Specialist, Mining and the Environment

EDUCATION

M.Sc., Metallurgical Engineering, Queens University,
1966

EXPERIENCE

2005-to date - SENES Consultants Limited

Senior project specialist and manager for multi-discipline projects including environmental assessments for new, existing, closed or abandoned mining facilities. This includes technological, environmental and social aspects for all stages for mineral developments up to and including decommissioning and mine site rehabilitation. Experienced in communicating the results of technological, environmental and risk assessments to interested groups and responsible stakeholders. Specific projects include training sessions, audits and reviewing best available practices in Canada and internationally.

2001-2005 - Environment Superintendent, Cambior Inc., South America

Guyana – Gold - Manager of environmental affairs and technical aspects for the large Omai Gold open pit mine in central Guyana. Critical aspects included management of cyanide and other hazardous materials, prevention of negative environmental impacts and development and implementation of a progressive mine site closure plan that met international standards and demonstrated no residual liabilities. At Omai Gold implemented a state-of-the art audit-verified ISO 14001-certified Environmental Management System with its required continuous improvement. Improved many aspects of environmental management to exceed normally accepted standards at a remote mine site including materials recycling, wildlife interaction and ecological assessment.

Guyana – Bauxite - Manager of Environmental Impact Assessment, permitting and implementation of an environmental reconstruction program for a previously state-run facility that had a wide range of environmental challenges including air, waste and materials management, acid rock drainage, mine site rehabilitation issues. Extensive communications with local citizens' groups, official government agencies as well as banks and insurance companies were undertaken to achieve consensus on a rehabilitation of the facilities

as well as prioritization of the environmental remediation. Completed an assessment of exposure of low level radiation from the bauxite ores.

Suriname - Management of Environmental Assessment for a new large-scale gold mine project in an area previously disturbed by small scale miners. The environmental management plan was accepted by all stakeholders including local villagers and the project was successfully initiated in 2004 and all environmental performance objectives have been met.

1997-2001 Director, Environment, Lakefield Research

Director of facility environmental management, and 20 technical staff specializing in environmental testing and consulting for a wide range of industrial, mining, municipal and government clients. Special projects included participation in an expert team (with SENES Consultants) to determine the optimum and community acceptable strategies for managing arsenic waste at Yellowknife, co-authoring state-of-the art documentation on mine/mill effluent treatment and toxicity testing. Chaired an international expert panel reviewing the causes and remediation of a major mine spill in Spain. Participated in an international panel reviewing mine-related environmental research in Sweden. Conducted environmental audits of municipal and industrial facilities Chaired the Environment Committee of the Ontario Mining Association...

1983-1997 - Natural Resources Canada, Government of Canada

Manager, MEND (Mine Environment Neutral Drainage Program) Directed a \$18 million industry-government research program on acid generating mine wastes. This internationally recognised program was successful in demonstrating the science and technology of predicting and preventing acid drainage from mine related development in a wide range of climactic and geological conditions. The success of the program was augmented by the extensive involvement of universities, public interest groups as well as Non-Governmental Organisation.

National Expert and Reviewer of Mine Developments in Canada including coal in Alberta, Uranium in Saskatchewan, Diamonds in the Northwest Territory.

International Consultant to the International Atomic Energy Agency for closed and abandoned uranium mines in the Czech Republic, Bulgaria, Ukraine, Romania and Slovenia. Reviewer of environmental liabilities of a large copper-gold mine in Papua New Guinea for BHP Corporation. Participation in an expert team (with SENES) reviewing and assessing decommissioning plans of Wismut, the former east German Uranium Mines company for the German Federal Ministry of Environment. Identification of overall program needs, strategies, and refocusing the program to achieve integration and optimization of the activities associated with decommissioning of facilities and clean-up of extensively disturbed lands in the former Soviet state.

Section Manager, Industrial Minerals Laboratory.

Managed a Government of Canada laboratory specializing in the sustainable development of mineral resources such as potash, carving and structural stone, mica, garnet and phosphate. Managed provincial-federal mineral development programs in Saskatchewan and Nova Scotia.

Technology Manager, National Tailings Program

Managed environmental field evaluation programs at active and inactive uranium mine tailings sites in Canada as well as technical assessment of technologies to prevent the dispersion of metal and radioactive components from the mines and waste management areas.

1968-1983 - Eldorado Nuclear

Plant Superintendent, Uranium City, Saskatchewan

Supervised the rehabilitation and efficient, environmentally sound operation of a complex uranium processing plant in northern Saskatchewan. Successfully introduced women including many from First Nations into traditionally male occupations. Managed health and safety, including radiation and uranium exposure as well as environmental control programs for the plant.

Senior Metallurgist Plant Superintendent

Conducted process and environmental research, drafted engineering plans and directed field tests and installations. Developed, designed and oversaw the installation of the first effluent treatment plant for radium removal from uranium mining effluent in Canada.

1966-1968 - Brunswick Mining and Smelting

Plant Metallurgist controlling metallurgical performance of a complex base metal mineral processing plant in New Brunswick.

1965-1966 - Minerals Research Laboratory, North Carolina

Developed industrial minerals recovery techniques, conducted field investigations and supervised pilot-scale plant tests.

RECENT TECHNICAL PAPERS AND PRESENTATIONS

- Acid Rock Drainage in Bauxite Mining, a case for consideration of social aspects; presentation to an international audience in Sweden 2005.
- Lessons Learned – Tailings Management at a Large Gold Mine in Guyana; presentation to an Industry-Government workshop on Tailings Management, 2005.
- Evaluation of the Options for managing Acid Rock Drainage from the abandoned Britannia Mine in British Columbia, 2003.
- Evaluation of the Development of a Radioactive Niobium Deposit in Brazil, 2002.
- State of the Art of the Technologies for Mine Effluent Treatment in the Northwest Territories, 2001.

BRUCE E. HALBERT, M.Sc.

Secretary-Treasurer, Director of Aquatic Environmental Studies

EDUCATION

M.Sc., Environmental Health Engineering, 1970,
University of Texas at Austin
B.A.Sc., Civil Engineering, 1968, University of Waterloo

PROFESSIONAL AFFILIATIONS

American Water Works Association
Water Environment Federation

EXPERIENCE

1980 to date - SENES Consultants Limited

Project responsibilities include management and co-ordination of water quality monitoring and modelling investigations, environmental impact assessments, risk assessments, sanitary engineering studies and research projects.

Risk Assessment - Project manager on human health and ecological risk assessments (HHERAs) of three proposed uranium mine developments and two mine closure plans in Saskatchewan, a proposed uranium mine decommissioning project in Ontario, a contaminated site cleanup investigation at a pulp and paper mill in Ontario, and a proposed municipal non-hazardous waste landfill in Ontario.

Project director on an investigation into the risk of a transportation accident occurring and resulting in a spill of uranium ore slurry and the environmental consequences of a spill.

Technical specialist in the development of a computer model, INTAKE, used in the above assessments for estimation of human and ecological risks of exposure to natural and anthropogenic sources of numerous organic and inorganic substances.

Northern Experience - Project director on screening level HHERAs undertaken on 24 northern contaminated sites and on Tier 2 HHERA of site remediation options at the Colomac, Giant and Port Radium mines sites in the NWT. Technical specialist on site investigations and on the development of remediation options for the Port Radium mine site.

Environmental Assessment - Technical specialist on the preparation of Environmental Impact Statements for five major uranium mining projects in northern Saskatchewan. Responsible for the design and interpretation of waste leachability tests, characterization of the quality of treated mine waters, and modelling the transport of chemical and

radionuclide releases to the aquatic ecosystems.

Project specialist in the preparation of Environmental Study Reports on several municipal sewage treatment projects in Ontario. Responsible for the characterization of baseline water quality and river low flow conditions and assessment of the impact on the trophic status and chemical quality of the receiving waters resulting from anticipated future growth.

Project manager on studies of the change in trophic status of recreational lakes in northern Ontario due to shoreline development proposals. Project director on an investigation into the effects of nuclear generating station emissions on water quality and water use in the Great Lakes.

Environmental Modelling - Co-ordinator of a multi-disciplinary team in the development of the uranium tailings assessment program - UTAP, a probabilistic assessment code for predicting the long-term effects of uranium mine tailings. Project manager on a study of uncertainty analysis in probabilistic modelling and on investigations into the application and interpretation of sensitivity and uncertainty analysis techniques.

Contributing author in the development of derived release limits for uranium refinery operations in three separate studies including evaluation of process wastewater characteristics and the resultant incremental increases in receiving water concentrations.

Project director on environmental pathways modelling assessments of five proposed uranium mines in Saskatchewan and seven uranium mine decommissioning projects in Ontario and Saskatchewan. These assessments involved development and application of modified versions of the UTAP code to predict the effects of chemical and radioactive releases on aquatic, atmospheric and terrestrial environments and on human and non-human receptors.

Environmental Monitoring - Technical specialist on several environmental baseline studies including: a long-term investigation of the effects of acidic precipitation on a forested watershed; an intensive one-year study to characterize tailings and the surrounding environs at a uranium tailings disposal site; a two-phase study on the distribution of naturally-occurring radionuclides in freshwater benthos and their environment; pre-operational baseline monitoring investigations at the site of a new uranium refinery on the North Channel of Lake Huron; a beryllium and rare earth deposit on the north shore of Great Slave Lake in the NWT and several proposed large scale landfill sites in southern and northern Ontario; and several river

assimilative capacity studies of the effects of municipal sewage treatment plant discharges.

Institutional Strengthening - Environmental monitoring specialist on a project funded by the Asian Development Bank to strengthen institutions engaged in environmental protection in Uzbekistan. Responsible for assessing current environmental conditions, environmental monitoring systems and their capacity, and identifying primary environmental concerns and requirements to strengthen monitoring capabilities.

Technical specialist on aquatic ecosystem issues pertaining to monitoring the effects on the environment of mining operations in the five southern provinces of Argentina. The project, which is funded by the World Bank, is intended to establish baseline environmental conditions and to assist the Argentinean government in formulating appropriate rules and standards.

Acid Mine Drainage - Project director in the development of the reactive acid tailings assessment program - RATAP, a comprehensive model of the processes controlling acid generation in sulphidic mine tailings. Lead researcher in an assessment of the role of bacteria in the oxidation of pyritic tailings, environmental factors controlling the rate of oxidation and the applicability of tailings management technologies in limiting acid generation.

Senior investigator in the evaluation of acid generation sources from uranium mining operations in northern Ontario including laboratory and field investigations of pyrite and ammonia oxidation rates.

Mine Tailings Management - Project manager on a study to assess the applicability of underwater tailings disposal for the management of uranium mine tailings. The project included estimation of tailings seepage characteristics, evaluation of receiving water quality impacts and development of environmental monitoring and contingency response plans.

Project manager on an investigation of tailings basin closure concepts for a base metal (zinc) mine in northern Ontario. The project included design of a leach column test program to assess the effects of varying water cover depth on sulphide mineral oxidation. Also, developed a tailings basin effluent discharge control strategy to minimize variations in receiving water quality and formation of meromictic conditions in downstream lakes.

Mine Decommissioning - Project director for the development of decommissioning and closure plans for three base metal mines in northern Ontario. Technical specialist in the application of the RATAP code to assess alternative strategies for decommissioning pyritic tailings at three sites.

Environmental specialist on a feasibility study of potential concepts for decommissioning and reclamation of a uranium mine/mill facility in northern Saskatchewan. Lead investigator of post-decommissioning environmental issues at this first ever closed-out uranium mine.

Project director on two separate studies to assess alternative concepts for decommissioning open pits at uranium mining properties in northern Saskatchewan including modelling of water quality changes and incremental doses to local residents. The implications of disposing mineralized wastes in the pits were also evaluated using a pit model developed specifically for this application.

Mine Waste Rock Management - Technical specialist in the development and application of a multi-nodal geochemical model (ROCKSTAR) for assessing the dynamic behaviour of radioactive and non-radioactive contaminants in waste rock piles, coal discard dumps, open pits and underground mine workings.

Project manager on investigations into decommissioning alternatives for: waste rock piles at gold mines in Kyrgyzstan and the U.S.A.; waste rock piles at uranium mines in Germany and Saskatchewan; and coal discard piles at two coal mine operations in South Africa. In each of these investigations, the proprietary model ROCKSTAR developed by SENES was applied to assess the effects on source contaminant loadings of alternative reclamation concepts.

Landfill Leachate - Technical specialist on several investigations of surface water quality impacts of municipal landfill leachate discharges. Certain investigations included assessment of the effects of leachate on adjacent natural wetland ecosystems. Also, undertook leachate characterization and treatment investigations including the design of a Powdered Activated Carbon Treatment (PACT) system, a constructed wetland, a leachate pre-treatment system and co-treatment of landfill leachate with municipal sewage.

1970-1980 - James F. MacLaren Limited

Assistant Manager, Water Treatment and Waste Disposal Division, 1974. Manager, Municipal Treatment, 1978.

TECHNICAL PAPERS

Mr. Halbert has co-authored over 30 technical papers.

RANDALL A. KNAPP, B.A.Sc., P.Eng.

Specialist Consultant Mining Projects

EDUCATION

B.A.Sc., Chemical Engineering, 1973, University of Waterloo

PROFESSIONAL AFFILIATIONS

Professional Engineers of Ontario
Canadian Institute of Mining and Metallurgy
Prospectors and Developers Association

EXPERIENCE

1980-date - SENES Consultants Limited

Responsible for strategic planning, management, co-ordination and conceptual design on projects related to mining and industrial wastes in Canada and internationally. Has provided services on six continents. Specific areas of expertise include acid mine drainage assessment, mine waste management, hazardous waste management, development of monitoring and response plans, industrial effluent treatment, environmental auditing and decommissioning and reclamation assessments.

Acid Mine Drainage - Extensive work has been completed in the management of acid mine drainage (AMD). The work has included: experimental design on techniques to assess AMD; numerous manuals; modelling and evaluation of AMD control technologies; design of treatment systems to manage acid releases; and evaluation of remedial measures to mitigate AMD production. Included in this work was completion of MEND reports on Chemical Treatment, ARD sampling manuals, Use of Pits for ARD waste disposal, state-of-the-art review on covers, use of elevated water tables and contribution to the overall MEND manual.

Mine Decommissioning & Closure - Development of more than 100 conceptual and detailed closure plans. Decommissioning and reclamation projects include project management of the environmental and modelling studies associated with the Beaverlodge mine decommissioning in northern Saskatchewan, the Quirke Panel, Stanleigh, Denison, Stanrock, Coldstream and the Agnew Lake mine in Ontario. Other mining projects have included conceptual closure plan development for all INCO Ontario mines; closure plans for several Falconbridge operations; assistance with closure plan development and costs for INCO Voisey's Bay; team member for the update of the Red Dog Closure Plan for Teck Cominco Alaska; member of the technical advisor team for the development of the closure plan for Giant Mine and its arsenic chambers; the development of the

conceptual closure plan for the Kam Kotia mine near Timmins; modelling of the cover benefits for the Equity Silver mine in B.C. Closure plans have been completed for mines in Ontario, British Columbia, Quebec, Nova Scotia, Newfoundland, Northwest Territories, Alaska, Chile and Portugal. Site cleanup and remediation works have been managed at 3 smelter sites and 4 tailings areas.

Mine Waste Management - Project director on numerous studies involving site selection, environmental baseline monitoring, environmental assessment, evaluation of treatment and waste disposal technologies, conceptual design of treatment systems, due diligence evaluations and environmental permitting. Specific projects have included: site selection studies for mines in Ontario, Nova Scotia, Quebec, Saskatchewan and the Northwest Territories; numerous effluent treatment plant evaluations and conceptual designs for base metal and precious metal effluents, environmental due diligence evaluations for properties in Canada, U.S.A., former Soviet Union, Africa, Australia and South America; and environmental permitting across Canada. Recent projects regarding mine effluent treatment have included: Review of treatment alternative for arsenic removal at Giant Mine; Review of alternative treatment options for long term management of Red Dog mine acid drainage; Review of ammonia removal options for the Omai Mine; Review of treatment options and laboratory testing of alternatives methods for management of Colomac tailings water; and the Evaluation of treatment options for the Goldstrike Mine, Nevada. Specific treatment reports include: Status of Chemical Treatment and Sludge Disposal Practice for MEND; State-of-the-Art review of Best Available Technology for Mine Effluents for Environment Canada and Fundamental Concepts and Technologies for Water Treatment and Disposal of residues from Uranium Mining for the German Ministry of Environment.

Hazardous Waste Management - Project manager on investigations involving the evaluation of treatment and disposal technologies, assessment of waste quantities and characteristics, waste minimization audits (3Rs) and PCB management services. Specific projects have included: evaluation and review of treatment technologies for cleanup of sites contaminated with chlorinated organics, metals, polycyclic aromatic hydrocarbons, PCBs and various hydrocarbons; expert witness on waste quantities and the need for new hazardous waste disposal facilities before the Environmental Assessment Board; review of waste production and minimization technologies for management of hazardous wastes; and direction of PCB

inspections and coordination of PCB decontamination of an industrial site.

Environmental Audits - Has performed more than 100 environmental audits and environmental due diligence reviews of mines and industrial facilities in nine provinces in Canada; seven states in the U.S.A.; South America, Australia, Mongolia, Portugal, Russia, Kazakhstan, Kurgistan, Uzbekistan, Africa, Mexico and Cuba.

Environmental Training - Short courses have been given in Canada and internationally in several areas including environmental auditing, operational due diligence, acid mine drainage assessment, water use/recycle, risk assessment, gold mining and the environment.

Industrial Site Cleanup and Remediation - Industrial site cleanups have included a pesticide facility, metal finishing facilities, secondary metals recovery site, gasoline stations, automotive manufacture facilities and miscellaneous industrial sites.

Industrial Wastes - Responsible for management and co-ordination of projects and specialist input related to environmental assessment, tailings management, water supply, and effluent treatment projects. Projects have included the design of effluent treatment facilities for automobile manufacturers, sulphate control for discharges to municipal sewers and design of treatment facilities for textile waste waters.

Environmental Assessment - Project manager for several environmental assessment studies for mining projects in Canada and abroad. These include EAs for 7 mine sites in Ontario and one site in Chile.

Testimony - Expert witness work has included testimony before the Provincial Court of Ontario, the Key Lake Board of Inquiry and the Ontario Environmental Assessment Board. Technical presentations have been made to numerous regulatory agencies, for public interest groups, before public meetings and numerous industry associations.

Provided expert testimony on tailings management, water utilization, and effluent treatment at environmental hearings into the Elliot Lake, Ontario uranium mining expansion and the Voisey's Bay Mine prospect in Newfoundland.

TECHNICAL PAPERS

Mr. Knapp has authored more than 50 technical papers, and has given dozens of presentations at workshops and conferences. Selected papers and presentations are provided upon request. A selection of key papers is provide below.

Fifty Years Environmental Record At Elliot Lake, Ontario Canada, Canadian Nuclear Society Conference "Waste Management, Decommissioning and Environmental Restoration for Canada's Nuclear Activities: Current Practices and Future Needs", 8-11 May 2005, Ottawa. (with M. Wiber, A. Coggan and R. Mansell)

The Elliot Lake Case Study, International Atomic Energy Agency, conference on Restoration of Environments with Radioactive Residues, Reference: J9-SM-379- Washington, December 2000.

Decommissioning of the Denison and Stanrock Tailings Areas. Presented at Uranium 2000-International Symposium on the Process Metallurgy of Uranium, September 2000 (with I.Ludgate, H. C. Counsell, and G. Feasby)

INCO's Copper Cliff Tailings Area, Presented at Sudbury' 95- Mining and the Environment, May 1995 (with M. Puro, W. Kipke, T. MacDonald and R. Stuparyk).

Interim Assessment of the Flooded Tailings Performance-Quirke Mine Waste management Area-Fourth International Conference on Acid Rock Drainage, June 1997 (with R. Payne, S. Kam and J. Balins)

Acid Generation Modelling - Equity Silver Waste Rock Dumps. Presented at the 16th Annual B.C. Mine Reclamation Symposium, Smithers, BC, 1992 (with C.M. Pettit, J.M. Scharer, R.V. Nicholson, R.J. Patterson).

Operational Due Diligence. Presented at Environmental Regulation Compliance and Management for Canadian Mining, Toronto, Sudbury and Vancouver 1991.

The Biogeochemistry of Acid generation in Sulphide Tailings and Waste Rock, Presented at the Acid Mine Drainage Seminar/Workshop, Halifax 1987.

Conceptual Design of Low-Level Radioactive Waste Disposal Facility. Presented at the Health Physics Society Meetings, Chicago, May 1985 (with G.G. Case and D.B. Chambers).

Evaluation of Biomass for the Removal of Metals from Process Effluents. Presented at BIOMINET 2nd Annual General Meeting, Sheridan Park, ON, October 1985 (with V.I. Lakshamanan, J. Christison, J.M. Scharer and V. Sanmugasunderam).

JEFF C. MARTIN, B.A.Sc., P.Eng.

Senior Geological/Environmental Engineer

EDUCATION

B.A.Sc. Geo-engineering (Exploration) 1985,
University of Toronto
Compliance with Environmental Legislation, 1990
Environmental Engineering, 1990
Exploration Techniques in Hydrogeology, 1991
Solid Waste Management, 1991
Contaminant Hydrogeology, 1992
Environmental Geology of Metro Toronto, 1994
(above courses at University of Toronto)

PROFESSIONAL AFFILIATIONS

Professional Engineers of Ontario (PEO)
Ontario Society of Professional Engineers (OSPE)

EXPERIENCE

1992 to date - SENES Consultants Limited

Engineer primarily involved in environmental aspects of mine development and mine closure planning, including studies relating to the assessment and management of metal leaching and acid rock drainage (ML/ARD) from mine wastes. Experience also includes hydrogeological assessments, risk assessments, environmental impact assessments, pathways analyses, environmental site assessments, and municipal solid waste planning and management.

Mine Development and Closure Planning - Project manager and key engineer for numerous mine closure plans developed in accordance with Ontario Regulation 240/00. These include certified closure plans that have been accepted by the Ontario Ministry of Northern Development and Mines (MNDM) for *ten* nickel-copper mines located near Sudbury, Ontario, and *two* gold mining properties located in Timmins, Ontario. Currently preparing several additional closure plans that have yet to be filed. These closure plans typically involve conceptual design of remediation strategies for waste rock dumps, tailings areas and other facilities, estimation of closure costs, assessment of current and future groundwater and surface water quality, and development of monitoring, and care and maintenance programs.

Also prepared: a decommissioning plan for the Kumtor Gold Mine, Kyrgyzstan; a conceptual plan for collection and treatment of contaminated seepage from a gold tailings area in Ontario; and a conceptual closure

plan for the Lacnor uranium tailings area, Elliot Lake, Ontario. Assisted in preparation of a decommissioning plan for the Stanleigh uranium mine, Elliot Lake, Ontario. Assisted in conceptual closure planning studies for nickel-copper mining facilities in the Sudbury area, which included a review of management plans for one of the largest tailings area in the world.

Metal Leaching and Acid Rock Drainage (ML/ARD)

Assessment – Conducted ML/ARD assessments at numerous sites including: the Hollinger Tailings Area in Timmins, Ontario; the Hope Brook Gold Mine in southwest Newfoundland; the Totten Mine, the Clarabelle Mill, the Gertrude Mine, the Creighton Mine #11 Shaft site, the Copper Cliff Smelter, the Copper Cliff Nickel Refinery, the Copper Cliff Copper Refinery, the South Mine, all near Sudbury, Ontario; the Nickel Rim South Advanced Exploration Project and the Bowell Project, near Falconbridge, Ontario; the Kumtor Gold Mine in Kyrgyzstan, Central Asia; and the Bogoso Gold Mine in Ghana, West Africa. Also conducted a neutral mine drainage assessment at the Rabbit Lake Uranium Mine, Saskatchewan. These assessments generally included a field evaluation of ML/ARD including waste rock and water sampling programs, design of laboratory analytical programs, interpretation of field and laboratory results, interpretation of geology and mining plans with respect to the potential for ML/ARD, assistance with geochemical modelling inputs (for some sites), and recommendations regarding waste rock management and monitoring programs. For three of the sites (Rabbit Lake, Nickel Rim South, and Bowell) the assessments have included supervision and interpretation of results from humidity cells. The assessments for Ontario sites have generally followed the guidance provided in British Columbia's *Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*, as this is a closure planning requirement in Ontario's Mine Rehabilitation Code. Designed a program to inhibit outflow of ARD from an underground base metal mine. Participated in a waste rock characterization study for MEND (including field work) for the Whistle nickel mine, Sudbury. Evaluated ML/ARD data for other sites including nickel-copper mines in the Levack-Onaping area and the Lockerby nickel-copper mine, all located near Sudbury, Ontario, and the McIntyre Concentrate Dump and Little Pearl Lake tailings disposal area, both located in Timmins, Ontario. Evaluated proposed oxygen barrier cover designs for several tailings areas and waste rock dumps using the Soilcover[®] and HELP models. Assessed slag and slag leachate properties to

provide input to a risk assessment. Participated in preparation of several reports for Canada's Mine Environment Neutral Drainage (MEND) program, including a handbook for waste rock sampling techniques, a guideline for monitoring acid mine drainage, and reports on the use of an elevated water table in tailings to inhibit the production of ML/ARD, in-pit disposal of waste rock, and ML/ARD prediction, prevention, control and treatment.

Hydrogeological Assessment - Completed a detailed hydrogeological assessment for nickel-copper mines in the Levack/Onaping area in support of a closure plan for the sites. Directed a hydrogeological assessment of a Timmins tailings area. Reviewed and interpreted hydrogeological data from numerous other mine sites and landfill facilities. Conducted environmental drilling and installation of monitoring wells in the Toronto area.

Environmental Assessment (EA) - Assisted with a screening report under the Canadian Environmental Assessment Act (CEAA) for historical uranium tailings properties in the Elliot Lake area, Ontario. Assisted with EAs for other Elliot Lake area uranium mines. Assisted with many aspects of the environmental impact assessment of proposed landfill sites in the Toronto area for the Interim Waste Authority (IWA).

Risk Assessment - Participated in risk assessments evaluating the effects of accidental and routine releases from a mine site, for the use of mining wastes as a construction material, and for an assessment of exposures arising from the transport of the low level radioactive material. Participated in a review of the state-of-the-art application of risk assessment principals to ML/ARD issues.

Solid Waste Management - Participant in numerous projects including landfill site selection and conceptual design, annual reports, Certificate of Approval applications, and analysis of solid waste disposal and diversion information. Involved in a wide range of tasks for the IWA Peel Region landfill site search including transportation issues, conceptual landfill design, analysis of waste quantities and vehicle trips, co-ordination of responses to Public Consultation, and preparation of EA documents.

1990 - 1992 - Engineer, Metro Toronto, Solid Waste Management Division

Solid Waste Planning and Management - Engineer responsible for analysis of solid waste disposal and diversion information. Participated in numerous planning projects for landfills and recycling facilities.

1988 - 1990 - Mining Property Management, Kerr Addison Mines Limited

Responsible for maintenance of the company's mining and exploration properties. Assisted in preparation of environmental reports.

1986 - 1988 - Geologist, Kerr Addison Mines

Played a major role in the discovery of the Troilus Mine, a 15,000 tonne/day open pit gold-copper mine north of Chibougamau, Quebec. Responsible for geological mapping, rock and soil sampling, logging/interpretation of drill core, interpretation of geochemical, geophysical and geological data, prospecting, preliminary estimation of geological reserves, and implementation of exploration programs.

Summer 1986 - Geologist, Silverside Resources

Conducted geological mapping, rock sampling, soil sampling and humus sampling. Interpreted results for sites at Kakagi Lake and Pickle Lake, Ontario.

Summer 1985 - Geologist, Geological Survey of Canada

Geological mapping in southwestern Newfoundland.

Summer 1984 - Geologist, UTEX Gold

Geological exploration and geochemical sampling east of Timmins, Ontario.

TECHNICAL PAPERS

Guide to Initial Phase Metal Leaching/Acid Rock Drainage Assessment. Sudbury 2003 - Mining and the Environment Conference.

Acid Rock Drainage Assessment Programs at the Kumtor Gold Mine, Kyrgyzstan, and the Bogoso Gold Mine, Ghana. Sudbury '99 Conference - Mining and the Environment II (with B.E. Halbert and M.E. Anderson).

Waste Rock Sampling Techniques for Acid Rock Drainage (ARD) Assessment. Sudbury '95 Conference - Mining and the Environment (with R.A. Knapp and C.M. Pettit).

GERD M. WIATZKA, B.A.Sc., P.Eng.

Principal, Sr. Project Manager, Manager Mining

EDUCATION

B.A.Sc., (Honours) Civil Engineering, 1974, University of Waterloo

PROFESSIONAL AFFILIATIONS

Professional Engineers of Ontario

EXPERIENCE

1991-date SENES Consultants Limited

Senior project engineer and project manager for multi-discipline environmental projects including environmental assessments for greenfield and brownfield developments, industrial and mine due diligence liability assessments and audits, assessment and development of mine decommissioning and rehabilitation programs, contaminated soils assessment, review of environmental and waste management practices, and development of state of the art reports on industry practice in Canada and internationally.

Northern Experience – Project Manager for Port Radium site field investigations and remediation options evaluations. Project specialist on facility risk for Giant Arsenic Assessment/ and on physical hazards assessment for 24 northern contaminated sites.

Mine Decommissioning and Audits - International - Technical and management review and assessment of the decommissioning plans of Wismut, the former east German Uranium Mines for the German Federal Ministry of Environment. Identification of overall program needs, strategies, and refocusing the program to achieve integration and optimization of the activities associated with decommissioning of disturbed lands including more than 500 Mm³ of waste rock, all located within close proximity to local populations.

Environmental assessments, audits; closure planning, site and liability assessments, and environmental management system (EMS) reviews of mines including Cero Vanguardia in Argentina; Morro Vello, Itajobi, Serra Grande in Brazil; Bogoso Gold in Ghana; Linmine Bauxite, Guyana; Kumtor Gold in the Kyrgyz Republic; Mongolia, Irokinda and Zun Holba Gold Mines in Buryatia, Siberia; Gros Rosebel, Suriname; small scale gold mining districts in Tanzania; the Atlas Moab uranium mill site, the International Uranium Mine Sites and White Mesa Mill, the Cripple Creek & Victor, Jerritt Canyon, and Big Springs Gold Mines,

and the Uravan Uranium Mill site in the United States.

Mine Decommissioning and Audits - Canada – Canadian and worldwide environmental status and due diligence assessment of Kinross, TVX, Echo mines. Decommissioning audits and financial liability assessments of more than 30 historic and operating coal mine sites and facilities in Nova Scotia. Corporate environmental overview of Royal Oak mine properties on behalf of Interim Receiver PricewaterhouseCoopers Inc. Development of decommissioning plans for Eastmaque Mines, Kirkland Lake, Willroy Mines, Manitouwadge in Ontario. Engineering assessments of closure options for Skyline Gold in B.C. Numerous North American due diligence, audits and liability assessments for internal and external parties have included: Faro, Grum, Vangorda and SA Dena Hess mines - Yukon, Giant and Colomac mines - Northwest Territories; Kemess, Gibraltar mines and the Stronsay project - B.C.; Cluff Lake - Saskatchewan; Hudson Bay Mining & Smelting Flin Flon Complex and Trout Lake Operation, New Britannia mine - Manitoba; Pamour and Holt McDermott Mines - Ontario; Cape Breton Development Corporation coal mines - Nova Scotia.

Confidential audit and EMS review for open pit mining operation in western Canada. Confidential audits and reviews for various banks.

Contaminated Soil Remediation - Provided review and assessment of contaminated soils including historical sources, existing distribution and impacts, and waste management options for the Toronto Economic Development Corporation TEDCO Lake Ontario Lands redevelopment project (130 ha site). C of A permit application and technical support for Low Temperature Thermal Desorption Plant for Armbrust Construction.

Applied Research - Manager of the State-of-the-Art of Chemical Treatment of Acid Mine Drainage and Sludge Management, for Canada's Mine Effluent Neutral Drainage Program MEND. Manager and principle author of a report on the State-of-the-Art Application of Risk Assessment to Acid Rock Drainage, on behalf of the International Network for Acid Prevention INAP. Manager of cyanide assessment practice guide, and several confidential state of the art research projects for industry.

**1991 - Toronto Branch Manager,
Steffen Robertson and Kirsten**

Introduced SRK's environmental services to industry

and government in eastern Canada and the U.S.A. Participated in Ontario's "Mine Closure Guideline Development" for the Ministry of Northern Development and Mines. One of five member mission representing Canadian environmental expertise, negotiated protocol agreement for decommissioning of East German uranium mines.

**1986-1990 - Director, Information Services,
Noranda Inc.**

Developed and implemented strategic, operating, and human resource plans refocusing an \$8 million/year data centre into a proactive technology consulting group providing business, commercial, and engineering systems leadership to the Noranda group including Oil and Gas, Forestry, Manufacturing and Mining companies.

Principal guiding project teams and consulting on effective use of information technology. Key initiatives included guidance on strategic systems planning, information architecture development, information systems integration, and introduction and development of Canada's first executive information system.

**1984-1986 - Manager, Business Services,
Noranda Inc.**

Revitalized Noranda's corporate planning and reporting systems. Introduced computer and communication technology to management and staff for over 65 corporate entities located at 40 separate locations throughout North America.

**1978-1983 - Mining Corporation of Canada Inc.,
Noranda Group**

Construction Manager - Responsible for all site construction aspects for a 350 ton per day gold mill. Muscocho Gold Mill in Montauban, Quebec.

Environmental Manager - Resolved key environmental issues throughout North America by working with government, industry, and special interest groups to arrive at cost effective solutions. Handled all aspects of obtaining environmental permits for mines in environmentally sensitive areas of Idaho, B.C. and the North West Territories, including operation, shutdown, abandonment and reclamation. Consulted on environmental programs and designs ranging from specific point discharge treatment to complete program design, permit application. Directed feasibility studies, process design, engineering, and procurement for two

state-of-the-art acid water treatment plants. Restructured major baseline environmental assessment for Alaska property saving \$200,000 and meeting all government needs. Investigated and assessed properties throughout North America, advising management of acquisition liabilities and opportunities.

1974-1978 - Kilborn Engineering Ltd.

Project engineer on a variety of environmental and civil projects in local and off-site locations. Projects ranged from feasibility and engineering studies for new mines and municipal projects to detailed design and construction management of major civil works. Positions held included:

Cognizant Civil Engineer, Nuclear Utility Services, Rockville, Md. Successful project management and client interface on major industrial wastewater treatment systems meeting EPA-NPDES for Commonwealth Edison's fossil fuel power plants in Illinois.

Project Engineer, Environmental Division. Project leader on numerous engineering studies and projects. Resource clients included Denison Mines, Exxon, Nanisivik, Rio Algom, Potash Corporation. Other clients included Petrosar Canada, Gulf Oil Canada, Towns of Little Current, Ancaster, Port Hope and the Ganaraska Conservation Authority.

Site Engineer, Third Depot Lake Dam. Supervised all aspects of work including raising of the main dam, extension of saddle dams, construction of spillway and control structure, and raising the township roads.

TECHNICAL PAPERS AND PRESENTATIONS

- Approach to Decommissioning In Europe: Decommissioning the Former East German Uranium Industry.
- Risk/Cost Analysis: A Case Scenario in the Decommissioning of a Radiological Site; at PSA96.
- Best Estimates of Potential Environmental Costs and Liabilities, Thompson, Corporate Legal Times.
- Steps towards Harmonization of Risk from Chemical & Radioactive Contaminants, Spectrum'98.
- State of the Art of the Application of Risk Assessment to ARD INAP Risk Assessment.
- Risk - What is it, and how to manage it? CIMM 2000.
- Uravan -A Case History, Illustrating Application of Risk Assessment Principles to Decommissioning of a Large U.S.-Title II Uranium Site, Uranium 2000.

