Education

B.Sc. Civil Engineering, University of Saskatchewan, 1974

M.Sc. Geotechnical Engineering, University of Saskatchewan, 1977

Professional Affiliations

Registered Professional Engineer, Ontario, Saskatchewan and Northwest Territories / Nunavut - Permission to Consult, Saskatchewan

Golder Associates Ltd. - Mississauga

Employment History

Golder Associates Ltd. – Mississauga, Ontario
Principal (2010 to Present)

Principal in the multi-disciplinary Mine Waste & Environment Division. Involved in the planning, permitting, design and closure of numerous mine waste facilities around the world. Responsible for project management, geotechnical / environmental engineering and costing for mine waste and mine water management components as part of pre-feasibility and feasibility studies or detailed design. Projects often focus on prediction and mitigation of environmental impacts, including: geochemical characterisation of mine wastes, consideration of alternative strategies to manage mine wastes to minimize acid generation, mine water management, mine closure planning, etc. Senior Reviewer for numerous mine closure plans around the world. Also conducts inspections, reviews and audits of mine waste facilities.

Golder Associates Pty Ltd – Brisbane
Principal (2007 to 2009)

Responsible for project management and geotechnical/environmental engineering on mine waste projects in Australasia and Asia, involving the siting, planning, permitting, design and closure of mine waste facilities. Responsible for geotechnical site inspections during the construction of the residue storage facility at the Goro Nickel Project. Project Manager for mine waste and mine water management aspects for pre-feasibility and feasibility studies for a gold mine in Laos.

Golder Associates Ltd. – Mississauga, Ontario
Associate, then Principal, Group Manager (1988 to 2006)

Manager of the Mine Waste & Environment Group (1999 - 2006). Involved in the planning, permitting, design and closure of numerous mine waste facilities. Responsible for project management and geotechnical engineering for tailings, waste rock and mine water management facilities for gold, uranium and base metal mines. Projects typically involved: facility siting, feasibility studies, permitting, tailings deposition planning, geotechnical investigations, construction materials assessment, design of dams and appurtenances, preparation of drawings and specifications, instrumentation and monitoring, and construction supervision. Projects often focused on environmental aspects, including: geochemical characterization, minimization of acid runoff from tailings or waste rock, mine water management, preparation of mine closure plans, assessment and mitigation of groundwater impacts, reclamation of mine sites, etc.

Golder Associates Ltd. – Saskatoon, Saskatchewan
Senior Geotechnical Engineer, then Associate (1984 to 1988)

Thurber Consultants Ltd. – Victoria, B.C.
Project Engineer (1978 to 1984)

Ground Engineering Ltd. – Regina & Saskatoon, Saskatchewan
Geotechnical Engineer (1976 to 1978)

PROJECT EXPERIENCE – MINE CLOSURE PLANNING

Kidd Metallurgical Site Timmins, Ontario, Canada	Preparation of two closure plans for Glencore's Kidd Metallurgical Site near Timmins, Ontario in 2001. One involved closure of the large metallurgical complex itself; the other involved the closure of the Tailings Management Area. With a gross area of over 11 km^2, the TMA comprises one of the world's largest thickened tailings cones, together with areas for slag disposal, for sludge disposal and for treatment of acidic water.
Kidd Metallurgical Site Timmins, Ontario, Canada	Extensive updating of the TMA Closure Plan in 2012. Background studies included hydrogeologic investigation and modelling as well as extensive soil cover modelling and design. The cost estimate for closure was detailed and updated following stage gate procedures.
Glencore Nickel Smelter Sudbury, Ontario, Canada	Preparation and more recently updating of a closure plan for Glencore Smelter complex near Sudbury, Ontario, which includes: two mines, 5 historic tailings areas, large slag deposits, extensive water management facilities, and the smelter complex itself. The project involved two years of studies involving: geochemical characterisation of a variety of wastes, assessment of groundwater impacts and remediation, seismic stability assessments, biological studies, hydrology, crown pillar stability evaluations, etc. This was followed by conceptual planning and costing of closure measures, and prediction of loadings and impacts.
New Tailings Area Sudbury, Ontario, Canada	Preparation and more recently updating of a closure plan for Glencore's New Tailings Area near the Sudbury, Ontario Smelter. This included geochemical characterization on tailings and prediction of impacts of flooding on the quality of surface water and groundwater.
Fault Lake Tailings Area Sudbury, Ontario, Canada	Preparation of a closure plan for Glencore's Fault Lake Tailings Area. Closure measures included the construction of a multi-element soil cover to reduce the rate of oxidation of existing sulphidic tailings and to mitigate impacts on regional groundwater.
Fecunis Tailings Area Onaping, Ontario, Canada	Study of options for closure of Glencore's Fecunis Tailings Area, considering the feasibility of: flooding, slimes cover, removal of tailings and perpetual treatment. A geotechnical/geochemical investigation lead to a detailed assessment of capital and operating costs for the various options.
NICO Project Northwest Territories , Canada	Preparation of a Conceptual Closure and Reclamation Plan (CCRP) for a proposed gold-cobalt-bismuth-copper mine. This was in support of permitting and licensure of the mine and included a detailed cost estimate for financial assurance.
Hammond Reef Project Atikokan, Ontario, Canada	Conceptual planning (for EIS) of closure measures for a proposed large tonnage gold mine. Preparation of a formal detailed closure plan for permitting purposes.

Holloway Complex Matheson, Ontario, Canada	Preparation of a comprehensive closure plan for three neighbouring underground gold mines, a mill complex and a tailings management facility. This involved detailed tailings deposition planning so that arseno-pyrite tailings would be submerged at closure. More recently, studies were completed in support of an amendment using subaerial tailings stacking.
Bicroft Tailings Area Bancroft, Ontario, Canada	Design, costing and construction supervision of an engineered decommissioning of the inactive uranium tailings basins at Bicroft Uranium Mine. The project involved remedial work and seismic stability upgrading of 4 existing tailings dams, construction of a new dam, and construction of several spillways.
Closure Plans for Stock, Clavos, Taylor and Hislop Mines Timmins, Ontario, Canada	Completion and subsequent updating of a mine closure plan for St. Andrew Goldfields Stock Mine, near Timmins, including detailed planning of tailings deposition and water management. Also, closure plans for satellite mines at: Clavos, Taylor and Hislop which focussed on water management and waste rock management.
Shakespeare Mine Agnew Lake, Ontario, Canada	Led the preparation and approval of a multi-stage closure plan for a base metal mine mill, water management system and co-disposal area for tailings and waste rock, including cost estimates.
Cerro Colorado Mine near Iquique, Chile	Technical advisor and reviewer for a closure plan for a large copper mine and heap leaching facility in a desert environment. Risk assessment was used to prioritise issues and identify preferred closure alternatives.
Alto Chicama Mine Andes Mountains, Peru	Technical Advisor and reviewer for a closure plan for a large open pit gold mine in the high Andes. The mine uses cyanide heap leaching.
Coldstream Mine Burchell Lake, Ontario, Canada	Detailed design and construction supervision of tailings relocation, water management channels and a soil covered tailings relocation area.
Eastmaque Mine Closure Kirkland Lake, Ontario, Canada	Completion of a mine closure plan for the Eastmaque tailings remilling project in Kirkland Lake. The project involved detailed design of several channels, spillways and control structures, dam remediation, etc.
Lisheen Mine Closure Thurles, Tipperary, Ireland	Internal review of closure planning for a complex comprising an underground base metal mine, mill and tailings area at end of mine life with closure imminent.

PROJECT EXPERIENCE – MANAGEMENT OF ACID MINE DRAINAGE

Los Frailes Mine Aznalcollar, Spain	Senior level participation on the team which planned and designed remedial measures for the stabilization and closure of the failed tailings impoundment at Boliden Apirsa's mill in Aznalcollar, Spain. Remedial measures included: dam lowering and berm construction, regrading to redirect drainage away from the failure, construction of a very large O_2 barrier cover over pyritic tailings, and measures to contain and intercept contaminated groundwater. Tailings recovered from the river valley was disposed together with waste rock in an existing open pit.

Owl Creek Mine
Timmins, Ontario , Canada

Conceptual design, costing and evaluation of various options for remediation of a severe acid generation problem involving waste rock from an open pit gold mine near Timmins, Ontario. As part of final closure, the waste rock was moved into the open pit and flooded with concurrent lime addition.

Mattagami Lake Mine
Mattagami, Quebec, Canada

Multidisciplinary study for disposal of acid generating mill tailings in exhausted underground and surface workings at Noranda Minerals' Mattagami Lake Mine. The study included preparation of two permitting documents for submission to Quebec Environment.

New Tailings Area
Sudbury, Ontario, Canada

Feasibility assessment, optimization, detailed design and construction supervision for the flooding of Glencore's New Tailings Area to mitigate future acid generation. The project involved: hydrologic assessment of runoff available to maintain flooding, hydrotechnical design of spillways, groundwater modelling to estimate seepage losses, detailed design of 4 earth dams and spillway facilities, preparation of plans and specs, and construction quality control.

Bouchard Hebert Mine
Rouyn - Noranda, Quebec, Canada

Planning, investigation, design, permitting and construction inspection for a tailings basin for Bouchard-Hebert Mine). The facility, which includes 7 dams up to 18 m high on soft clay foundations, was originally designed to be flooded upon closure to prevent acid generation by the sulphidic tailings.

PROJECT EXPERIENCE – INTERNATIONAL TECHNOLOGY TRANSFER

CANMET Project
Belo Horizonte, Brazil

Participated in a CANMET Project involving transfer of technology on mine closure and mine waste management to Brazil. Presented an invited lecture on planning and implementation of mine closure in Belo Horizonte, Brazil.

PerCan Project
Peru

One of the lead authors of two documents prepared for the Peruvian Ministry of Energy and Mines as part of the PerCan I Project. The documents comprised a Guideline for the Evaluation of Mine Closure Plans, and a discussion paper on the technology of sub-aqueous deposition of tailings. Also presented three lectures in Lima on sub-aqueous tailings placement and mine closure planning

APEC Mine Closure Checklist
Asia-Pacific Region

One of four co-authors of a checklist for mine closure planning for regulators in the 21 nations in the Asia-Pacific Economic Cooperation region. The project was coordinated on behalf of APEC by NRCan.

PUBLICATIONS

Conference Proceedings

DeVos, Ken, Dave Ritchie and Ken Bocking. 1999. *Practical Considerations for Covering Sulphidic Tailings Deposits Situated above the Groundwater Table*. Sudbury 1999 Mining and the Environment, October. Sudbury, Canada.

Bocking, Ken, Ken DeVos, Bruce Mikkila and Glen Hall. 1999. *Closure Planning for the Falconbridge Limited Smelter Complex, Sudbury, Ontario - Issues and Experience.* Sudbury 1999 Mining and the Environment, March. Sudbury, Canada.

Bocking, K.A., K.J. DeVos and M. Butler. 2007. *Practical Considerations for Choosing Covers for Sulphidic Tailings Areas*. Mine Closure 2007, October. Santiago, Chile.

Bocking, K.A., S.N. Kam, D.E. Welch and D.A. Williams. 2009. *Management of Mine Sites After Closure*. Mine Closure 2009, September. Perth, Australia.

Journal Articles

Bocking, Ken. Post-closure liabilities, invited article in ACG Newsletter. *Australian Centre for Geomechanics* (December 2010, Perth Australia)