



# IEG Nunasi Consultants Ltd.

Offering engineering and environmental services in northern Canada.  
IEG Nunasi Consultants Ltd. is a joint venture between: Nunasi Corporation  
[www.nunasi.com](http://www.nunasi.com) and Klohn Crippen Berger Ltd. [www.klohn.com](http://www.klohn.com)

## MINE SERVICES



*Mine waste  
and geotechnical  
design*

*Socio-  
environmental and  
consultation*

*Environmental  
guidance for design  
and permitting*

*Total mine water  
management  
solutions*

Down to Earth. Up to the Challenge.

## About us

# IEG Nunasi Consultants Ltd.

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Nunasi Corporation is a birthright development corporation wholly-owned by its shareholders which are all Inuit enrolled as beneficiaries under the Nunavut Land Claim Agreement. Nunasi Corporation is governed by a Board of Directors which represents all regions of Nunavut and their respective regional Inuit development corporations. The Board of Directors is overseen by a Board of Trustees which is also reflective of all three regions.



Nunasi's mandate is to maximize profits for its shareholders and while doing so, create value added benefits such as training, employment and other economic opportunities for the Inuit of Nunavut. The corporation was formed in 1976 by the Inuit Tapirisat Kanatami so that, even before the land claims were settled, the people of Nunavut could begin to take their place in the Canadian business world.



Klohn Crippen Berger (KCB) is an international engineering and environmental consulting firm with its head office in Vancouver and eight offices in strategic locations in Canada, Peru and Australia. We have a strong reputation for quality service and technical expertise in a range of services including: Mining, Environmental, Water, Power, Transportation, and Oil and Gas. Formed in 1951, we have a long history of participation in local projects, as well as a strong international reputation. We are working on some of the largest, most challenging engineering projects, both nationally and internationally.

We provide comprehensive services for environmental and engineering management of mine development projects focusing on mine waste management and environmental stewardship. We have worked on hundreds of mining projects worldwide, including some of the largest mining projects developed. KCB is a specialist in tailings dam design and have designed hundreds of dams. Our integration with the environmental and social design drives our continued development as a leading-edge provider of these services.





## Team leaders

**Brian Rogers** has over 30 years of diverse experience in the design and construction of civil resource development and water resources projects.

**Len Murray** is a civil and geotechnical engineer who has undertaken design, construction, and project management skills for projects worldwide over the last 30 years.

**Harvey McLeod** has 35 years experience in all aspects of mine waste management, with major studies for more than 100 mining projects internationally, including some of the largest mining operations in the world.

**Bob Chambers** is a geotechnical engineer with more than 20 years experience in all areas of mine development, from site assessment and design to mine closure plans.

**Howard Plewes** is a civil engineer with more than 20 years international experience in dam engineering and mine waste management, with some of the largest tailings facilities in the world.

**Debra Lamash** has developed socioeconomic, regulatory review, consultation and First Nations programs for clients across a variety of sectors, including hydro for over 20 years.

**Chris Langton** has 20 years of experience in groundwater projects for mine environmental management, groundwater supply and groundwater contamination.

**Brett Stephens** has over 18 years of experience in geotechnical and environmental engineering projects. His experience includes water supply dams, tailings dams, highway projects, bridges, buildings, landslip remediation and large-scale civil earthworks.

**Warren Vincent-Lambert** has over 13 years of experience in mining, environmental investigations and water management.

**Stephen Buck** has more than 15 years of experience as a geotechnical engineer and hydrogeologist.

**Lawrence Clelland** Manager Sudbury, has more than 25 years experience in the study, design and construction supervision of major civil engineering projects.

**Robin FitzGerald** has more than 30 years diverse experience in the design and construction of civil, resource development and water resources projects.



# Mine Tailings and Rock Engineering Services

**Tailings Technologies:** Designs to reduce water management and project footprint using dewatered, paste and thickened tailings. Alternative technologies using co-disposal with waste rock, cells to limit evaporation losses, cycloning and thickening of select tailing streams and combinations of conventional tailings storage and new technologies.

**Dam Design:** Geotechnical design of major dams, considering seismicity, seepage control, stability, natural hazards, water management.

**Environmental Design:** Integration of limiting environmental factors, such as water quality, seepage, water treatment/discharge, social concerns.

**Waste Management:** Integration of International best practices following Mining Association of Canada, International

Congress of Large Dams and World Bank/ IFC guidelines. Preparation of Operation, Maintenance and Surveillance Manuals and Emergency Preparedness Plans.

**Construction:** Focused on building a project that works for the client, QA/QC services, construction supervision/monitoring and cost control.

**Waste Rock and Water Management:** Geotechnical and environmental design of waste rock dumps. Water balance, water management and hydraulic structures associated with dams, waste dumps and open pits.

**Risk and Benefit Assessment:** Risk assessment and risk management plans for mine waste and water facilities. Benefit assessment to balance and mitigate potential risks.

**Closure:** Design for long-term sustainable closure of dams, tailing impoundments and waste dumps.

**International Recognition:** We have been trusted with some of the largest, most challenging tailings dams, and some of our clients have been with us for over 30 years.



# MINE TAILINGS AND ROCK ENGINEERING



## Experience

**Large Copper Projects:** Design of tailings storage facilities for some of the largest copper mines in the world. Recent and active projects include international projects, such as: Oyu Tolgoi (Mongolia), Tampakan (Philippines), Ok Tedi (Papua New Guinea), and Montanore and Resolution Copper (USA). Canadian projects include: Kerr-Sulphurets, Yellowhead, Kemess North, Morrison, Gibraltar, and Highland Valley Copper. Designs include different combinations of cycloned sand dams, waste rock dams, high density thickening, tailings desulphidization and co-disposal of ARD waste rock with tailings; and production rates range from 30,000 tpd to 170,000 tpd. Dam heights range from 80 m to 300 m high.

**Oil Sands:** KCB is the designer of record for many of the large oil sand tailings facilities located in northern Alberta. The projects range up to 240,000 tpd and integrate evolving technologies for management of

mature fine tailings. Recent and active projects include: Syncrude, Suncor, Fort Hills and Albion.

**Massive Sulphide and Nickel Mines:** Design and management of numerous facilities in Canada and worldwide, including many of Vale Inco nickel mines in the Sudbury basin. Massive sulphide mines in western Canada include: Yukon Zinc, Tulsequah Chief, J & L. Peruvian mines have included: Andaychagua, Huaron, Cobriza and others.

**Uranium and Rare Earth Metals:** KCB carried out environmental baseline studies for Blizzard Uranium in British Columbia. Other projects include design of the tailings facility for a confidential mine in Australia and a Tantalum – Niobium mine in British Columbia.

**Tailings Technologies:** KCB has integrated evolving tailing technologies into the dewatered tailings at Greens Creek (Alaska), paste tailings at Myra Falls (British

Columbia), tailings desulphidization at Ok Tedi (Papua New Guinea), cycloning and thickening of cyclone overflow at Albion (Alberta).

**Waste Rock Facilities:** KCB incorporates the waste management planning of the waste rock dumps into design of the project and have included co-disposal with tailings into the Kemess North design and the Yellowhead mine tailings designs. Water management facilities for waste dumps have been designed and constructed for the Antamina zinc-copper mine in Peru, which include treatment ponds and wetlands.





# Water Management Services

## **Acid Rock Drainage and Metal Leaching:**

Geochemical assessment of mine waste rock and tailings. Water quality predictions for operations and closure. Limiting water quality issues and integration of controls as part of facility engineering design.

## **Water Balance and Water Management:**

Optimizing water recovery in arid climates and improving storage, treatment and release of water in wet climates.

**Mine Dewatering:** Design of mine dewatering systems that manage both quantity and quality of mine water. Design of depressurization systems for pit wall stability.

## **Water Supply and Water Rights:**

Groundwater and surface water supply and storage assessment of mine water supply.

**Hydraulic Structures:** Design and construction of diversion structures, diversion channels, spillways, sediment ponds and decant systems. Assessment of hypothetical “Dam Break” and “Tailings Run-out” effects to support Emergency Preparedness Planning (EPP).

**Environmental Design:** Water quality modelling to integrate facility engineering design with limiting environmental factors in the receiving waters, such as aquatic life or downstream water use.

**Groundwater:** Groundwater plume modelling, including dispersion modelling and absorption/attenuation models. Groundwater monitoring programs and the design and construction of groundwater remediation systems.

**Wetlands:** Design and construction of wetlands to mitigate water quality and/or to enhance aquatic habitat.

**Regulatory Compliance:** We work closely with government, aboriginal groups and other communities and industries to develop successful solutions for environmental, social and resource requirements. Our professionals have the capabilities to complete wellsite inspections, right-of-way inspections, liability assessments, monitoring and reporting for environmental approval purposes.

**Project Management:** Addressing scope, quality, time and budget is essential to a successful project. Let us prove to you how we can meet your project goals and objectives through allocation and integration of resources.



## Experience

**Antamina Mine, Peru:** Design and construction of an engineered wetland at 4000 m elevation and sediment and water treatment ponds for runoff from the mine waste rock dumps.

**Lihir Gold Mine, Papua New Guinea:** Development of a Mine Water, Sediment and Acid Rock Drainage plan for a mine located on an island formed around 5 volcanoes.

**Vale Inco Mine, Sudbury Canada:** Conceptual design, detailed design and construction monitoring of a site wide Water Management System to reduce hydraulic overload at the central Waste Water Treatment Plant. The system services 60 square kilometers of Canadian Shield watershed and features 21 ponds, reservoirs and lakes connected by a fibre optic monitoring and remote control discharge systems.

**Water Balance and Flood Design:** Water management for all of the active tailings projects being carried out by KCB, including design of spillways, decant systems, erosion protection works and diversions.

**Ok Tedi Mine, Papua New Guinea:** Design of pit dewatering system for this 300 m deep pit extension in a high rainfall (10 m/yr) environment.

**Dam Break Assessments:** As part of the new Canadian Dam Safety Guidelines, dam break analyses are carried out for all tailings dams and water supply to assess classification, to formulate design criteria, and to assess downstream flood impacts. KCB has carried this out for the 150m-high Highland Valley Copper tailings dam in British Columbia and other projects.

**Ruby Creek Water Supply:** Hydrological and hydrogeological studies, groundwater field investigations, and detailed design of surface water diversion, groundwater extraction and water conveyance works for the proposed mine.

**Ruby Creek Aquatic Habitat:** Civil and hydrotechnical design for habitat compensation/migration works incorporating bio-engineered structures such as large woody debris, rootwads, boulder clusters, etc.



# Socioeconomics and Consultation Services

**Stakeholder and First Nations/Aboriginal Consultation:** Facilitating understanding, involvement, and information exchange during all project stages through use of a variety of tools and techniques such as meetings, communications materials, and open houses.

**Communications and Consultation Plans and Materials:** Developing and implementing project-specific plans and supporting communications materials, including culturally appropriate materials.

**Regulatory Consultation and Advisory Services:** Developing strategies that advance the review and regulatory approval processes. KCB has experience with federal, provincial and territorial processes in Canada and International Finance Corporation standards, World Bank guidelines, Equatorial Principles, and numerous country specific processes worldwide.

**Socioeconomic Baseline and Impact Assessments:** Characterizing pre-project social and economic conditions in the potential area of influence of a project; assessing the potential short, medium and long-term effects on people, communities and economies; and developing mitigation, enhancement and monitoring strategies in concert with stakeholders and First Nations.

**Capacity Building:** Training, skills development and capacity building for local communities and First Nations/Aboriginal groups.

**Traditional Use and Traditional Ecological Knowledge:** Incorporating traditional use and traditional ecological knowledge into socioeconomic and environmental baseline and impact assessment studies.

**Corporate Social Responsibility and Sustainability:** Working with clients to integrate social, economic, and environmental considerations into corporate decision making.

**Health and Safety:** Development of Health & Safety programs and integration of safety into project design.

**Joint Ventures:** IEG Consultants Ltd. and IEG Nunasi Consultants Ltd. are joint ventures between Klohn Crippen Berger and the Inuvialuit Development Corporation and Nunasi Corporation, respectively. Dedicated to the communities and people of northern Canada, the joint ventures deliver quality environmental and engineering services to industry, government and aboriginal organizations.



# SOCIOECONOMICS AND CONSULTATION



## Experience

**Rainy River Gold Mine, Canada:** KCB initiated baseline data-gathering for this advanced exploration-phase gold project in 2009. In 2010 we will complete the baseline, and work with local community members and First Nations to identify means through which to enhance socioeconomic benefits, minimize effects, and develop a conceptual closure plan. Ongoing consultation will be key to project success.

**Minto Mine Phase IV Expansion, Canada:** KCB is undertaking the socioeconomic assessment for the expansion of the Minto Mine located on Selkirk First Nation Category A Settlement Lands.

**Ruby Creek Molybdenum Mine, Canada:** This remote mine, located in the traditional territory of the Taku Tlingit First Nation, was approved by federal and provincial regulatory agencies. KCB led the socioenvironmental assessment; consulted with the community, First Nations and

regulatory agencies and designed the waste management facilities. First Nations participated in project studies and we worked with First Nations to develop an adaptive management plan.

**Fenix Nickel Mine, Guatemala:** KCB worked with a team of local consultants to develop a baseline and complete a socioenvironmental impact assessment for the re-opening of a mining and milling operation. The studies were undertaken in accordance with IFC Performance Standards, World Bank guidelines and Government of Guatemala regulations.

**Mica Units 5 and 6, Canada:** KCB led the socioenvironmental assessment for this Project located in the overlapping traditional territory of 25 First Nations. We also advised and supported the client in consultation and regulatory activities, undertook an alternatives assessment and worked with First Nations to involve them in project studies.

**Tampakan Copper Mine, Philippines:** KCB completed a Social Impact Assessment and Community Consultation Program for a mine access road. We worked closely with local consultants and experts from the local university to complete the project.

**Molejon Gold Mine, Panama:** KCB developed consultation protocols for use by our client to gather input from local communities. We also conducted due diligence reviews, and completed the socioenvironmental studies for the Project.

**Antamina Mine, Peru:** KCB managed a team of consultants that undertook a social baseline study and consultation for a mine closure plan in accordance with Peruvian law. KCB developed a plan to monitor the results and effectiveness of social programs.





# Mine Environment Services

**Environment by design:** integrating the environment into the engineering and social plans building successful projects.

**Environmental Baseline Studies:** Characterize baseline conditions, e.g. climate, aquatic and terrestrial biology, water quality, visual terrain.

**Environmental Impact Assessment:** Integrate the project design into the effects assessment to optimize mitigation opportunities. Incorporation of social effects and preparation of Socio-Environmental Impact Assessments (EIA).

**Permitting:** Guidance for permitting throughout the EIA stage, construction, operations and closure.

**Remediation and Monitoring:** We have successfully remediated and monitored environmental impacts identified during environmental assessments. Site specific remedial options involving modeling, design,

in-situ/ex-situ remediation strategies and risk assessments may be developed. We are familiar with compliance monitoring designs and monitoring designs for operational performance.

**Environmental Audits and Risk Assessment:** Assessments of existing operations or acquisition targets. Conducting risk assessment workshops and preparing risk management plans.

**Aquatic Biology:** Fisheries and fish habitat assessment including habitat restoration and compensation planning.

**Terrestrial Biology:** Wildlife inventory surveys, terrestrial ecosystem mapping and identification and management of endangered species. Vegetation assessments, monitoring and management plans.

**Closure and Sustainability:** Incorporation of environmental and social factors into the final land use and water use planning for the mine.

Design for closure to optimize opportunities and minimize long-term risks.

**Meteorology and Climate:** Air quality assessment, modelling and permitting. Chemical transport and exposure modeling. Greenhouse gas emission inventory, forecasting and reduction strategies.

**Reclamation:** We have successfully reclaimed sites utilizing current reclamation methods to achieve the desired end land use. Our team has the capability to complete detailed site assessments, reclamation plans, surface contouring, re-vegetation, weed management and reclamation applications to regulators for site closure.



# Experience

**Rainy River Gold, Canada:** We are carrying out environmental baseline studies for the proposed open pit gold mine in Ontario. The work also includes preliminary assessment of the geochemistry and design of the tailings facility, waste dump and pit slopes.

**Ruby Creek, Canada:** We have guided this mining project from its conception to the recent award of an Environmental Assessment Certificate from the BC Government.

Design of the socioeconomic management plan and incorporation of First Nations interests were an integral part of the design. In addition, the work included engineering for the mine tailings and waste rock facilities to minimize potential effects for operations and closure.

**Suncor – “End of pit” Lakes Research Study:** KCB are part of a team carrying out a full scale pilot program to test the potential for reclamation of oil sand open pit mines with a sustainable lake. The work will include a worldwide research program and

construction of a full scale prototype in a completed open pit area.

**Phase I, II, III Environmental Site Assessments and Reclamation Projects:** Investigated and managed Phase I and II environmental site assessments, remediation, surface reclamation, detailed site assessments and reclamation applications of oil and gas facilities to obtain site closures on private, public and aboriginal lands.

**Suncor Steepbank Groundwater Monitoring:** KCB is conducting groundwater monitoring for Suncor’s Steepbank Mines north of Fort McMurray, Alberta. The plan includes sampling of the current monitoring networks and the development of alternative monitoring strategies.

**Antamina, Peru:** Klohn Crippen Berger received an award of merit from the BC Consulting Engineers for our innovative work on this poly-metallic mine located high in the Andes. We designed an award-winning wetlands water treatment system

of the waste dump waters. We are also carrying out the detailed closure plan.

**Molejon Gold, Panama / Tassawini Gold, Guyana:** Klohn Crippen Berger is conducting socioeconomic and environmental impact studies for gold mines in Panama and Guyana. These ongoing studies include preparing field protocols for baseline data collection by national consultants; due diligence field assessments; and preparation of the Social Environmental Assessment to International Finance Corporation standards.

*Excellence,  
teamwork and  
innovation building a  
better world*



# Site Assessments & Remediation Services

**Regulatory Permitting:** Completion of the permitting processes for access, development, operation, closure and reclamation.

**Baseline Studies:** Biophysical assessments to define and document the pre-development site characteristics and provide as basis for assessing potential development impacts.

**Environmental Site Assessments:** We have managed projects from the Phase 1 study through permitting for access, implementation of remedial works and reclamation of the site.

**Phase 1** - Non-intrusive assessment of historical and current activities to identify impacts and potential impacts on local ecology.

**Phase 2** – Intrusive site assessment to confirm the presence and characterise the substances of concern as well as delineate impacts.

**Phase 3** – If the results of the Phase 2 assessment indicate that significant contamination exists, a detailed intrusive site assessment is undertaken. Refines contaminant delineation and addresses outstanding issues in order to develop a remedial action plan.

**Phase 4** – Remedial action plan to ameliorate contamination on-site, or to remove contaminants from the site. Implementation of the approved reclamation plan to achieve the target land use status

**Liability Assessments:** Provision of estimated site remediation and reclamation costs for financial liability.

**Regulatory Compliance:** Site and regional monitoring during development, operations and post closure to confirm site compliance with regulatory approval conditions

*Challenge us to take on your toughest projects*





## Experience

**Sheep Creek, Yukon:** We conducted an assessment following the release of hydrocarbons at the Sheep Creek Warden Station. We quantified the volume of impacted soils at the site and presented remediation options to Parks Canada. A biocell was determined to be the best available and economic option to conduct soil remediation at the site.

**Unipkat I-22, NWT:** Phase II Environmental Site Assessment of the former Unipkat I-22 well site and drilling sump. Prior to the commencement of onsite activities all required regulatory requirements were completed to access the site. Activities included the logistical and project management aspects of the project including sourcing of heliportable drilling rig, helicopter charter, and subcontractors.

**DEW Line Site Monitoring, NWT:** This project involved the collection of post construction landfill monitoring data from 23 landfills located at 6 former DEW Line sites. The DEW Line sites are located in the Inuvialuit Settlement Region of the Western Canadian Arctic. We were responsible

for all project logistics including aircraft charter, remote camp accommodations, data collection, reporting, and project management. At each landfill groundwater and soil samples were collected, thermal data from onsite thermistors were downloaded, and visual inspections of landfill stability were completed.

**Johnson Point Remediation, NWT:** Clean-up of the former logistics base at Johnson Point. We were responsible for the delineation and treatment of petroleum contaminated soil and groundwater. A practical soil and groundwater treatment option was planned including a purpose-built water treatment system, to remediate contaminated groundwater before it was returned to the environment. An soil remediation program is scheduled to decrease hydrocarbon concentrations in contaminated soil.





# Transportation Infrastructure Services

For over 40 years, Klohn Crippen Berger, its affiliates and predecessor organizations have been active in the planning, design and construction of a wide variety of ports, harbours, and marine terminals. Our experience ranges from economic evaluations, structural assessments and remedial designs, through to site development, wharf design and site services for major new terminals. Klohn Crippen Berger's background of marine engineering experience is a significant advantage to clients on port projects.

We can meet the diverse project requirements of our port and harbour clients through the following areas of expertise:

**Port Feasibility & Planning** from pre-investment and feasibility studies to site selection and conceptual design.

**Marine & Structural Engineering** ranging from dredging, reclamation works, loading ramps, piled decks, bulkheads and caisson wharves.

**Geotechnical & Environmental Engineering** including shallow and deep foundations for heavy civil structures and equipment, dynamic loading, seismic design, and ground improvement.

**Coastal & River Engineering** including aquatic construction considerations such as water levels, floods, foundation and flow considerations particular to wet structures and infrastructure.

**Construction Management Services** ranging from field inspection, contract administration, claims negotiation to scheduling and cost estimating

*Over 50 years  
of award-winning  
engineering*



## Experience

**San Francisco-Oakland Bay Bridge, California, USA:** Klohn Crippen Berger (KCB) is providing structural and geotechnical design for the temporary works for the \$1.4B signature span in San Francisco Bay. Once completed, it will be the world's largest self-anchored suspension bridge. Our design component includes: twin 700 m temporary steel trusses, piled marine foundations in the soft soils of San Francisco Bay designed for seismic and ship impact loading, and design of a 163 m tall temporary tower for the erection of the single steel suspension bridge tower.

**Kicking Horse Cantilever Structure, BC:** KCB provided an innovative Value Engineering design to widen a 2.1km section of the Trans Canada Highway. Through careful realignment of the highway in difficult terrain and the use of a unique cantilever structure, two river crossing bridges were eliminated, resulting in savings of approximately \$2.4M.

**Deltaport Container Wharf and Terminal, BC:** KCB is currently leading the design and construction management for the 430m

long Berth 3 expansion of this facility. We led an integrated, multidisciplinary team of engineers to address all aspects of the civil engineering for this important \$200M waterfront development. The original container port facility, built in 1994-1997, was also designed by KCB. Berths 1 and 2 included a two-berth, 670m long caisson wharf for post-Panamax vessels and barges, and development of a 40 hectare container terminal featuring an intermodal rail facility to handle two 2,100m trains, provision for 600 refrigerated containers and up to six wharf cranes.

**Guam Kilo Ammunition Wharf Extension, Guam:** KCB was retained by the US Navy as part of the Moffatt & Nichol team in early 2006 for detailed engineering for the Kilo Ammunition Wharf Extension project on Guam, Marianas Islands. Kilo Wharf, located in the outer Apra Harbour, is the primary and most strategically important ordnance facility within the Pacific fleet area of operations. The wharf extension comprises 6 caissons of varying sizes, designed to resist seismic events plus seismic retrofit of existing caissons.

**Halifax Caisson Jetty "NJ", Halifax, NS:**

In 2002, the Department of National Defence decided to construct a replacement wharf for their existing timber Jetties in Halifax Harbour. This new \$35 M marginal wharf, Jetty "NJ", is to provide full-service berthing for Canadian Patrol Frigates and Advanced Logistic Support Carriers. KCB was selected as caisson designer for conceptual and final engineering phases, tender assistance and field review.

**Esquimalt Graving Dock Evaluation, BC:**

KCB was retained by Public Works Canada to evaluate the structural condition and overall stability of 6 existing timber crib (caisson) structures, which form the North Landing Wharf, and to evaluate the seismic integrity and stability of the Dry Dock Walls and South Jetty structures.

**Rocky Point Jetty Condition Inspection & Structural Evaluation, BC:**

KCB conducted a full inspection of the jetty above and below water, including: all piling, pile wraps, sheet piled, caissons, deck structure and the fender pile system.



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## Experience

**Paktoa, Devon Corporation:** KCB provided geotechnical engineering support to Devon Canada for their ongoing exploration program in the Canadian Beaufort Sea. This included several on-ice site investigations and the review of different platforms for year round drilling. KCB completed foundation design for use of the SDC drilling platform at Paktoa C-60, and supported operations staff in the installation and monitoring of piezometers and inclinometers during the winter drilling season. Additional studies were completed to look at development options and the feasibility and cost estimate for a phase development of the Paktoa field, including a pipeline route to the Mackenzie Delta.

**Granular Resources Inventory of Artificial Islands in the Canadian Beaufort Sea, DIAND:** Approximately 40 million cubic metres of granular material have been dredged from the Canadian Beaufort continental shelf to create artificial islands

or subsea berms for caisson retained islands and drilling barges. These islands were constructed to provide temporary drilling structures for hydrocarbon exploration. After completing drilling and removing the equipment and consumables, these islands were abandoned to natural erosion, or partially scalped and reused in other exploration sites.

A series of reports by KCB for the Department of Indian and Northern Affairs, Canada, have documented these old islands as available sources of good quality granular material that could potentially be used in future developments.

### **Molikpaq Drilling Platform, Sakhalin**

**Energy Investment Company Ltd:** Sakhalin Energy Investment Company Ltd. purchased the Molikpaq drilling platform for re-deployment near Sakhalin Island in eastern Russia. KCB were the geotechnical engineers for this re-deployment, which

involved design and construction monitoring. The design included a seabed foundation structure stability analyses for the earthquake, ice and wave loading at the site. A major issue in the design was to provide resistance against liquefaction of the internal sand core. Klohn Crippen Berger identified and provided recommendations for suitable sand borrow material used for infilling of the Molikpaq foundation caisson and provided construction supervision services to ensure proper grain size and placement densities. KCB has also provided recommendations for the design of water wells thin the sand core.





# Power Services

Klohn Crippen Berger Ltd. (KCB) offers full engineering and environmental services for hydro projects. Our project design experience ranges from a 7 MW, single-unit project in Canada to a large 1074 MW, multi-unit project in Laos. Our professional staff, comprising environmental scientists and geotechnical, hydrotechnical, civil, structural, mechanical and electrical engineers, delivers total facilities design on small to large hydro projects, both domestically and internationally.

**Engineering, Environmental and Permitting Studies:** Constructing a new hydro facility or rehabilitating an existing hydro facility requires appropriate studies. KCB staff is experienced in hydrological studies (flow determination, flood studies), environmental and permitting studies, energy calculations and power studies, and equipment optimization studies.

**Dams and Intakes:** Whether the project is run-of-river with a low coanda weir and minimal storage or a world class roller-

compacted concrete (RCC) dam for flood control, irrigation and power generation, our engineers and environmental scientists understand how to permit, design and build economic structures to store, divert and control a project's water.

**Geotechnical Design:** Geotechnical risk can be one of the most significant risk issues associated with hydro developments. Our extensive geotechnical experience with tunnels (both drill-and-blast and tunnel boring machine, excavated), other underground works and open-cut excavations for powerhouses, tunnel portals, and canals is known throughout the world.

**Water Conveyance System:** KCB's experience will ensure the water conveyance components including canals, tunnels and penstocks are configured in a practical, economic arrangement based on a sound technical design that provides appropriate hydraulic performance.

**Powerhouses:** KCB has extensive experience with the civil-structural and equipment layout design of powerhouses utilizing Francis, Pelton and Kaplan turbines. Our staff is experienced with the mechanical and electrical equipment layout for the entire water-to-wire equipment package.

**Project Services:** KCB also offers project management and construction supervision services in roles as diverse as Lender's Engineer, Owner's Engineer and Buyer's Due Diligence.



# Experience

## **The Nam Theun 2 Hydroelectric Project,**

**Laos:** is the most important project in a long-term collaborative effort between the Lao People's Democratic Republic (Laos) and Thailand to develop hydropower energy in Laos for export to Thailand. We provided bid design, final design and construction engineering services for the two main civil works packages of this 1074 MW project.

## **Snoqualmie Falls Redevelopment,**

**Washington, USA:** consists of upgrades of two power plants and a weir to increase the installed capacity from 42 to 52 MW. Our services for this project include preliminary design, detailed design and construction services.

## **Brilliant Powerplant Expansion Project,**

**Castlegar, BC:** a 120 MW expansion at the Brilliant Dam on the Kootenay River. KCB provided Owner's Engineer services from the project identification phase through to commercial operation.

## **Arrow Lakes Generating Station, Castlegar,**

**BC:** is a 170 MW project on the Columbia River. KCB was the Owner's Engineer for this project, responsible for conceptual design, reviewing the EPC contractor's design and monitoring the work of the EPC contractor during construction and commissioning. This project received the prestigious Blue Planet prize in 2005.

## **Mayo and Wareham Dams, Dam Safety and Seismic Review, Yukon:**

KCB performed a dam safety review of Mayo and Wareham Dams for Yukon Energy in 2005. During the safety review a high seismic risk was recognised that was subsequently assessed and evaluated as part of a seismic review that was completed in 2007.

## **Zeballos Hydro Project, Vancouver Island,**

**BC:** will add 22 MW of ECOLogo certified green power to the provincial power grid. KCB designed the tunnel, penstock and powerhouses for this project that will be in service in 2009.

## **Irrican Project, southern Alberta:**

is a 7 MW run-of-canal project. Three existing irrigation canal drops were bypassed and the water put through a small generating station that utilized an S-type turbine. KCB designed the powerhouse, intake and all associated mechanical and electrical works.

*Klohn Crippen  
Berger delivers total  
design for hydro  
projects*





PO Box 3178, Inuvik, NT, X0E 0T0 CANADA

T 867-777-8520 | F 867-777-2747 | E [info@ieg.ca](mailto:info@ieg.ca) | [www.ieg.ca](http://www.ieg.ca)



500-2618 Hopewell Place NE, Calgary, AB, T1Y 7J7 CANADA

T 403-274-3424 | F 403-274-5349 | E [info@klohn.com](mailto:info@klohn.com) | [www.klohn.com](http://www.klohn.com)

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