

ENGINEERING EARTH'S DEVELOPMENT, PRESERVING EARTH'S INTEGRITY

# TECHNICALLY SPEAKING

ISSUE NUMBER 82  
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▶ FOCUSED ON:  
**DESIGN & CONSTRUCTION**

EXCLUSIVE:

RECLAMATION PLANT ENSURES  
**WATER SAFETY**

**DESIGN-BUILD PROJECT**  
Completed at US-Funded Contaminated Site

**HOSPITAL SEEKS TO INCREASE**  
Its Energy Performance



## IN THIS ISSUE:

A CONVERSATION WITH  
JOHN TREW  
**02**

RECLAMATION PLANT ENSURES  
WATER SAFETY  
**03**

DEMONSTRATING TURNKEY  
CAPABILITIES IN LANDFILL  
RE-ENGINEERING  
**04**

DESIGN-BUILD PROJECT  
COMPLETED AT US-FUNDED  
CONTAMINATED SITE  
**05-06**

APPLYING DESIGN EXPERTISE TO  
MINE RECLAMATION PHASE  
**07**

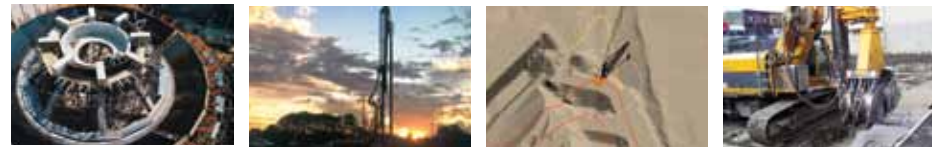
HOSPITAL SEEKS TO INCREASE ITS  
ENERGY PERFORMANCE  
**07**

GROUND IMPROVEMENTS HELP  
WITH SEISMIC STABILITY  
**08**

NEWS FROM GOLDER  
**09-10**

KNOWLEDGE EXCHANGE  
**10**

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## DESIGN & CONSTRUCTION

**AS GOLDER BUILDS ON MORE THAN 50 YEARS OF SUCCESS IN GROUND ENGINEERING AND ENVIRONMENTAL SERVICES, WE ARE ACTIVELY TURNING TO OPPORTUNITIES IN THE DETAILED DESIGN AND CONSTRUCTION PHASES OF OUR CLIENTS' PROJECTS.**

Increasingly, our clients want Golder to be involved in all aspects of their project development and implementation through our integrated solutions approach.

In particular, we are targeting projects where our specialised services and technologies, as well as innovative commercial and project delivery methods, add value.

Golder offers multiple project delivery options including design-build, construction management, EPCM (engineering, procurement, construction management), EPC (engineering, procurement, construction), early contractor involvement, and specialised civil, environmental and geotechnical contracting.

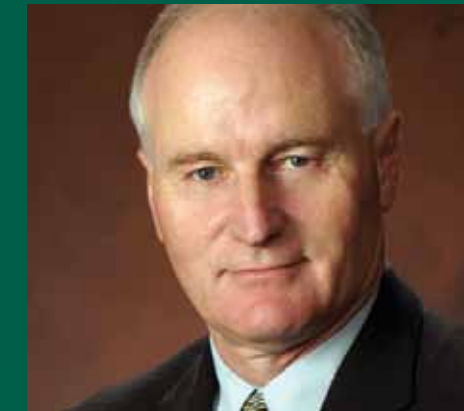
This issue of Technically Speaking features several projects that highlight integrated solutions delivered by our design or construction teams. They range from a water reclamation plant for a mining project to using cutter soil mixer technology for seismic stabilisation or site remediation purposes, post-topographical mining design with 3-D software, and detailed design work for energy management improvements.

We have the capability to be involved in all or significant parts of projects in our specialised areas of expertise, including planning, permitting, consulting, detailed design, construction, operation, and decommissioning.

We intend to move well into the design and construction project phases – particularly where there are opportunities to conserve, protect, sustainably develop or help our clients utilise water, energy, and other natural resources. This will be done in a manner consistent with our desire to preserve earth's integrity and create a brighter future for future generations.

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## A CONVERSATION WITH JOHN TREW



**E**arly Contractor Involvement" (ECI) is an emerging trend globally in design and construction. We have been following this approach with our clients for many years, without giving it a formal title until now. Unlike the more conventional design-bid-build or even design-build approaches, ECI encourages all parties – owner, engineer and contractor – to collaborate on the design and construction. This helps achieve an appropriate balance among technical complexity, practicality, risk, and the cost associated with a particular solution.

We spoke with John Trew, a principal in Golder's Ottawa, Ontario office, who has recently been appointed president of Golder Construction in Canada, about why the ECI model appeals to knowledgeable clients who see it as a way to facilitate earlier execution of projects.

### What is entailed in ECI?

The model brings the client, consultant, designer and constructor together at an early stage to evaluate alternative solutions and arrive at an optimal design by taking into account constructability, cost, and the timeline required for implementing the final solution.

### How does it differ from design-build?

The ECI process allows owners to remain involved throughout the process to advise on operational requirements, acceptability of risk, and budget constraints while the engineering consultant can lead the design, advise the client, and ensure that the overall intent of the project is being met. The contractor provides input on methodology, practicality, cost, and health and safety. Ideally, the contractor can challenge the design team in a spirit

of collaboration to consider alternatives where they can be advantageous to the overall scheme.

### Where is ECI particularly beneficial?

It's especially helpful for projects where the scope is developing as the project proceeds, where the schedule is critical, and where physical conditions or other unique aspects, either geotechnical or environmental in nature, are poorly defined and require the project team to do a reactive design.

### What is involved in being selected to participate in projects as the ECI contractor?

The client is typically looking for a sophisticated and technically advanced contractor that can work well as part of a team and who can put the client's objectives ahead of its own short-term goals. The client also expects the ECI contractor to have expertise in the efficient and cost-effective delivery of the solutions to their problem. I think that is an ideal match for the way Golder offers integrated solutions to our clients.

For one recent proposed dam seepage control upgrade project, Golder Construction led a multi-national team of highly qualified specialist engineers and contractors, including colleagues from Sweden, Australia and the US, subconsultants from Germany and New Zealand, and contractors from Canada and the US. The ECI project was awarded to two teams, one of which was the Golder team. We worked for six months with the client's internal design group to develop and design a construction methodology to the point where all parties had a high degree of confidence in the practicality and efficacy of construction, the residual levels of risk, and the projected costs for the work. It's very satisfying to see how valuable a collaborative ECI process can be to challenging projects.

*John Trew is a civil engineer with over 35 years experience with specialist geotechnical and large civil contractors in the UK and Canada. He joined Golder in 1997 and has been involved with Golder Construction since 2000. John was recently appointed president of Golder Construction. He holds a bachelors degree from the University of Birmingham and a masters degree from the University of Toronto specialising in geotechnical engineering and construction management. John can be reached at JTrew@golder.com.*



## RECLAMATION PLANT ENSURES WATER SAFETY

Although acid mine drainage poses a significant threat to the environment, it also constitutes a significant resource for the production of high-quality drinking water through the process of desalination. Optimum Colliery, a wholly-owned subsidiary of Optimum Coal Holdings, has harnessed this resource in a sustainable manner as a result of a water reclamation project in Mpumalanga in eastern South Africa.

As lead Engineering, Procurement and Construction Management (EPCM) contractor, Golder was responsible for the following key infrastructure components: mine water collection; mine water treatment; reclaimed water storage and distribution; sludge and brine disposal; and bulk electrical power supply.

**“The reverse osmosis process chosen has the ability to treat the mine water into potable water of a standard equivalent to bottled drinking water.”**

An initial review of Optimum Colliery’s overall mine water balance had suggested that urgent measures were required to address the mine’s excess water intake (estimated at 26 million litres, or 6.9 million gallons per day) from old underground and current opencast mine works.

A mine water treatment plant and associated infrastructure were proposed to treat up to 15 million litres (almost 4 million gallons) per day of this excess mine water into potable standards. The plant also became a solution to address the dire shortage of potable water in the nearby Steve Tshwete Local Municipality. The project calls for up to 95 percent of the potable water coming from the treatment plant to be sent to one of the most affected areas of the municipality known as Hendrina / KwaZamakuhle. The reverse osmosis process chosen has the ability to treat the mine water into potable water of a standard equivalent to bottled drinking water.

Optimum Colliery now has a means of sustainably managing its surplus impacted water for the next 22 years as well as after closure of the mine while, at the same time, meeting the water needs of the local communities.

This project is only the second plant of its kind in South Africa and is leading the way internationally with respect to mine water treatment.



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This water reclamation plant in South Africa is a self-sustaining facility that is economically viable and of benefit to the greater community for its water needs.

## DEMONSTRATING TURNKEY CAPABILITIES IN LANDFILL RE-ENGINEERING



A state-of-the-art liner and leachate collection system were installed at the Barrie, Ontario, Canada landfill.

**“Although the primary intent of this effort is to reduce environmental impact, this process is also expected to extend the life of the city’s landfill by up to seven years”**

The City of Barrie’s landfill, in the Canadian province of Ontario, has serviced the solid waste disposal needs of the community since 1964. The landfill, which has a licensed volume of 3,900,000 m<sup>3</sup>, was originally constructed without an engineered liner. This meant that groundwater collection systems were required to intercept leachate impacts within the site boundaries. To address the potential for long-term environmental impacts from the landfill and to apply for an approval to upgrade the landfill design to current standards, the City of Barrie retained Golder to provide design alternatives.

The approved design and operations plan to upgrade the landfill incorporates reclamation of waste, which is the process of excavating existing waste fill, screening it to remove the fine soil fraction, and replacing it using a greater level of compaction and less soil cover. This is followed by re-engineering the facility to incorporate a liner and leachate collection system and a purge well system. A landfill gas collection system and

flare are also included in the design.

Construction on this project began in 2007 and is projected to be completed by 2015. Golder Construction was retained in 2007 to provide the City of Barrie with the detailed design, construction drawings and specifications, bid documents and management of the tender process, and construction supervision/management services for Cell 3A. The landfill design also incorporated the first composite synthetic liner (geosynthetic clay liner, overlain by a high density polyethylene layer) in Ontario. Golder Construction also provided construction management for the first phase of the full-scale landfill reclamation and cell construction, which was completed in 2010.

The innovative design and project management approach of the reclamation operation will bring the landfill site into environmental compliance, improve groundwater protection, reduce the amount of time that the purge well system will be required, and reduce flow to the wastewater

treatment plant. Although the primary intent of this effort is to reduce environmental impact, this process is also expected to extend the life of the city’s landfill by up to seven years, due in large part to a substantial recovery of landfill space associated with the re-use of fines from the reclamation process.

The Consulting Engineers of Ontario recognised this project with an award in the Project Management, Studies & Research category for the approach to management.



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## DESIGN-BUILD PROJECT COMPLETED AT US-FUNDED CONTAMINATED SITE

**S**uperfund™ is a program established by the US government to address and cleanup abandoned hazardous waste sites. The name also applies to the fund created by the US Environmental Protection Agency (EPA) to remediate these sites by compelling responsible parties to perform clean-ups or reimburse for EPA-directed efforts.

A former wood treatment operation in the southeastern US that had closed in 1991 is one such site. Ongoing investigations performed by the government discovered extensive contamination within the soil, shallow groundwater and also a nearby creek as a result of open dumping and accidental spills over 30 years of operation. Despite a series of remedial actions, additional groundwater contamination had been uncovered migrating off-site, and the EPA determined that an outer barrier wall would be the most appropriate and cost-effective approach for managing the contamination.

Golder designed and constructed a hydraulic barrier cutoff wall system, using deep soil mixing to contain migrating groundwater from going further off-site. We self-performed the construction of the barrier wall using cutter soil mixer (CSM) technology, marking the first barrier wall system of this type for a Superfund site. The process involved in situ blending of native soil with admixture binders of cement and bentonite to create a low permeable barrier wall. CSM is a unique form of deep soil mixing using specialized cutting wheels connected to a fixed mast "kelly" bar mounted on a large base carrier drill rig. CSM creates rectangular columns that can be interlinked to create a continuous subterranean barrier wall.

We also developed a construction quality assurance program, including both field and laboratory testing, and produced continuous "real-time" monitoring of CSM production parameters during installation. Barrier wall "wet samples" were collected from various depths and later tested for permeability and strength. Golder developed special sample preparation techniques specific to this project.

CSM technology brought innovation and elevated levels of precision and quality control compared to what is typically expected in barrier wall construction.



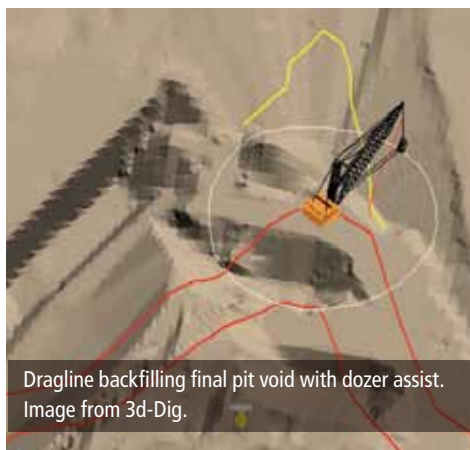
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**"Golder designed and constructed a hydraulic barrier cutoff wall system, using deep soil mixing to contain migrating groundwater from going further off-site."**

This Superfund site in the US necessitated working under tight constraints due to nearby rail and overhead utility lines.



## APPLYING DESIGN EXPERTISE TO MINE RECLAMATION PHASE



Dragline backfilling final pit void with dozer assist. Image from 3d-Dig.

Post-mining topographical (PMT) design is an important part of reclamation, once either surface coal mining reserves have been exhausted or mining operations are moving to other sites on a property.

A project done in the southwestern part of the US by Marston, a full-service mining consultancy that is now part of Golder Associates, for a mine that had ceased operations, featured this aspect of design work. It illustrates a careful design process

that can help mine operators understand how to utilise draglines to remove spoil peaks and place excess material in designated areas to meet the PMT.

Marston utilised a modeling software package known as 3D-Dig to facilitate putting together a plan and communicating the design process to the client. 3D-Dig is a tool normally used to model the excavation, dumping and spoil transport processes involving, for example, standing dragline spoil peaks and truck waste dumps. The time and step-by-step details on accomplishing the post-mining topography with a dragline were also provided.

The modeling results also yielded data on estimated rehandle volumes, or the amount of material that would need to be moved more than once. This consideration is invaluable to budgeting and constructing a timeline for this stage of the reclamation.

The process for this particular mine entailed three rounds of design simulations, as successive iterations were based on ideas gleaned from looking at various methods and then rejecting certain

approaches when flaws were uncovered through “visualizing” the plan. The benefit of simulating material movement is the ability to determine if the material balance will work by applying real-world conditions to see the whole picture.

Once reclaimed, mining areas such as this must be viewed as stable by law with diverse vegetation comparable to pre-mining land uses. In this part of the US, reclaimed land is typically returned to pasture and wildlife habitat.

*(Marston specialises in mine planning and geologic services for open pit and underground coal, metals, oil sands, and industrial mineral mines).*



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## HOSPITAL SEEKS TO INCREASE ITS ENERGY PERFORMANCE

Energy demand from buildings is estimated at 40 percent of the total load across the European continent, which has led the European Union (EU) to focus on ensuring that less energy is used through its Energy Performance of Buildings Directive. This legislation calls for all EU countries to enhance their building regulations and to introduce energy certification requirements for existing structures and those under construction.

Extensive energy efficiency improvements at S. Luigi, a full-service acute care hospital in the town of Orbassano near Turin, Italy, call for a new energy production and fluid distribution system with combined power, heating, and cooling.

Two engines, the existing one fueled by methane gas and a new one fueled by vegetable oil (liquid biomass), produce electricity and hot water, which are used during winter for space heating and

domestic hot water and, during the summer, to produce domestic hot water and to supply the adsorption refrigerators to produce cold water.

Golder, as part of the energy and facility management provider team led by Olicar SpA, did the total preliminary and detailed design activity, which covered the hospital's six main buildings. This entailed definition of technical specifications of all installations and the internal technological systems for certain buildings. The construction phase will be complete in 2012, with Golder as the technical consultant for the construction management.

The energy renovation changes also involve two rooftop photovoltaic panel systems for producing electricity as well as other design considerations. These include installing high-efficiency lighting fixtures; reconstructing the heating substations of the single buildings; replacing air treatment units,

switchboards and transformers; and improving the thermal efficiency characteristics of one of the buildings in poor condition.

Working in accordance with the energy specifications established by national and regional laws in Italy, this project illustrates the annual energy and cost savings to be achieved through new installations, efficient maintenance and energy management.



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## GROUND IMPROVEMENTS HELP WITH SEISMIC STABILITY



Construction of the flagship Vancouver Island Conference Centre near the picturesque harbour in Nanaimo, British Columbia presented a number of geotechnical and environmental challenges for which an innovative solution was achieved.

The site, originally a sandstone inlet off the harbour, had been infilled with natural and man-made materials, as well as coal waste. This material was susceptible to liquefaction and large-scale movement in the event of an earthquake, posing major risk of settlement or collapse of the proposed conference centre.

Because Nanaimo is located in one of Canada's highest-risk regions for a major earthquake, ground improvement solutions were required to address seismic risks. Many ground improvement solutions were considered for the site; however the cost of these solutions ranged from \$5 million to over \$10 million, well beyond the budgetary constraints of the project.

Additionally, an environmental site assessment indicated the presence of contaminants in the site's soil, which meant thousands of tonnes of material would need to be transported off site for disposal. This would add considerable cost to the project as well.

An innovative ground improvement option stood out as the preferred approach as it would address the seismic risks and accommodate the established project budget. Golder's foundation design for the conference centre considered using cutter soil mixer (CSM) technology to conduct deep soil mixing at select footing locations. This in situ ground modification constructs soil-cement walls through the loose site soils, keying the walls into competent ground (such as glacial till or bedrock) at depth. The design was developed to resist large lateral ground movements with a cellular structure of strengthened soil. This was to provide adequate shear resistance and confinement of adjacent liquefiable soils within its cells. The soil-cement structure also provided vertical foundation support by transferring the load of the building foundations to the underlying competent ground.

This process negated the need for expensive removal and disposal of soil at a remediation site. Permeability was also reduced, which helped seal off the existing contaminated groundwater.

Providing stable foundation conditions, to meet local and national building codes, are becoming a large portion of the overall capital costs of projects in seismically active regions. Consequently, innovative approaches are needed to meet ground performance requirements, while maintaining the costs within feasible margins.

Golder continues to research the potential of CSM as a cost-effective method of providing stabilization for seismically unstable ground, with applications ranging from building or infrastructure foundation support to dike and hillside stabilization.

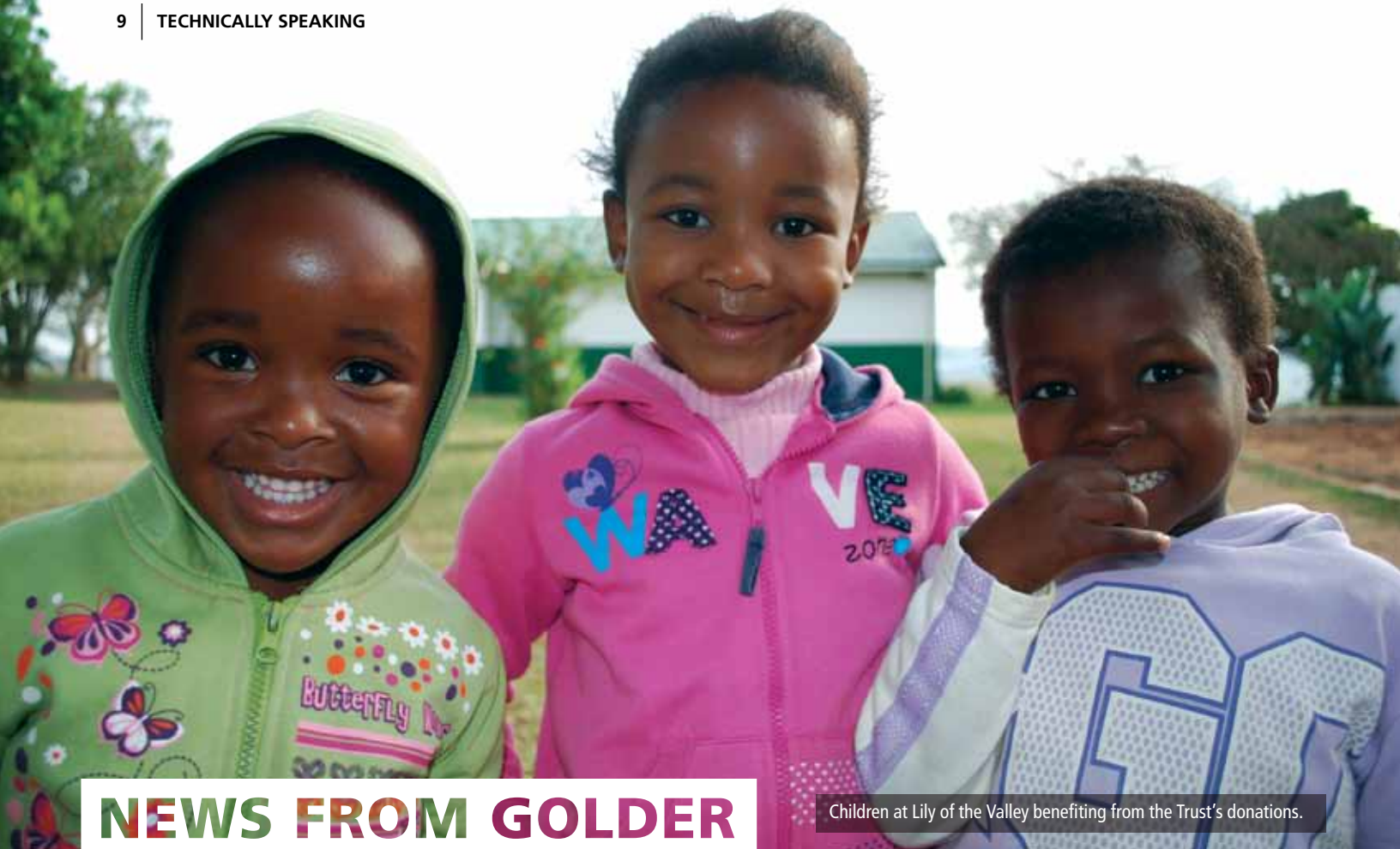
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### PROJECT AWARDS:

- Golder Associates Innovative Applications' (GAIA) Sustainability Award (2008/2009)
- Canadian Urban Institute's (CUI) Brownie Award – Sustainable Remediation Technologies & Technological Innovation (2008)
- Association of Consulting Engineering Companies' (ACEC) Award of Excellence in Building (2007)
- Consulting Engineers of British Columbia's (CEBC) Awards for Engineering Excellence - Award of Merit (2007)
- Deep Foundations Institute – Outstanding Project Award – Special Recognition Award

European cutter soil mixer technology conducts deep soil mixing, an in situ ground modification, by which cement is blended with soil at depth by mechanical or rotary tools.





Children at Lily of the Valley benefiting from the Trust's donations.

## NEWS FROM GOLDER

### ACCOLADES

Golder was listed as #17 in the Top 200 Environmental Firms rankings published annually by Engineering News-Record (ENR). For this list, the 200 largest North American-based environmental firms were ranked based on 2010 global environmental services revenues. Our revenues are derived from various market categories, with 80 percent coming from services that are grouped under environmental science, environmental management, and hazardous waste, and the rest under air, water, wastewater treatment, and nuclear. ENR ranks companies engaged in general contracting, specialty contracting, engineering, architecture, planning and studies.

Golder ranked among the Top 25 firms in the 2011 International Design Firms list published annually by Engineering News-Record (ENR). The 200 largest world design firms were ranked for this list based on design-specific export revenue that was generated from projects outside each firm's respective home country. Golder achieved the ranking of 24th in size on this global list, up from the 30th position in 2010. In addition, we ranked 10th in the US in size. In terms of revenue generated globally in specific market sectors, Golder ranked first in the manufacturing market and 5th in size in the waste sector.



Golder in Canada has achieved Canada's highest accolades for business excellence and sustainable growth, earning the distinction as a 2010 Canada's Best Managed Companies Platinum Club Member. This marks our 11th year of recognition as a Canadian business leader in the Best Managed program, investing in our people and supporting our clients. The distinction of Platinum Club member is reserved for those outstanding companies that have sustained a standard of excellence and leadership in all areas of business, and have achieved Best Managed status for a minimum of six consecutive years. This award recognises Canadian companies that have implemented world-class business practices and created value through innovation.

Environmental Analyst, a specialist publishing and market research organisation focusing on the environmental consulting (EC) and support services sector, ranked Golder fourth in its list of the top 12 global firms providing EC services (rankings based on global gross EC revenues). According to Environmental Analyst, the value of the global EC market was US\$25.4 billion in 2009/10 and is forecast to reach \$30 billion by 2014/15.

At the Consulting Engineers South Africa (CESA) Engineering Excellence Awards Gala in Midrand, South Africa, Golder was commended for our involvement in the projects within the following categories:

- Projects with a value greater than R250-million:** Commendation for the Optimum Colliery Mine Water Reclamation Project – Mpumalanga, South Africa. We were the lead Engineering, Procurement and Construction Management (EPCM) contractor. The project involved the construction of a mine water treatment plant and associated infrastructure that would treat up to 15ML/day of excess mine water into potable standards.
- Best International Project:** Commendation for the Amoma Project – Brong-Ahafo, Ghana. We completed the detailed design, engineering and construction of all infrastructure related to the mine pit. We handed the project to the client US\$9-million under budget, three months ahead of schedule and with a top safety record.



## COMMUNITY

Lily of the Valley is a children's home, medical centre, training facility and agricultural enterprise located just outside of Durban, South Africa where HIV positive orphans can go to live and receive long-term care and education. In 2011, the Golder Trust for Orphans will donate US\$60,000 to Lily of the Valley to help them expand their hydroponic tomato operation. The funds from the increased revenues will go to help refurbish the homes for the 140 children who are currently living there. For more information visit [www.goldertrust.org](http://www.goldertrust.org).



Hydroponic tomato tunnel.

### GEOGRAPHIC EXPANSIONS

In the USA, we recently opened a new office in Walnut Creek, California. This office will help further our growth strategy in the western US and expand our services to mining and oil and gas clients. Jay Norwood will serve as the office contact and will oversee a staff of design engineers supporting both national and international mining projects requiring pipeline design and engineering services.

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### LEADERSHIP CHANGES

Rick Keenan of our Jacksonville, Florida, USA office has been named the new leader of the National Construction Division for Golder in the US. Rick will be responsible for providing leadership to create and implement a common vision and strategy for our US Construction Division. He will work with our construction colleagues in the US and Canada to enhance the collaborative working relationship between our traditional consulting practice and our design and construction capabilities to develop clients and execute projects across North America. For more information, contact Rick Keenan at [RKeenan@golder.com](mailto:RKeenan@golder.com).



Rich Galle recently joined Golder as our new global VP, Health, Safety and Environment. A Certified Safety Professional, Rich has nearly 20 years

of experience in health and safety, including experience in implementing health and safety programs in large, global organisations. Rich will focus on designing and implementing strategies and systems that move us forward on our journey toward an interdependent health and safety culture. He will also help us raise our commitment to environmental protection and stewardship. Rich will be based in our Houston, Texas, USA office and can be reached at [RGalle@golder.com](mailto:RGalle@golder.com).

### OTHER NEWS

Golder will have a presence at COP17 in Durban, South Africa. Follow @GolderAssociate on Twitter in October and November to find out more! To learn more about our climate change services, visit [www.golder.com](http://www.golder.com).

Our Italian colleagues are pleased to announce that their [www.golder.com](http://www.golder.com) site is now available in Italian as well as English, and is the latest of the European sites to offer information in their operating language. The site is also available in Danish, Finnish, Hungarian, Norwegian and Sweden, with other languages set to be added soon.

Golder's Power Owners Engineering and Advisory Services (OEAS) Group has expanded to include asset management, high-voltage electrical transmission, mechanical engineering and due diligence capabilities as part of our overall services to owners, operators and developers of power-related projects. The group provides development, design and contracting services to constructors, electric utilities and independent power producers for fossil fuel and renewable power generation technologies, and supports "energy consumers," such as mining and manufacturing industries. OEAS supports the early stages of project development and can facilitate access to understanding our clients' strategies, processes and scheduling expectations. The OEAS Group positions Golder as a "one stop/one shop" source for engineering, environmental, permitting, construction and due diligence services. For more information, contact Paul Doherty at [PDoherty@golder.com](mailto:PDoherty@golder.com).

## KNOWLEDGE EXCHANGE

### UPCOMING CONFERENCES

**AIHA 2011 – Asia Pacific OH & EHS Conference & Exhibition**  
October 11-13, 2011, Singapore

**WEFTEC 2011**  
October 15-19, 2011, Los Angeles, California, USA

**ISRM International Congress on Rock Mechanics**  
October 18-21, 2011, Beijing, China

**Remediation Technologies Symposium 2011 (REMTECH)**  
October 19-21, 2011, Banff, AB, Canada

**19th Annual NAEM EHS Management Forum**  
October 19-20, Tucson, Arizona, USA

**Africa Oil Week**  
Oct. 31-Nov. 4, 2011, Cape Town, South Africa

**8th Fennoscandian Exploration and Mining (FEM 2011)**  
November 1-3, 2011, Levi, Lapland, Finland

**Tailings and Mine Waste 2011**  
November 6-9, 2011, Vancouver, BC, Canada

**APPEA Environment Conference 2011**  
November 7-9, 2011, Sunshine Coast, QLD, Australia

**International Water Conference (IWC)**  
November 13-17, Orlando, Florida, USA

**ENVIROMINE 2011**  
November 23-25, 2011, Santiago, Chile

**COP17**  
Nov. 28-Dec. 9, 2011, Durban, South Africa

**World Petroleum Congress**  
December 4-8, 2011, Doha, Qatar

**Mines & Money London 2011**  
December 6-7, 2011, London, UK

**Power Gen International**  
December 13-15, 2011, Las Vegas, Nevada, USA

### Questions?

E-mail [TechnicallySpeaking@golder.com](mailto:TechnicallySpeaking@golder.com) or visit [www.golder.com](http://www.golder.com) for more information.





### **TECHNICALLY SPEAKING**

Technically Speaking is published for valued clients, employees and friends of Golder Associates. This quarterly newsletter includes articles showcasing innovative and technically challenging projects that Golder professionals have worked on throughout the world.

Please contact Erin Johnson, Managing Editor, at + 1 651 697 9737 or [ejohnson@golder.com](mailto:ejohnson@golder.com) if you have any questions or comments.

### **ADDRESS & SUBSCRIPTION CHANGES**

Email [TechnicallySpeaking@golder.com](mailto:TechnicallySpeaking@golder.com) to inform us of any mailing changes or subscription requests.

### **GOLDER ASSOCIATES**

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and the related areas of energy. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organisational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth, now employing more than 7,000 people who operate from more than 160 offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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