



MESSAGE FROM THE CHAIRMAN OF OUR

## Ground Engineering Group



Golder Associates' roots lie in foundation engineering, a relatively young science when the firm was established in Hugh Golder's name in 1960. At that time almost any ground engineering problem was a challenge, and our resourceful engineers soon developed a reputation for being able to rise to the challenge and to provide cost-effective, technically sound solutions.

The science, or art, as some might think of it, of ground engineering has evolved over the years, as has our company. While we have continued to further the profession of ground engineering and expanded to include rock mechanics, mining, groundwater and surface water, we have also diversified into a worldwide group of companies providing a wide range of environmental and earth science consulting and contracting services. All the while that we have been growing and building a strong reputation in these broader fields, a significant number of our professionals have been quietly designing and overseeing the construction of hidden or subsurface structures such as tunnels, foundations, excavations, river crossings, waste containment facilities and water supply reservoirs — structures that must endure the ravages of time. Accordingly, this edition of Technically Speaking focuses on "Solutions that Stand the Test of Time" and features several projects in this important segment of our business.

We welcome the opportunity to share the work of our ground engineering people with you.

Sincerely,



Max Ervin  
Director and Principal, Melbourne, Australia

## GOLD MINE becomes a bonanza for CHINESE FARMERS

**TAILINGS TREATMENT AT A GOLD MINE IN SHAANXI PROVINCE, CENTRAL CHINA, HAS NOT ONLY PRODUCED A SECURE, LONG-TERM SOLUTION FOR TAILINGS DISPOSAL, BUT HAS EXPANDED THE AMOUNT OF LAND AVAILABLE TO LOCAL FARMERS.**

Sino Gold Limited's Jianchaling gold mine is located in a remote and mountainous part of China. Golder has been involved in the project since the initial exploration phases, and part of our work has been to develop a safe, permanent way to store tailings generated by the mine. A waste tailings storage facility was designed and constructed across a valley that had previously received tailings from a closed asbestos mine.

After closure of this new tailings storage facility, the surface of the tailings deposits will be used for farmland. Presently, productive farmland is mostly confined to the narrow valley floor. Conversion to farmland has already happened downstream of the tailings storage facility, where asbestos tailings covered good farming land in the valley. As part of the Jianchaling operation, these tailings were removed and incorporated into the gold mine's tailings embankment. The former location of the asbestos tailings is now productive farmland, with one crop already produced.

Sound engineering has helped secure the gold tailings on a long-term basis, and the additional farmland will become a valuable and permanent resource for the local community.



# SECURING the future of the Rock of GIBRALTAR

**“GIBRALTAR” IS A BYWORD FOR “PERMANENCE”; HOWEVER, RECENT HOUSING EXCAVATION THREATENED THE FUTURE OF PART OF THE ROCK, A DANGER NOW REMOVED THROUGH TIMELY INTERVENTION.**

Part of the bedrock underlying the huge limestone mass of Gibraltar is a type of shale that is particularly vulnerable to erosion. Most of this shale is protected from weathering by soil and other cover, but in 1996, housing construction activities exposed some of the shale. Since then, this rock has eroded significantly, causing overhangs in the limestone above it. This erosion, combined with numerous faults within the limestone, created a danger of collapse for part of this world-renowned landmark.

Gibraltar authorities looked for ways to stabilize the slope and prevent further erosion, and commissioned Golder to perform a geotechnical appraisal and provide recommendations. Our team found that access to the hillside would be difficult for work crews, and that the eroded cliff face was highly irregular. As a result, the best solution was determined to be reinforced “shotcrete” facing.

This facing is to be reinforced with over 350 soil nails, which are specially designed steel rods

up to eight meters (24 ft.) long. Inserted into holes drilled into the shale and limestone, they will help hold the facing and the rock in place. Grout is then poured into the holes to secure the nails. The natural cavities in the rock present a challenge as they may absorb large quantities of grout before the soil nail is secured.

When the work is completed, the historic Rock will be more secure as it stands proudly at the gateway between the Mediterranean and the Atlantic.



## Difficult SITE CONDITIONS require an innovative SOLUTION

**CHALLENGING SOIL CONDITIONS UNDER A RIVER BED IN BRITISH COLUMBIA, CANADA, HAVE SPURRED THE DEVELOPMENT OF AN INNOVATIVE HYBRID OPEN-CUT/ “TRENCHLESS” SEWER INSTALLATION TECHNIQUE THAT MEETS ENVIRONMENTAL PROTECTION REQUIREMENTS.**

Local population growth necessitated twinning a sewer pipeline, involving a 500-meter crossing of the Nicomekl River. In such situations, a common approach is Horizontal Directional Drilling (HDD), which eliminates digging a trench across the river. Called in to assist with the project, Golder soon discovered that subsurface conditions included gravel and larger cobbles, which presented significant risks for HDD. There was a real concern that the drilling equipment would become stuck beneath the channel and that the approach would not be successful.

Accordingly, Golder looked for a solution to meet the client’s objectives while satisfying

environmental requirements. The resulting solution focused on the realization that the tidal mudflats along the river bank were the most environmentally sensitive area, while the river channel was much less so.

This meant that the environmental impact would be acceptable if the center of the river was crossed using open trenching, but beneath the more delicate mudflats on either side, the sewer was installed using trenchless pipe ramming techniques. The new sewer was winched through steel casings under the mudflats and through the central channel open trench.

This new river-crossing technique may well see application elsewhere. As concern builds to reduce the environmental impacts of construction, there is increasing need for innovative solutions that will work in a wide variety of situations and still meet environmental demands — solutions that stand the test of time.

## Bringing NEW LIFE

**PROPERTY NEAR MELBOURNE, AUSTRALIA, PREVIOUSLY USED AS A QUARRY, IS NOW BEING TURNED INTO HIGHLY DESIRABLE BUILDING LOTS, WITH SPACE FOR 800 HOUSEHOLDS, THANKS TO SOUND GEOTECHNICAL WORK.**

The former Niddrie Quarry, about 10 km from Melbourne’s city center, is a prime location for housing development. Parts of the quarry offer commanding views of the city skyline, and it is close to a major freeway.

Housing has grown up all around the 48-hectare site. However, the disused quarry remained undeveloped, partly because of challenges in filling deep excavations. Development was made more challenging by the requirement that the only fill that could be used was the 2.4 million cubic meters of waste soil and rock left on site.



# Underground expansion refits CANADIAN LANDMARK for a new age

**A PART OF CANADA'S CULTURAL HERITAGE, WHICH ALSO PLAYS A MAJOR ROLE IN THE COUNTRY'S GOVERNMENT, HAS BEEN PRESERVED AND MADE MORE USEABLE DUE TO IMAGINATIVE PLANNING AND USE OF TECHNOLOGY.**

The Parliamentary Library in Ottawa, a neo-Gothic masterpiece dating to the mid-1800s, has always been too small for its intended purpose, which is to store information resources for Canada's national government. Yet building an addition onto the library would have marred the appearance of the entire Parliament Hill complex, a national heritage site.

The solution was to expand the library out of sight — underground — no easy feat. The heavy masonry walls and foundations, resting on

fractured limestone, are fragile. Any shifting in the rock due to excavation or vibration might have damaged the structure. Add to this the fact that the Library is a working building, and that noisy activities could not take place while Parliament was in session. These, and complex excavation geometries, put severe restrictions on the work methods.

As rock engineering consultants on the project, Golder adapted hard-rock mining equipment, developed unique pre-support methods to



strengthen the supporting rock before excavating beneath it, and used state-of-the-art, high-precision, geotechnical instrumentation to detect movements in the rock and the structure itself.

The newly expanded Library will be able to meet the needs of Parliament and will help preserve the historic structure for many generations to come.

## to a rock quarry

VicUrban, the Victorian state government's development agency, asked Golder to help turn the former eyesore into a housing development. Golder has provided geotechnical, hydrogeological, and environmental investigation and design services.

A major obstacle came from engineering the waste stockpiles into high-quality fill, up to 35 meters thick, but still solid enough to build upon. In many cases, building on such a depth of fill would require pilings down to the level of natural solid ground, which would have increased costs and put the houses out of reach of many potential owners.

Due in part to good engineering of the fill and the design of the earthworks, houses over even the deepest fill can be built using just standard footings, with confidence that the ground beneath will remain stable over the long term. As a result, residents of the new Valley Lake housing development can expect their homes to be safe and enjoyable for years to come.



## INNOVATIVE reservoir design proven effective over the long term

**TWO RESERVOIRS IN NORTHERN GEORGIA, USA, BUILT IN THE EARLY 1990s WITH WHAT WAS THEN CONSIDERED LEADING-EDGE DESIGN, HAVE PROVEN THEIR WORTH OVER THE PAST DECADE IN SATISFYING A WATER-HUNGRY INDUSTRY, WHILE AVOIDING DISRUPTION TO ENDANGERED SPECIES AND THEIR HABITAT.**

Dalton, Georgia has a powerful need for water. As the "Carpet Capital of the World," this small city of 23,000 produces 40 percent of the world's carpet, and in the process consumes more water than any other municipality in Georgia, with the exception of the City of Atlanta. To stay globally competitive, a cheap, reliable source of clean water is vital. This need runs squarely up against the need to protect local watercourses, such as the nearby Conasauga River, home to several endangered fish and mussel species.

Traditional reservoirs usually involve a dam placed across a watercourse, which changes the environment in many ways. When Golder designed two new reservoirs a decade ago, the decision was made to minimize impacts by keeping the reservoirs separate from the watercourse. To achieve this, the reservoirs were constructed on the floodplain and water is pumped into them from the river.

To compensate for some loss of wetland habitat, Golder developed a "high-value" artificial wetland. Wetlands were restored on a floodplain that had been ditched and drained for pasture many years ago. Additional wetland and upland forest was protected to provide habitat for a wide variety of wildlife.

To add further value, Golder developed an interpretive trail through the habitat, with informational signs, which has been warmly welcomed by local residents and has seen many school excursion groups.

Clearly, innovation has paid off in providing a long-term solution to keeping Dalton's carpet mills competitive, while protecting the environment.



# Restoring RAIL LINK for NEW YORK commuters

A CENTURY-OLD SECTION OF NEW YORK'S COMMUTER RAIL SYSTEM, INTERRUPTED BY THE 2001 ATTACKS ON THE WORLD TRADE CENTER (WTC) TOWERS, IS BEING RESTORED THROUGH A COMBINATION OF TEAMWORK AND INNOVATION.

When the WTC towers collapsed, they severed a vital transportation link between New Jersey and New York City — a link that provided commuter service to lower Manhattan through the Port Authority Trans-Hudson (PATH) Hudson River tunnels, which have origins dating back to the mid-1870s. Huge volumes of water, used to fight the WTC fires, flooded the PATH tunnels, forcing the closure of the Exchange Place Station in Jersey City, New Jersey.

To help the area's economy recover, the Port Authority of New York and New Jersey authorized a restoration program

with a demanding schedule, which required the Exchange Place Station to be re-opened within 18 months and the WTC Station to be re-opened within 24 months. This ambitious commitment required the mobilization of a wide array of technical professionals.

Golder was the Lead Tunnel Designer to the Exchange Place Project, and had to overcome numerous technical and scheduling challenges, including limited access to and constrained conditions within the tunnels, and the tight schedule demands of the Owner, the Contractor and the other design consultants working



on the project. One particular difficulty was designing underground caverns with upwards of 18-meter (60 ft.) spans, while working beneath buildings whose foundations were, in some cases, only eight meters (25 ft.) overhead.

The team worked closely to complete the project on schedule, and the Exchange Place Station re-opened on June 29, 2003. The new station allows for a more efficient flow of train traffic and was designed with an eye to the future — the station can now accommodate greater passenger volumes, so it can continue to operate for many years to come.

For more information about the projects featured in this newsletter please contact us at: [solutions@golder.com](mailto:solutions@golder.com). Electronic versions of the newsletter are available at [www.golder.com](http://www.golder.com). Just follow the links to our "Library" and "Newsletters".

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# SAFE NUCLEAR waste disposal in HUNGARY

PROTECTING FUTURE GENERATIONS IS ESSENTIAL WHEN IT COMES TO NUCLEAR WASTE, AND IN THIS AREA HUNGARY'S POPULATION IS BEING PROTECTED BY WORLD-CLASS TECHNOLOGY.

Looking for a safe place to store low- and intermediate-level waste from the Paks Nuclear Power Plant, the Hungarian Public Agency for Radioactive Waste

Management turned to Golder to participate in the geological exploration program and to evaluate the safety of a proposed underground storage site.

One of the main considerations is finding a location where the geological environment, together with the engineered barriers around the waste, provides a high level of protection over a very long period. It is important that this waste, which includes radioactive materials, be isolated from the biosphere.

An extensive geological exploration program has been carried out at the chosen site, near the village of Bataapáti, in south Hungary. The program has included

boreholes, trenches and surface and borehole geophysical and hydrogeological measurements. Through these investigations, the geological suitability was confirmed, and underground work will start on the proposed repository site this year.

To meet the client's expectations, the Golder office in Budapest has drawn on expertise from other parts of the firm, and has used state-of-the-art equipment and software from Germany and the USA.

Once constructed, the repository will satisfy European Union requirements for the storage of radioactive waste, and will confine these materials and protect the safety of future generations.



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Technically Speaking is published for valued clients

and employees of Golder Associates. This quarterly newsletter includes articles showcasing innovative and technically challenging projects that Golder professionals have worked on throughout the world. We value your opinions. Please contact Gregory A. Beckstrom at + 1 651 697 9737 or [gbeckstrom@golder.com](mailto:gbeckstrom@golder.com) if you have any questions or comments.