



PROJECT PROFILE

Decommissioned Madawaska Mine Site

KEY ELEMENTS

■ **Client Contact**
Andrew Pool
EWL Management Ltd.
(403) 645-7861

■ **Project Value**
+\$20,000,000

■ **Duration**
2006 - Present

■ **Project Managers**
Mike Gunsinger
(Design)
Kyle Matter
(Construction)

Key Project Personnel

Ken DeVos
Brian Daniels
(Construction)
Toivo Pallop
(Construction)
Sue Longo
Jonathon Taylor
Bruno Mandl

■ **Key Services**
- Former mine site closure and remediation.

- Multidisciplinary environmental and geotechnical investigations, remediation construction.

■ **Project Location**
Madawaska Mine
Central Ontario

EWL Management Ltd. (EWL) retained Golder Associates Ltd. (Golder) to provide environmental/engineering services and Construction Operations as the General Contractor, at the decommissioned Madawaska mine site (Madawaska).

The Madawaska site is located in Central Ontario, and is a former underground uranium mine that operated during two phases: 1957 to 1964 and 1976 to 1982. The uranium ore was milled and concentrated on-site, and the uranium tailings are currently stored within two subaerial Tailings Management Areas.

Golder's approach to the Madawaska project consisted of the following steps:

- 1) Environmental and geotechnical investigations to better understand the chemical and physical stability of the site.
- 2) Identification of risks and aspects of the site that require remediation.
- 3) Develop remediation framework.
- 4) Remediation alternatives assessment.
- 5) Selection of preferred remediation strategy, as required.
- 6) Detailed design.
- 7) And construction.

The overall objective is to close the Madawaska site in accordance with appropriate regulatory requirements (i.e., Mining Act and Nuclear Safety and Control Act) and site-specific criteria.



Figure 1: Paste backfill entering the pump hopper.



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As part of this project, Golder provided the following services as part of a design-build effort:

- Geotechnical investigations of mine openings to surface and near-surface crown pillars for purposes of stability assessment, followed by detailed design and construction of the preferred remediation strategies for the mine openings to surface and crown pillars using a combination of reinforced concrete caps and paste backfill.
- Detailed design of the paste backfill system including stope production layouts, sequencing plans, material sourcing, recipe development and laboratory testing. In addition, equipment sizing and specifications for the paste production, as well as water and binder supply systems were also completed.
- A pilot trial was also executed to confirm the performance of the equipment and systems. A flow loop and on-site testing was conducted as part of the pilot trial.

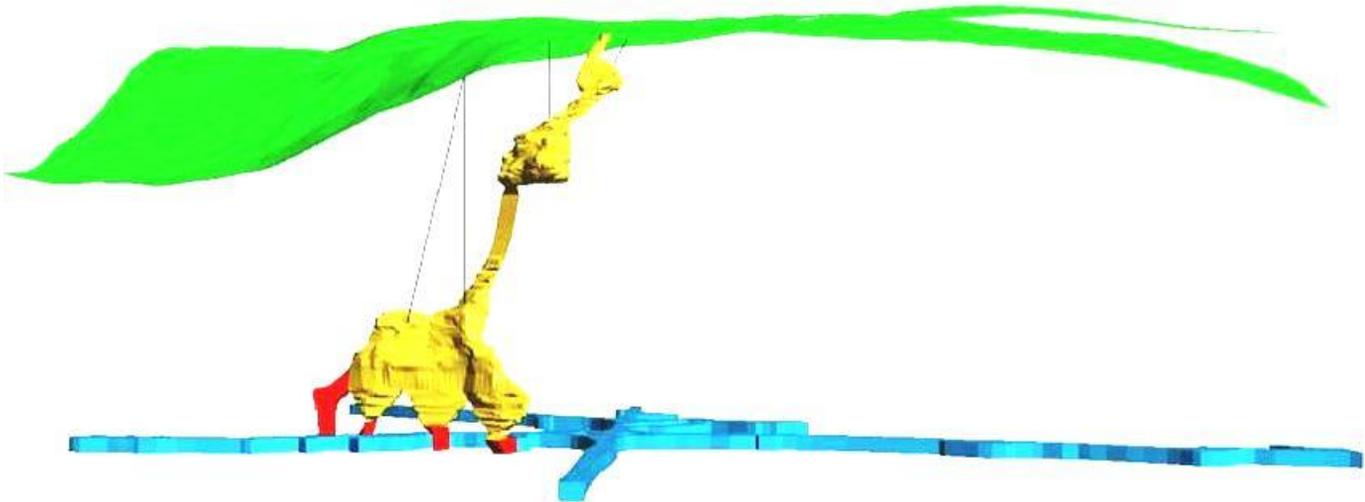


Figure 2: A stope section showing the areas in red and gold requiring backfill.



PROJECT PROFILE

Three Sisters Mountain Village Development

KEY ELEMENTS

- **Client**
Three Sisters Mountain Village Ltd.
- **Client Contact**
Chris Ollenberger, P.Eng.,
President
- **Duration**
2007
- **Key Personnel**
Sue Longo
Mark Labelle
- **Services**
Site Visit, Laboratory Testing and Paste Backfilling of Old Mine Workings
- **Project Location**
Canmore, Alberta,
Canada

Transformation of Old Coal Mine Properties into Modern Day Use

The site is located in the northern region of the northwest trending Cascade Coal Basin of Alberta on the eastern edge of Canmore, Alberta. Coal mines opened up in 1887 in support of the Trans Continental Railway. Since that time, 17 different coal operations have existed, the last having ceased operation in 1979.

Underground drifts rise and fall with the coal seam, at times, to surface. Standard mining operations were done in a room and pillar fashion. There is a history of ground subsidence in the area.

Three Sisters Mountain Village Development received permission to develop an 800 Ha site in the area encompassing the old mine sites. They plan to build a housing community of 10,000 people, with a completion date of 2010. The development includes wildlife corridors (60% of 800 Ha), two 18 hole golf courses, wellness centre, school, commercial buildings and. To date, between \$150M and \$200M in property has been sold.

Key factors to development were recognizing existing hazards to public and wildlife, Government Regulations allowing proven mitigation practices, moratorium on Banff development, and location.

Alberta Provincial Regulation (114 / 97) requires a developer to have the situation studied by an undermining engineer, who prepares a report and recommendations. When these recommendations are carried out, the engineer certifies the results, which in turn are certified by an independent expert.

Golder Associates Ltd. was commissioned by Three Sisters to study the site and make recommendations. Paste technology was chosen as the practical and most economical solution. 600 exploratory and injection holes have been drilled, with 24,000m³ of paste injected to date.





PROJECT PROFILE

St. Anthony's Paste Backfill, Drumheller, Alberta, Canada

KEY ELEMENTS

- **Client**
Christ the Redeemer
Catholic Schools
 - **Client Contact**
Mr. Jim Yurchevich
 - **Project Value**
\$320,000
 - **Duration**
March-April 2009
 - **Key Personnel**
Ray Predika
Jimmy Falcioni
Isaac Ahmed
 - **Services**
Project planning and design

Site testing, monitoring,
and supervision

Equipment mobilisation
and demobilisation
 - **Project Location**
Drumheller, Alberta,
Canada
- In early 2009, Golder's Paste Engineering and Design (PED) group was contacted to provide an engineered paste backfill solution for the location of a future school. The property, owned by Christ the Redeemer Catholic Schools, was previously the site of an extensive coal mine operation and its underground workings were required to be stabilised prior to redevelopment. Drawing upon previous mobile paste backfill operation experience in Alberta and British Columbia, the Golder PED group was well positioned to offer a streamlined process to the client.
- Golder's Paste Engineering and Design group and Golder's Calgary geotechnical group provided services that included site material testing, monitoring and supervision, borehole drilling, equipment mobilisation and demobilisation as well as an extensive quality control program. In addition, the Paste Engineering and Design group designed and implemented a paste recipe with appropriate cement content to support the future construction of the school. With this operation, a local sand source was combined with cement and water to produce a paste backfill. The resulting material is both pumpable and flowable for the filling of the underground voids. In some cases, with water logged boreholes, the paste was observed to displace the water.
- The on-site backfill work, delivering 1,500 m³ of paste, was carried out over the course of three weeks in April 2009.



Mobile Paste Backfill Equipment



Paste Injection into Borehole



PROJECT PROFILE

Lynx Pit Crown Pillar Backfill, Myra Falls, Vancouver Island, British Columbia

KEY ELEMENTS

- **Client**
Breakwater Resources

The Lynx Pit project, located near Campbell River on Vancouver Island, involved the filling of several underground mine voids with cemented paste backfill. This was done after gaps were found between the existing backfill and the crown pillar of the mine. The new paste backfill ensured that the crown pillar was properly supported and that the risk of crown pillar failure and mine collapse was mitigated.

- **Client Contact**
Mr. Ken Ball

- **Project Value**
\$300,000

- **Duration**
July-September 2005

Golder completed the planning, site testing, monitoring, and equipment allocation for the project duration. This included the design, testing and implementation of an optimal paste recipe, including appropriate cement content to provide adequate support for the mine and consistent particle size and solids consistency to flow into narrow cracks and veins.

- **Services**
Project planning and design

Site testing, monitoring, and supervision

Equipment mobilisation and demobilisation

Challenges associated with the project were focused around the uneven pit floor, which was unsuitable for the drilling operations needed for paste injection. The solution was the design of a second paste recipe with quick setting properties. This quick drying paste was deposited and became the new floor on which safer and more effective drilling could take place.

- **Project Location**
Myra Falls, Vancouver Island, British Columbia, Canada

The on-site activity for the project was initiated in August 2005 and was completed in September 2005.



Paste Mixing and Injection



Drilling on Dried Paste Surface



PROJECT PROFILE

Alpine Homes Paste Backfill, Canmore, Alberta, Canada

KEY ELEMENTS

- **Client**
Alpine Homes (Canada) Inc.

In recent years, residential communities have been steadily growing in and around the town of Canmore, Alberta. Further residential developments in the vicinity were planned by Alpine Homes however the proposed sites were situated overtop of abandoned and unstable coal mine workings in the area. The stabilisation of these mine workings was essential prior to development in order to minimize subsidence risks to the planned community. To achieve this goal, a paste backfill solution was sought.

- **Client Contact**
Mr. Lawrence Hill,
P. Eng, President

- **Project Value**
\$225,000

- **Duration**
June-December 2007

- **Key Personnel**
Ray Predika
Mark Labelle
Sue Longo

Golder's Paste Engineering and Design Group was asked to design and implement a paste backfill solution to mitigate the risk of mine collapse and ground subsidence. Drawing upon its experience with similar projects at the nearby Three Sisters Mountain Village Development, Golder's paste group and Golder's geotechnical group provided: material testing, site supervision, borehole drilling, monitoring, equipment mobilisation and demobilisation, as well as quality assurance and quality control on paste production. Lastly, slump and unconfined compressive strength (UCS) tests, typically used in the concrete industry, were some of the characteristics monitored for paste quality assurance purposes.

- **Services**
Project planning and design

Site testing, monitoring, and supervision

Equipment mobilisation and demobilisation

The project was carried out from June to December 2007 with on-site activity beginning in August and terminating in September.

- **Project Location**
Canmore, Alberta,
Canada



Trailside Sample Slump Test



Ground Subsidence