

**NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES
STIRLING MINE SHAFT CAPPING DEMONSTRATION PROJECT
AS-BUILT REPORT
STIRLING MINE
RICHMOND COUNTY, NOVA SCOTIA
PROJECT NO. 10903**



Jacques Whitford

Consulting Engineers
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NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES

ON

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STIRLING MINE
RICHMOND COUNTY, NOVA SCOTIA**

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EXECUTIVE SUMMARY

The Stirling Mine was a former underground lead, zinc, copper, silver and gold producer which has been abandoned since 1956. The mine site is located near the community of Stirling, Richmond County, Cape Breton, Nova Scotia. Following abandonment of the mine, all buildings and equipment were removed from the site, although, concrete foundations from the site structures and two open mine shafts and two service/ventilation raises remain.

These abandoned mine openings represented a potential hazard to public safety. To eliminate this hazard and permit the assessment of various methods to secure and seal abandoned mine openings, the Nova Scotia Department of Natural Resources (NSDNR), contracted to have the four mine openings capped. The project was conducted to both increase public safety for people using the mine site, and serve as a demonstration project to evaluate the design, construction techniques and suitability of various closure methods for the four mine openings on the Stirling Mine site, along with other similar abandoned mine openings located throughout the province.

Following completion of the design and site construction, this as-built report was prepared to document the design and construction activities associated with the four closure methods. The report describes the salient features of the design, material procurement, site preparation and construction of the closure methods for the two shafts and two raises.

To permit the evaluation and assessment of various shaft and raise closure alternatives, a different capping methods was designed for each of the four mine openings.

Shaft No. 1: A cast-in-place concrete cap positioned directly over the existing concrete shaft collar.

Shaft No. 2: Steel grating positioned over the shaft opening and held in place using a combination of a concrete anchor ring and steel brackets.

Raise No. 1: A monolithic concrete slab cast directly on the base of a subsidence feature located over the top of the raise opening.

Raise No. 2: Pre-cast concrete panels positioned directly on bedrock over the raise opening.

Materials, supplies, equipment and services for the construction project were mobilized from Dartmouth, Port Hawkesbury, Mulgrave (Auld Cove), Sydney and North Sydney. On-site construction activity lasted for a period of five days, beginning on the morning of October 23, 1995 and ending on the afternoon of



October 27, 1995. There were no delays in construction as a result of weather or shortages of material.

With the exception of No. 2 Raise, there was no requirement to significantly modify the design of the closure methods because of unexpected conditions encountered in the field during construction. Minor field modifications were, however, made to the original designs during construction. These modifications consisted of an increase in the thickness of both the cast-in-place concrete cap at No. 1 Shaft and the monolithic concrete slab over No. 1 Raise, and a slight decrease in width of the concrete anchor ring at No. 2 Shaft.

The 28-day concrete compressive strength at No. 1 and No. 2 Shaft was 1.6 MPa below design specifications. However, because of the increased cap thickness at No. 1 Shaft, the shaft cap still has sufficient strength to support loading specifications. The decreased concrete strength at No. 2 Shaft is also not considered critical because the concrete anchor ring is not subjected to loading.

A combination of material problems associated with the pre-cast panels and uneven bedrock conditions encountered along a portion of the south side of the raise opening, resulted in the requirement to modify the closure method. With the approval of the NSDNR, a combination of pre-cast concrete panels and a cast-in-place concrete cap were used as the closure method for No. 2 Raise. The use of the cast-in-place concrete cap was a modification to the original pre-cast concrete panel closure design.

The cast-in-place concrete cap used at No. 2 Raise eliminated the requirement to use fill or concrete for a levelling course; permitted use of the three undamaged pre-cast concrete panels; eliminated delays as a result of casting two additional pre-cast panels; and gave the added advantage of a fifth type of closure method. The cast-in-place cap used to replace the damaged pre-cast panels was designed to meet the original strength specifications of the pre-cast panels which it replaced.

It was also determined that the pre-cast panels fabricated off-site did not meet design specifications for concrete thickness and rebar reinforcement. Although the three undamaged pre-cast panels were utilized, two of the three panels which are positioned over the raise opening will be replaced in the spring of 1996 with new pre-cast concrete panels which meet original design specifications. The third panel, which is primarily located over bedrock at the east end of the raise, will be left in place. One of the panels which will be removed will be positioned over this third panel to provide additional support.

Only a few problems were encountered during the construction activities. These problems related to the transport of the pre-cast concrete panels; local availability of materials and supplies; and the preparation of the bedrock surface at No. 2 Raise.



Relative elevations of the concrete closure caps on No. 1 and No. 2 Raises and No. 1 Shaft, were determined following completion of construction. Future elevations can be compared to the initial values to determine if the concrete caps are subsiding or shifting over time.

During construction, all appropriate health and safety measures were taken to ensure the safety of workers and minimize the potential for injuries and accidents. The use of safety lines was particularly important when work was conducted around open holes.

To permit vehicle access to No. 1 Shaft for construction purposes, it was necessary to cross Stachans Brook which flows across the mine site. To comply with Nova Scotia Department of the Environment (NSDOE) regulations pertaining to stream crossings with vehicles and construction equipment, a Stream Crossing Permit from NSDOE was obtained.

To determine the actual strength of the concrete, three concrete cylinders were obtained both times concrete was delivered to the site. In addition to obtaining concrete cylinders, tests were conducted on the concrete to determine the percent entrained air and slump.

