

Approaches for the Remediation of Abandoned Mines and NOAMI

Gilles A. Tremblay and Charlene M. Hogan

NOAMI and MEND Secretariat
Natural Resources Canada, Ottawa, Ontario

ABSTRACT

The National Orphaned/Abandoned Mines Initiative (NOAMI) was established in 2002. The multi-stakeholder nature of NOAMI has provided a uniquely Canadian opportunity for governments, non-governmental organisations, Aboriginal Canadians and the mining industry to discuss issues and barriers associated with the clean-up and remediation of orphaned and abandoned mine sites. This convergence of interests and mutual commitment to progress has fostered the success of this internationally recognized approach to influencing public policy and addressing issues of common concern.

Over the past 5 years, NOAMI has been working diligently to influence policy and build capacity in Canada to address these issues. Various workshops, conferences and publications have provided the background information, analysis and network building that have driven the agenda forward. During this time, there has also been a substantial increase in remedial activities carried out by the jurisdictions across Canada.

This paper provides a five-year summary of NOAMI's efforts and an overview of the remedial activities in the Canadian jurisdictions. The jurisdictional highlights feature many of the different approaches and partnerships employed across Canada. The paper also includes several international case studies of novel regeneration projects completed on legacy sites.

THE ISSUE

Canada's long history in mining has resulted in more than 10,000 orphaned or abandoned mine sites, with different levels of risk and requiring varying degrees of rehabilitation. This legacy of orphaned/abandoned mines (OAMs), with the associated environmental liabilities, human health and safety concerns and the financial costs of clean-up, continues to be a serious issue facing Canada.

The most serious environmental issues for abandoned mines are acidic drainage and metal leaching. Sources include, underground workings, open pit mine faces and workings, waste rock dumps, and tailing deposits. Public health and safety hazards result from mine openings, mine wastes, abandoned infrastructure and subsidence. Policy implications concern standards, fiscal responsibility and funding models, jurisdictional liabilities and possible re-use of the land (future mining, recreational activities, etc).

RESPONSE TO THE PROBLEM

The National Orphaned/Abandoned Mines Initiative (NOAMI) was launched in 2002, with advisory committee members from the federal, provincial and territorial governments (F/P/T), the Canadian mining industry, First Nations, and environmental non-governmental organizations. NOAMI adopted the MEND framework of multistakeholder co-operation to develop a multi-year policy-based program for remediation of orphaned and abandoned mine sites in Canada (Tremblay and Hogan, 2007). The Advisory Committee takes direction from the Mines Ministers, and reports back annually at the Mines Minister Conference. An annual workplan is developed by the committee and presented for approval at the Mines Ministers Conference. Activities are jointly funded by the F/P/T governments and the mining organizations, and the program is administrated by the Secretariat at CANMET-MMSL. Funding for NOAMI was about \$100 K/year in the first few years, but increased to \$330 K/per year when the program was expanded in 2005.

NOAMI TASK GROUPS

Once the workplan was approved, task groups were formed to address the priority areas. These groups focussed on: information gathering towards building a national inventory; community involvement; funding options and approaches; legislative and institutional barriers to collaboration; and most recently, a jurisdictional legislative review. In the past six years NOAMI has made good progress in seeking solutions to the legacy of orphaned/abandoned mines in Canada. Summaries of these task groups are provided below.

Information Gathering Towards a National Inventory

A principal objective of NOAMI was to develop capacity for a national inventory of orphaned and abandoned mine sites based on compatible inventories from each province and territory. All Canadian provinces and territories with a history of mining, and several federal agencies, maintain their own inventory of mining and exploration sites that pose a risk to human health and safety or the environment. There is a large discrepancy in the level of detail and completeness of these inventories from jurisdiction to jurisdiction. The concept of a national database must allow for these gaps in coverage, detail and standardization, but permit the future inclusion of additional information.

The first step towards building the national inventory was to reach consensus on the definitions and terminology to be applied to orphaned/abandoned mine sites. The definition of “orphaned” and “abandoned” mines or sites varies among jurisdictions in Canada. The NOAMI definition does not differentiate between the two terms, and loosely defines orphaned/abandoned mines as those mines for which the owner cannot be found, or for which the owner is financially unable to carry out clean-up. A primary criterion for the inventory was to develop a set of definitions under which information from all jurisdictions could be defined and compiled, and to avoid many of the existing inventory definitions, which could be in conflict. A comprehensive review of Canadian and international efforts to inventory OAMs, along with high level definitions were documented in “Capacity Building for a National Inventory of Orphaned/Abandoned Mines in Canada” (Cal Data, 2005). The proposed definitions were designed to be independent of most existing definitions and would provide a framework in which the existing definitions could be linked.

The Cal Data report recommended a high level inventory that included all inactive mineral sites, was web-based and had a map interface. Such a system acts as a portal to the existing inventories maintained within the provinces, territories and federal agencies. Internet links are utilized to make the investigative experience of the user virtually seamless between the national database and the component databases.

Various options were explored to determine the most suitable host for the NOAMI Internet map site. Natural Resources Canada (NRCan) was selected to host the portal based on several criteria. NRCan maintains several sites using MapGuide-based technology, which deal with mineral producers and related areas, such as Aboriginal communities at http://mmsd1.mms.nrcan.gc.ca/maps/intro_e.asp. An important element of the inventory was to obtain federal, provincial and territorial participation, which was facilitated through existing data sharing agreements with NRCan. Some additional requirements included; that NRCan would be provided access and use of the jurisdictional OAM site data, consent for the data to be publicly accessible, and that access and use of the data would be provided on a long-term basis to ensure maintenance. A key consideration to obtain jurisdiction consent was to establish a system or link that would not impact their current operational status.

Population of the national inventory with jurisdictional datasets is now well-underway and most jurisdictions have finalized agreements to integrate their datasets. NOAMI has developed an interactive map displaying the OAMs across Canada. The map also includes satellite imagery and details displaying infrastructure at the regional and national level. Initially, a set of national definitions based on legal status was developed and used to provide a uniform framework for the comparison of sites across Canada. While this classification illustrates the location of mineral sites that are considered orphaned/abandoned, it does not describe the type and magnitude of the physical risks presented by these sites. After a review of the developed portal, the NOAMI Advisory Committee requested that the framework be based on a ranking of the mineral sites according to their physical features and risk to human health, safety and the environment. A mandate will be awarded to Cal Data to review the existing databases and determine if and how the present information can be re-aligned to be feature based. NOAMI in collaboration with NRCan as well as the provinces and territories are working together to accomplish this important task.

Community Involvement

Approaches are needed that will foster community involvement in decision-making on closure and rehabilitation, and ensure that targeted end-use and rehabilitation standards are

acceptable to local communities. In 2002, case studies related to community involvement were completed for three abandoned Canadian mine sites (Giant Mine – NT, Deloro Mine – ON, Mount Washington Mine – BC), along with experiences in community involvement at abandoned mines in the United States (NOAMI, 2003a). Report findings were based on personal interviews with key contacts in the community to reflect a diversity of perspectives. These case studies contain more complicated issues than many abandoned properties and they illustrate the importance of effective community involvement in decision-making from the onset for OAMs. The “lessons learned” from these studies were developed into a series of guidelines and published in the pamphlet “Best Practices in Community Involvement”. The final report and the pamphlet are available on the NOAMI web site (www.abandoned-mines.org).

After completion of this project, the NOAMI Advisory Committee continued to examine ways to foster community involvement and engagement in abandoned mine remediation through other projects and workshops, in particular the 2006 multi-stakeholder workshop “Orphaned/Abandoned Mines: A Workshop to Explore Best Practices”.

One recommendation from this workshop was for NOAMI to support a community based pilot project on “Building the Capacity of Local Communities to Understand Abandoned Mines”. The objective is to build capacity, via a modular tool-kit, in areas such as community engagement, environmental concerns, legal and corporate matters, funding and partnerships, decision-making and aboriginal issues. Three diverse communities; Ymir-BC (near Yankee Girl), Chibougamau-QC and Virginiatown-ON (near Kerr-Addison Mine) will be visited and engaged in workshops and focal groups to assess, build upon, and adapt the ability of the developed toolkit to increase capacity of local people to understand and deal with these issues. This mandate was recently awarded to the Centre for Indigenous Environmental Resources (CIER) in Winnipeg.

Legislative Barriers to Collaboration

A background study “Barriers to Collaboration: Orphaned/Abandoned Mines in Canada” was undertaken to examine existing legislative requirements in Canada, and selected international jurisdictions, on regulatory or institutional barriers, liability disincentives, and collaborative opportunities regarding voluntary abatement, remediation, and rehabilitation of OAMs (Castrilli, 2002). Particular emphasis was placed on four approaches: “Good Samaritan” legislation; permit blocking; allocative versus joint and several responsibility; and non-compliance registries. The report findings provided background for a multistakeholder workshop “Legal and Institutional Barriers to Collaboration” in Ottawa, 2003 that assessed key barriers and developed approaches to overcome them. These recommendations were further integrated into a report on the Jurisdictional Legislative Review (Castrilli, 2007). The reports and the Workshop Proceedings are posted on the NOAMI web site.

Guidelines for Jurisdictional Legislative Reviews

In 2003, the Mines Ministers asked NOAMI to complete guidelines for jurisdictional legislative reviews with respect to collaboration, liability and funding to ensure that approaches across jurisdictions are consistent, certain, transparent, coordinated and efficient. A series of guidelines (NOAMI, 2004) was developed to facilitate a focused review of legislative/regulatory/policy frameworks as they apply to OAMs across Canada. A report on all legislation relevant to the remediation of orphaned/abandoned mine sites “Report on the Legislative, Regulatory, and Policy Framework Respecting Collaboration, Liability, and Funding Measures in relation to Orphaned/Abandoned, Contaminated and Operating Mines

in Canada” was released on CD-ROM in 2007. It contains a synthesis of the jurisdictional analyses, including an assessment of gaps, limitations, barriers and opportunities to remediation, along with a summary of observations. Legislative/policy/program matrixes are presented that allows a comparison by jurisdiction with respect to mining and environmental regulations and policies. A toolkit of policy/legislative approaches outlining a number of options to assist jurisdictions towards implementation of legislative change is part of the workplan for 2009.

Funding Approaches

This task group was to identify funding approaches and preferred options for the remediation of OAMs across Canada that could be adapted to meet the needs of each jurisdiction. The report titled “Potential Funding Approaches for Orphaned/Abandoned Mines in Canada” (Castrilli, 2003) outlined a variety of funding approaches to be considered for the clean-up or management of liabilities related to OAMs. It was concluded that no single funding approach would constitute a complete solution; a combination of a number of approaches would likely be required.

A multistakeholder workshop on “Assessing Liabilities and Funding Options” was held in Ottawa in 2005 that further developed funding approaches and related issues for OAMs. A roll-up discussion identified gaps and future priorities for NOAMI. One recommendation was for a “toolkit”, outlining a series of funding options and illustrated with case studies. This would be a resource document for use by jurisdictions across Canada to help guide the establishment of potential funding options for the remediation of OAMs. The report “Rehabilitating Abandoned Mines in Canada: A Toolkit of Funding Options” (Cowan Minerals, 2006) was completed and is posted on the website, along with the above stated Proceedings and report.

TECHNOLOGY TRANSFER

Orphaned and abandoned mines are a “hot issue” in Canada and the public wants to be kept well informed. Efficient and timely sharing of information to the mining community and the public is an important function of NOAMI and other multistakeholder initiatives. NOAMI uses a number of routes to transfer information. The Secretariat distributes documents, such as the NOAMI Newsletter, and other bulletins, to a huge mailing list. The NOAMI web site (www.abandoned-mines.org) was recently redesigned and streamlined to improve visibility and access to the program’s activities and publications. The site is regularly updated with information, such as NOAMI reports, workshop proceedings, pamphlets, announcements and newsletters.

The priority issues identified by NOAMI, and the multi-year action plan and activities to address these areas, has generated much interest both domestically and internationally. NOAMI has collaborated with other initiatives to share this information, and has presented findings at many international forums. Earlier this year, members of the NOAMI Advisory Committee were invited to the International Roundtable on the Restoration on Mining Legacy Sites (jointly run by the World Conservation Union, the International Council on Mining and Metals, and the Post-Mining Alliance) to discuss challenges in OAMs and present Canada’s work. Information of these discussions is available at www.postmining.org.

Workshops are the preferred vehicle to share information and obtain feedback from the mining community. Several NOAMI workshops were held and were previously discussed (i.e. Legal and Institutional Barriers to Collaboration, Assessing Liabilities and Funding Options, Best Practices). An upcoming workshop planned for November 2008 will explore different perspectives related to the risk assessment process at OAMs, with presentations and discussions clustered around the themes of risk assessment planning, human health risk assessment, ecological risk assessment and geotechnical risk assessment. In addition, a case study session will allow for more focused discussion of specific risk assessment studies from the perspectives of the community, government, industry and practitioners. The Proceedings and Presentations for all the NOAMI workshops are posted on the website www.abandoned-mines.org.

At present, the NOAMI Advisory Committee is developing a communication strategy to heighten awareness of the issues of OAMs, the work completed by NOAMI, and the initiatives undertaken by F/P/T jurisdictions in addressing this issue. One component of this strategy is the production of the NOAMI Five-Year Performance Report (2002-2007), which is currently underway. The report outlines the impacts and benefits of NOAMI, the accomplishments of the jurisdictional partners, and the remaining challenges. The document is aimed for a general audience, and will be published in both official languages, as a brochure and on CD-ROM.

JURISDICTIONAL PARTNERSHIPS

Provinces, territories and Indian and Northern Affairs Canada (for sites north of 60) in Canada have made significant progress in remediation of abandoned mines in their jurisdictions. Various partnership and collaborative approaches have been used, and this information is invaluable for the development of toolkits that can be applied on a national basis. Although a number of partnerships have been formed to remediate OAMs in Canada, this paper will refer to several that are relevant to NOAMI's mandate for the development of collaborative partnerships in the implementation of remedial programs. Additional information on jurisdictional activities and partnerships will be provided in the Five-Year Performance Report.

Québec

The Québec Ministère des Ressources naturelles et de la Faune (MRNF) developed several partnership approaches to address contaminated sites. Although application of these partnerships may be limited in scope, the key messages are that they provide an opportunity wherein both parties benefit, and that both parties were willing to consider some innovative approaches. Five different types of partnerships were used for rehabilitation of closed sites:

- Partnerships between Ministries. MRNF and MDDEP (Ministère de du Développement durable, de l'Environnement et Parcs) signed a cooperative agreement to facilitate rehabilitation for the Sullivan Mine.
- Partnerships with Mining Industry.
 - In 1996, Les Terrains Aurifères site (Barrick Gold) utilized neutral tailings from the government-owned Malartic Goldfield Mine as a component in the multi-layer dry cover

placed over their acid-generating tailings. The arrangement saved the government \$500,000 (MEND 2.22.4, 1999).

- More recently, alkaline tailings from the Agnico-Eagle Mines Goldex mine are used to rehabilitate the acid-generating tailings on the Manitou abandoned mine site. The tailings are deposited on the old Manitou tailings, and will raise the water level, which will result in an elevated water table, thus saturating the acid generating tailings. Over the 12 year life of the mine, the estimated savings are \$12 million for the Québec government.

- Partnerships with Forest Industry. The rehabilitation plan for the East Sullivan mine site included the placement of a cover over the acid-generating tailings. Coincidentally, the forest industry needed a place to store its wood waste products. Wood waste proved to be an adequate cover, and 2-metre of waste was placed over the tailings. This win-win partnership cost the government \$9.5 million instead of the estimated \$30 million
- Partnerships with Local Organizations. The Eustis mine complex near Capelton in the Eastern Township is owned by a non-profit organization that wanted to develop the site as a historic and recreational area. The owners do not have the necessary funds to complete the rehabilitation of many of the acid-generating sites located on their land, which included the Albert Mine. A partnership was formed among the organization, the government and the local paper industry, which needed a place to store their wastes. De-inking sludge produced from the paper industry was used as a cover for the 4.5 ha Albert Mine site. This material in combination with a compost layer was found to be an excellent growth media. This partnership saved the government \$850,000 in remedial costs.
- Partnerships with Aboriginal Peoples. In the summer of 2007, an agreement was signed to rehabilitate abandoned mining exploration sites in Northern Québec (Nunavik Region). The four partners in the agreement include the Kativik Regional Government, the community of Makivik, le Ministère des Ressources naturelles et de la faune du Québec and the Fonds Restor-Action Nunavik, a group of exploration companies that are willing to help with the rehabilitation of old abandoned properties. The agreement will ensure that by March 31, 2012, the 18 exploration sites considered top priority will be rehabilitated. Total cost for the 18 sites was estimated to be about \$4 million dollars in November 2007. As of October 2008, the partners are confident that the work can be completed on time and on budget. With the agreement, the government has estimated a saving of more than \$1.5 million.

Ontario

Ontario Ministry of Northern Development and Mines (MNDM) has been active in remediation of their abandoned mines since 1999. The **Abandoned Mines Rehabilitation Program** was created to allow MNDM to conduct rehabilitation work on Crown-held abandoned mine sites throughout Ontario. Funding for this program is as follows:

- 1999 – 2003: \$27 million
- 2003 – 2007: \$41 million
- 2006 – 2012: \$60 million

Ontario has been working on a formalized abandoned mines prioritization system. Prioritization of Ontario's abandoned mine sites was undertaken during the 1990s, but it required upgrading. Over the last 18 months MNDM has implemented a multi-staged approach to prioritization as follows:

- Every abandoned mine record now reflects all available information (i.e. from site assessment reports, tailings assessment reports, etc.)
- Sites that did not require ranking were determined and set aside, including:
 - sites that are subject to a federal license;
 - sites that are covered by a closure or rehabilitation plan;
 - sites not under the jurisdiction the *Mining Act* (e.g. sites under the *Aggregate Resources Act*, etc.); or
 - sites with only shallow surface exploratory workings.

A ranking of the remaining sites was completed by MNDM. The sites were classified into three categories, which were based on the size of the site and its estimated cost of rehabilitation. A second round of ranking is now underway using a more objective system than that used during the 1990s. Between 2002 and 2007, \$51 million has been spent on the rehabilitating the highest priority crown-held mine sites in Ontario.

Industry has long signaled interest in assisting the Crown in the remediation of abandoned mine sites to demonstrate its commitment to the environment and a sense of responsibility to the community. While a MOU between the Ontario Mining Association and MNDM was a good start for leveraging funds and addressing abandoned mine hazards in the province, the Industry has indicated that more could be done to address the legacy of abandoned mine sites at no cost to tax payers if regulatory liability risk could be reduced for “Good Samaritans” in the industry that volunteer to take on the required rehabilitation. To achieve this, amendments to the *Mining Act* were passed in 2007 and MNDM has drafted related regulation, which was recently posted for public comment on the Environmental Registry. Once the **Voluntary Reclamation (Good Samaritan)** provisions are in place, persons (volunteer(s)) working on Crown-held abandoned mine sites will be able to conduct their MNDM-approved rehabilitation work without being subject to the *Environmental Protection Act* and the *Ontario Water Resources Act* regarding other pre-existing mine features and hazards on the site. However, the volunteer(s) will still be liable under that legislation if it either causes or permits a spill on, or from, the site. Reducing regulatory barriers to conduct the rehabilitation of abandoned mine hazards will benefit all Ontarians by reducing public health and safety risks, environmental impacts, and the amount of future public spending. Industry may have the expertise, technology and equipment to allow the remediation to be conducted more efficiently and cost-effectively than if Ontario was to contract the work at public expense.

Several partnership agreements are in place for mine rehabilitation projects.

MNDM and Porcupine Joint Venture have a cost sharing agreement to address mine subsidence related issues in and around the former Hollinger and McIntyre Mine sites in Timmins, ON. Subsidence has become more serious since dewatering of the mines ceased, and it is believed that the sand backfill has flowed and left voids in the upper workings. A major part of the problem is that the surface rights for the mine were severed and sold to private individuals, so that many of these events occur right in the community. This partnership, along with several others, is detailed in the NOAMI report “Rehabilitating Abandoned Mines in Canada: A Toolkit of Funding Options” (Cowan Minerals Ltd, 2006).

MNDM and Ontario Mining Association (OMA) have cost sharing agreements in place in which funds acquired by OMA are matched by MNDM to work on OAMs of mutual interest.

Since 2002, two remedial projects have been undertaken at the Kam Kotia Mine site under this agreement.

British Columbia

The BC Crown Contaminated Sites Branch (recently renamed the Crown Land Restoration Branch (CLRB)) was formed in response to the 2002/2003 Report from the Office of the Auditor General that was critical of management of contaminated sites in BC. Since 2001, B.C. has committed over \$190 million for the management of the province's contaminated sites, and from 2002 to 2007 CLRB spent \$35 million on activities related to OAMs. While there are currently no partnership funding programs in B.C. with the mining industry, and no "Good Samaritan" programs, the work of NOAMI provides a starting point for advancing these key policy areas.

CLRB manages contaminated sites for BC, assists in policy development and identification of priority sites (risk based approach). There is a contaminated sites database for crown land that is continually updated. Under the program, 21 historic mine sites were investigated, and 48 sites are under investigation. Four mine sites have been completed.

A risk ranking methodology that looked at human health and environmental risk was used to prioritize the sites. Exposure pathways were examined. This method gives ranking of sites with respect to priority. For the second phase, expert practitioners are convened to confirm that those sites are high risk. For the 2008/2009, fiscal year the program has been allocated \$27 million dollars.

Manitoba

Manitoba's Orphaned/Abandoned Mine Site Rehabilitation Program was established in 2000 in response to the Mine Closure Regulation that Manitoba adopted in 1999. The Regulations required that environmental liabilities incurred during mining operations be financially secured to cover future remediation costs. In addition, mine closure plans and financial security must be filed and approved prior to a permit being granted for a new mine operation. The Mine Closure Regulation is currently undergoing a formal review to ensure that its requirements remain relevant and consistent with the government policies and programs.

The program's mandate is to address public safety and environmental health concerns associated with OAM sites. The program received initial funding of \$2 million in order to address safety issues and identify environmental concerns at five high priority sites: Lynn Lake, Sherridon, Gods Lake, Snow Lake and Baker Patton. Environmental and risk assessments were completed at these sites by consultants retained by the Province. Inspections and identification of hazards were also completed at an additional 144 orphaned and abandoned sites. Based on these inspections and preliminary engineering work, a total of 31 sites were considered to be high hazard sites. In response, a risk-based matrix was created and a schedule was developed that will see these sites remediated by 2012. \$110 million dollars has been committed to address the issues.

NATIONAL AND INTERNATIONAL POST-MINING REGENERATION PROJECTS

The International Roundtable on the Restoration on Mining Legacy Sites (Toronto, March 2008) plans to release shortly the results of, and a discussion paper for, an international survey on the challenges surrounding mining legacies along with the discussions at the roundtable (www.postmining.org). Regeneration was an important topic and survey results suggested a long list of examples and models of good practice in regeneration from around the world. Many of these were good examples of technical environmental solutions, few dealt with the negative social impacts. It is important to focus on the positive examples, to explore what works and why, and to determine how the lessons learned can be applied elsewhere. Local community involvement was the most important lesson learned in the cited examples, followed by partnership/stakeholder approaches and government involvement.

The Roundtable report contains many examples of regeneration projects, but several high profile examples are given below.

Butchart Gardens, Victoria, BC

In 1904, the concept of The Butchart Gardens began with an effort to beautify a worked-out quarry site on the 130-acre estate of Mr. and Mrs. R.P. Butchart, pioneers in the manufacture of Portland Cement in Canada. Tons of top soil were brought in from nearby to line the floor of the abandoned quarry. Little by little this abandoned quarry blossomed into a spectacular garden with over 1,000,000 bedding plants in some 700 varieties used throughout the Gardens to ensure uninterrupted bloom from March through October. Close to a million people visit each year, and the gardens have grown to a world class scale and have been designated a National Historic Site.

The Eden Project, Cornwall, UK

The Eden Project is located in a 170-year old china clay pit near St. Austell in Cornwall, England. It is regarded as the biggest social and economic event to impact on the county for decades. Eden is an impressive example of a post-mining regeneration project with a strong socio-economic focus (www.edenproject.com). As a successful botanical visitor destination, the project is successfully growing all the world's major crops in artificial soils and in semi-controlled greenhouse environments.

Eden opened in March 2001 and attracted their 10 millionth visitor during the summer of 2008, generating over £839 million in the local economy in this time, and employing 450 people. Following a highly successful "social enterprise" model, the economic and social impact of Eden has been maximized by aggressively following policies of local employment and local sourcing (£10 million a year).

Eden is an environmental education charity which was funded by public-private partnership (initial construction: £86 million) and other public sources (subsequent investment: £30 million) for a total of about Can \$275 million.

Medieval Salt Mine, Bochnia, Poland

The salt mine in Bochnia in southern Poland, was built in 1248 and is still accessible today. This mine thrived for eight centuries providing significant wealth to the kings of state.

Mining ceased about 17 years ago due to economic changes and depletion of resources. At that time, the mine was designated as a museum. Many benefits from the mine emerged after closure. The fascinating historical mine museum, with numerous underground tourist trails (which passes through chapels, a banquet hall, horse stables, recreational facilities and hotel-quality sleeping quarters), a sanatorium and spa has become known internationally, and attracts tens of thousands of visitors per year. Economically, the salt mine is an important sustainable income source for the city and surrounding region.

Dalhalla Outdoor Concert Hall, Dalhalla, Sweden

Dalhalla (www.dalhalla.se) is considered to be one of the world's most beautiful and exotic outdoor arenas. It was rebuilt from an abandoned limestone quarry (Draggangama) to a musical stage with superb acoustics and impressive lighting effects. Mining created a natural amphitheatre, with dimensions of 400 m long, 175 m wide and 60 m deep. The first concert was held in 1993, and now people come in thousands to get the unique, magic experience from music and drama, combined with breathtaking nature.

Braga Municipal Stadium – Braga, Portugal

The stadium was carved off a quarry (Monte Castro) that overlooks the city of Braga. It was built in 2003 at a cost of 83.1 million Euros and seats over 30,000 people. The stadium is considered one of the most original stadiums in the world.

Hypoxic Mine Track Yanahara, Japan

An abandoned mine in the town of Yanahara has been converted in a running track to simulate high-altitude training. The characteristics of the mineshaft such as air tightness and the ability to maintain constant temperature and humidity levels throughout the year make this is an unique training facility. It also makes effective use of the industrial assets left behind in an abandoned mine.

CONCLUSIONS

The legacy of orphaned/abandoned mines, with their associated environmental liabilities, human health and safety concerns and the financial costs of clean up, is a serious issue facing Canada. Since its creation in 2002, NOAMI has addressed the problem across a number of fronts. Although much progress has been made, many challenges and opportunities exist for rehabilitation of orphaned/abandoned mines. NOAMI members are committed to working together to seek solutions to these issues.

REFERENCES

Cal Data Ltd. 2005. Capacity Building for a National Inventory of Orphaned/Abandoned Mines in Canada. Final report submitted to NOAMI. Posted at: www.abandoned-mines.org

Castrilli, J.F. 2002. Barriers to Collaboration: Orphaned/Abandoned Mines in Canada. Final report submitted to NOAMI. Posted at: www.abandoned-mines.org

Castrilli, J.F. and C.N. Watson and Associates, 2003. Potential Funding Approaches for Orphaned/Abandoned Mines in Canada. Final report submitted to NOAMI. Posted at: www.abandoned-mines.org

Castrilli, J.F. 2007. Report on the Legislative, Regulatory, and Policy Framework Respecting Collaboration, Liability and Funding Measures in relation to Orphaned/Abandoned, Contaminated, and Operating Mines in Canada. 2007. Final report submitted to NOAMI. Posted at: www.abandoned-mines.org

Cowan Minerals Ltd., 2006. Rehabilitating Abandoned Mines in Canada: A Toolkit of Funding Options. Final report submitted to NOAMI. Posted at: www.abandoned-mines.org

MEND 2.22.4a. 1999. Construction and Instrumentation of a Multi-layer Cover, Les Terrains Aurifères.

NOAMI. 2003a. Lessons Learned on Community Involvement in the Remediation of Orphaned and Abandoned Mines – Case Studies and Analysis. Posted at: www.abandoned-mines.org

NOAMI. 2003b. Best Practices in Community Involvement Pamphlet. Posted at: www.abandoned-mines.org

NOAMI. 2004. Guidelines for Legislative Review. Posted at: www.abandoned-mines.org

NOAMI. 2008. NOAMI Five-Year Performance Report 2002-2007. In progress.

Popielak, R.S. and Zieba, K. 2007. Medieval Salt Mine – A Modern Tourist Attraction with an Ancient History. In: Proceedings of the Second International Seminar on Mine Closure. Edited by: A. Fourie, M. Tibbet and J. Wiertz. Santiago, Chile. October 16-19. pp 869-877.

Tremblay, G. and C. Hogan. 2007. Experience of Canadian Partnership Programs – MEND and NOAMI. In: Proceedings of the Second International Seminar on Mine Closure. Edited by: A. Fourie, M. Tibbet and J. Wiertz. Santiago, Chile. October 16-19. pp. 43-52.