

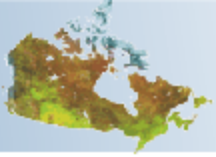
Strategy Themes and Outcomes - MEND and NOAMI

MEND Manitoba Workshop
June 4, 2008



Gilles Tremblay and Charlene Hogan
MEND, NOAMI and GARD Guide
Secretariats





Presentation Highlights

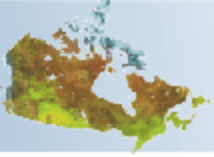
Consortia

MEND

- Background
- Work plan
- Global Alliance

NOAMI

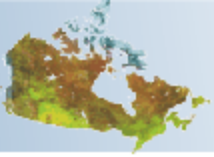




Current Trends in Canada

- Enlightened sustainable development policies
 - Mining recognized as a sustainable industry
 - Environmental problems can be prevented
 - No public \$
- New mining and waste technologies
- Site - specific solutions and criteria
- Recent legislation in Canada
 - Metal Mine Effluent Regulations
 - Provincial
- Cooperative problem solving
 - Consortia

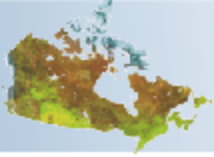




Consortia in Canada

- Co-operative initiative among industry, various levels of governments, non-governmental organizations and aboriginal Canadians
- Address issues of national importance
- Ensure that government policy is based on sound science
- Benefits
 - Open sharing for evaluation of technologies
 - Collaborative efforts result in a better perspective of the issues
 - Continuity
 - Avoids duplication

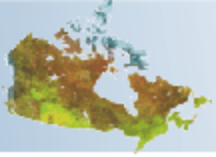




Mine Environment Neutral Drainage (MEND) Program

- The original MEND program (1989-1997) and its successors contributed enormously to understanding of acidic drainage and its prevention, and to increasing the transfer of knowledge to improve environmental management

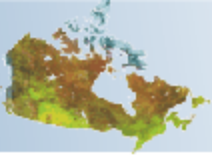




MEND Program

- 1989 – 2008
- Extensive national and international Network
- ~\$20M in 19 yrs
- Focused research work plan
- Technology transfer





MEND Steering Committee

Elizabeth Gardiner – Chair, MAC

Mike Aziz – Goldcorp

Kim Bellefontaine – Province of BC

Louis Bienvenu – Province of QC

Catherine Coumans - MiningWatch

Amy Crook – CSP2

Chris Doiron/Charles Dumaresq –
EC

Charlene Hogan – MEND
Secretariat, NRCan

Joe Fyfe - Xstrata

Bill Price - NRCan

Doina Priscu, Province of MB

Chris Hamblin – Province of ON

Wade Strogan – NA Tungsten

Gilles Tremblay – MEND
Secretariat, NRCan

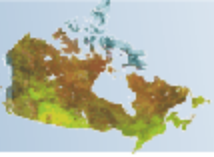
Maxine Wiber – BHP Billiton





Where metal leaching/acidic drainage is a concern, mining is usually not a temporary use of the land

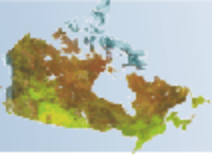




MEND Supported Technologies

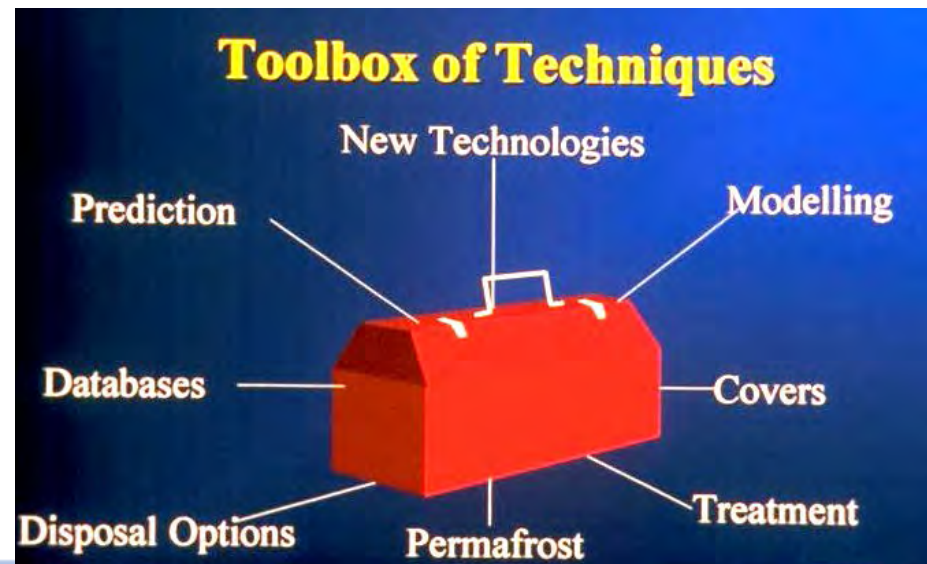
- Prediction techniques
- Water covers for unoxidized and partially oxidized wastes
- Dry covers using soils/tailings, organic materials and geomembranes
- Mine waste management options for tailings, waste rock and treatment sludges
- Active and passive treatment
- Cold climate issues (permafrost)

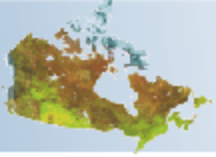




MEND Results

- Toolbox of methods to reduce environmental impacts of mining
 - Prevention best strategy
 - Increased understanding of acidic drainage (AD)
- Consensus building among government, industry and NGOs
- Recognition for Canada's leadership role in addressing AD for metal mines



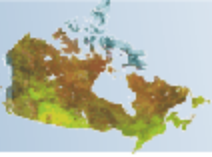


Current Work Plan

Addresses top ranking priorities identified by Canadian experts.

- Closure Management/Case Studies
- Verification of Technologies/Case Studies
- Metal Leaching - Neutral pH
- Passive Treatment
- Sludge Management
- Early Prediction
- Cold Temperature Effects
- Paste Backfill
- Guidance Documents/Manuals





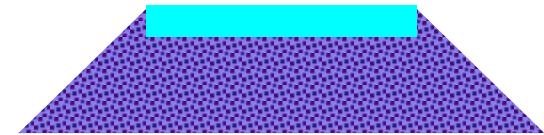
Closure Management

Cover Technologies

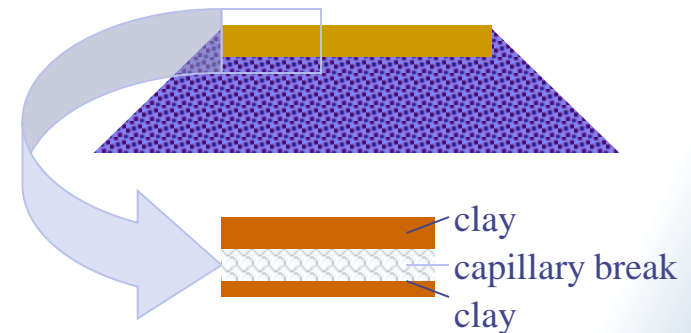
- Soil / Vegetation Cover
- Engineered Dry Covers
- Water Covers
 - Saturation (elevated water table)

Isolation of reactive mine waste

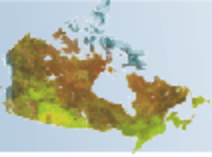
- Separation and segregation
- Backfilling (in-pit) and co-disposal
- Permafrost



Water covers



Dry covers



Engineered Dry Covers

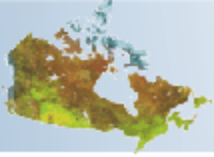
Objectives

- Control the ingress of oxygen
 - High saturation layer
 - Multilayer design
- Control water infiltration
 - Low permeability layer
 - Store and release of moisture

Types of Covers

- Soil/Tailings
- Organics
 - Wood waste, peat, municipal waste
 - Oxygen consuming barrier
 - Availability/economics site specific
 - Longevity
- Geomembranes





Engineered Dry Covers

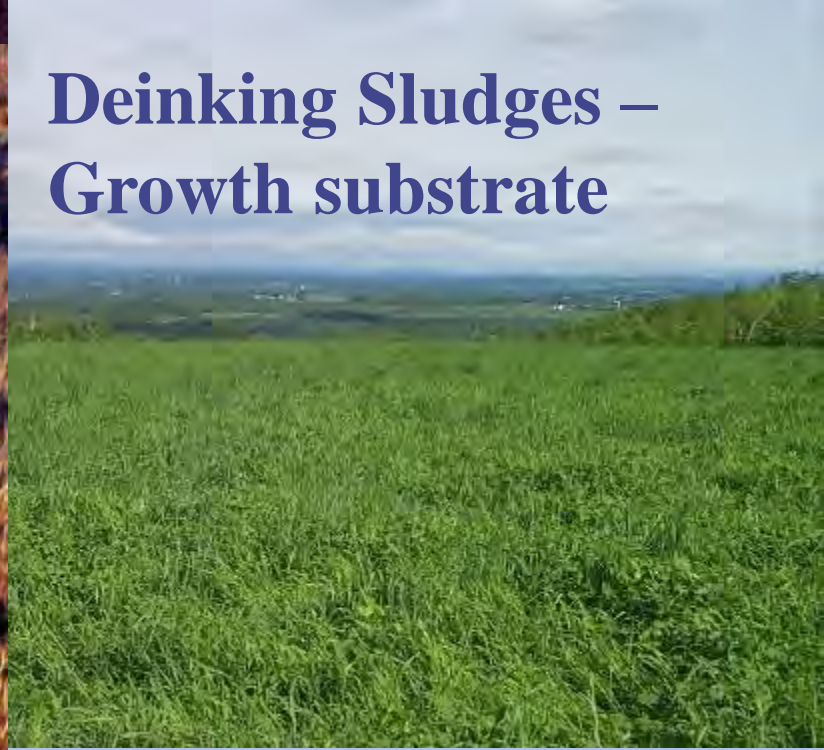


Equity Silver Mine, BC



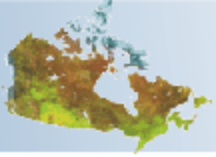


Albert Mine, QC



Deinking Sludges – Growth substrate





CANMET Mining and Mineral Sciences Laboratories



Poirier 1998 - 2001

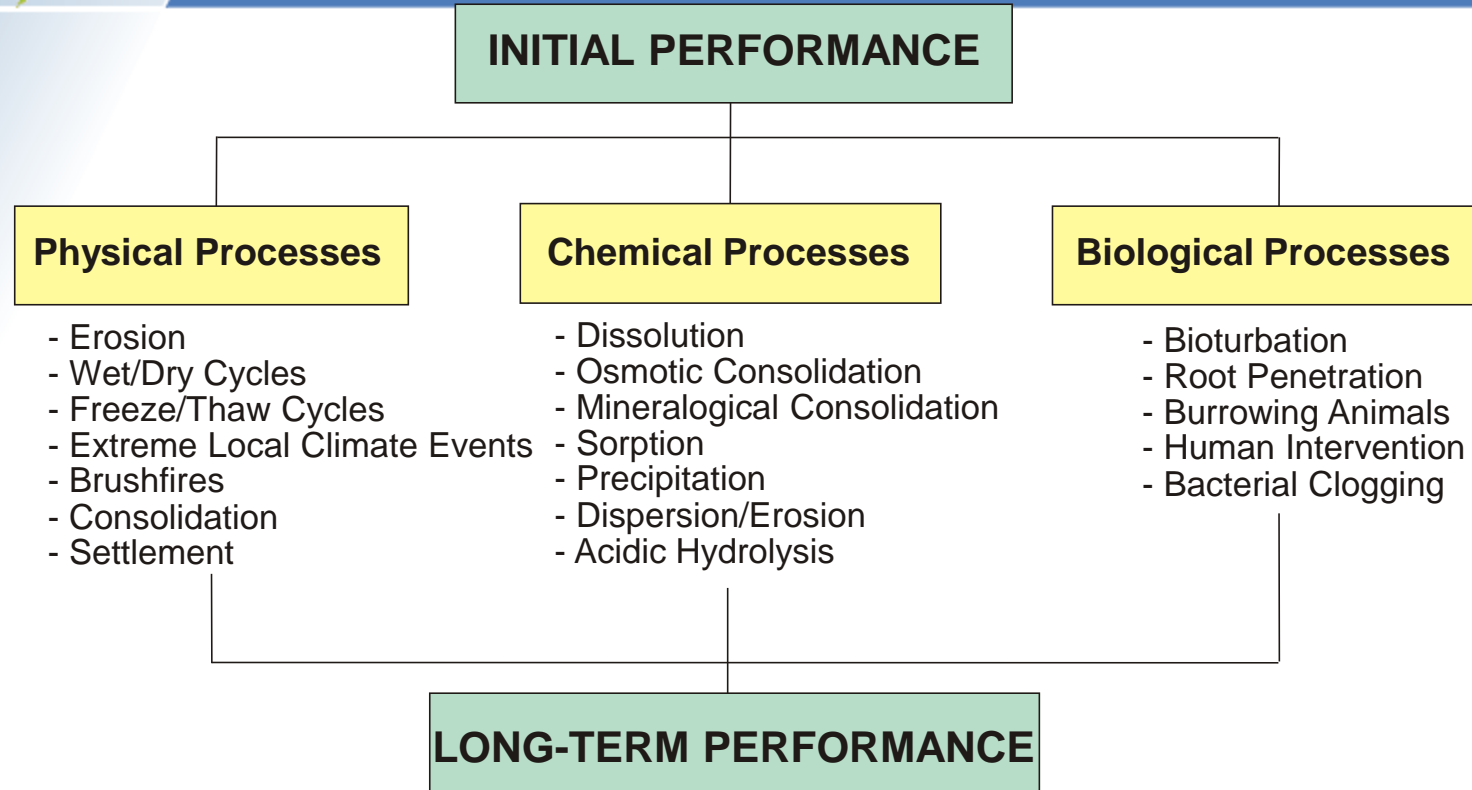
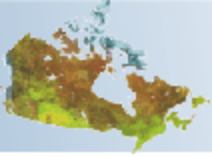
Unique solution using
existing liner technology



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Ressources naturelles
Canada

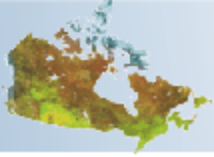
Canada



Resulting In:

- ***Change in Field Hydraulic Conductivity***
- ***Change in Moisture Retention Characteristics***
- ***Change in Oxygen Diffusion Characteristics***
- ***Change in Physical Integrity of Cover System***





Dry Cover Manuals

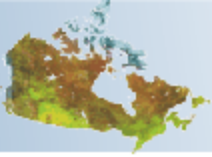
Dry Covers Manual (Micro-scale)

5-volume set available in hard copy or CD-ROM:

1. Summary
2. Theory and Background
3. Site Characterization, and Numerical Analyses of Cover Performance
4. Field Performance Monitoring, Sustainable Performance of Cover Systems
5. Case Studies

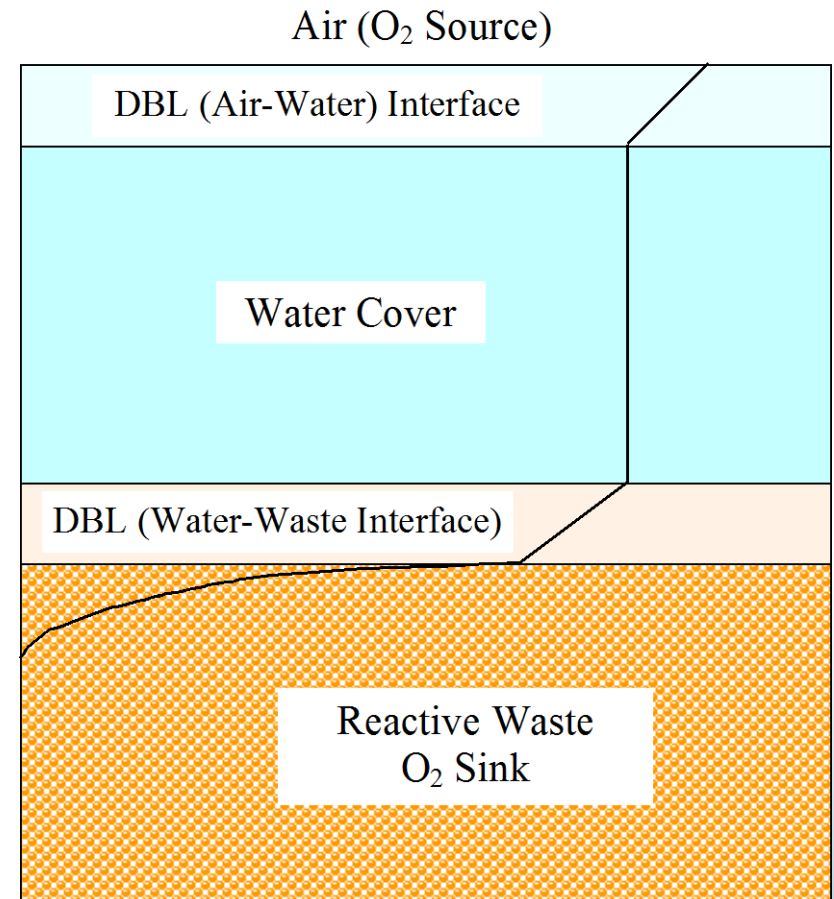
Macro-Scale Cover Design and Performance Monitoring Manual (MEND 2.21.5)

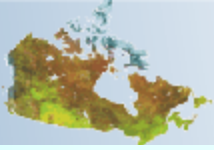




Water Covers

- Water covers - oxygen limiting
- Diffusion barrier to both oxygen in the water cover and contaminants in the submerged waste
- Development of Diffusion Barriers Layers (DBL) at the water-waste and water-air interfaces





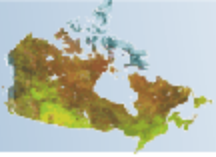
CANMET Mining and Mineral Sciences Laboratories



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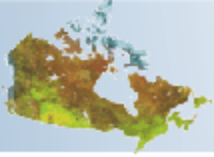
CANMET Mining and Mineral Sciences Laboratories



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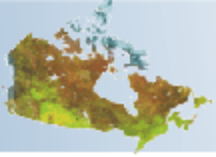
Canada 



Shallow Water Cover at Louvicourt

- 1994 – 2004
- 28% pyrite (average)
- 45% of tailings deposited in man-made tailings impoundment
- 4.7Mm³ capacity in pond
- Design for 1m cover





Louvicourt - Results

- Shallow water covers are effective
- Oxygen penetration typically less than 1cm
- Overall effect of periphyton biofilm positive

MEND 2.12.2 Long Term Performance of a Shallow Water Cover to Limit Oxidation of Reactive Tailings at Louvicourt



Solbec



FIND THE MINE



Panel

**Man-made
Impoundments –
Water covers**

Equity Silver



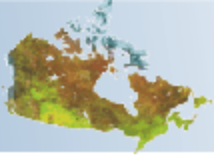
Heath Steele



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Mine Water Treatment Technologies

Chemical Treatment Technologies

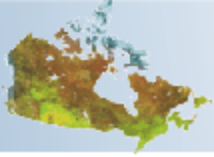
- Acidic Effluents
- Neutral Effluents
- As, Se and Mo Removal

MEND 3.42.3 Review of Disposal, Reprocessing and Reuse Options for Acidic Drainage Treatment Sludge

MEND 10.1 Review of Water Quality Issues in Neutral pH Drainage

MEND 10.1.1 Environmental Management Criteria for Se and Mo





Mine Water Treatment Technologies

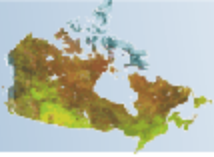
- Membrane Separation Technologies

Near completion....

MEND Report – Application of Membrane Separation Technologies for Mine Effluents

- Passive Treatment Technologies
 - Wetlands
 - Limestone Neutralization Channels
 - Permeable Reactive Barriers





Treatment Plant Survey

- Most sites employ some form of chemical treatment to address acidic drainage issues
- Currently there is no single, comprehensive database containing treatment and sludge management information for mine sites in Canada or worldwide
- MEND survey to address
 - Treatment processes, reagent/flocculant usage, solid/liquid separation
 - Sludge management practices, sludge production and metal leaching/monitoring data
 - Costing



CASE STUDIES



Sulphurets



Johnny Mountain Site in May



East Kemptville, BHP Billiton



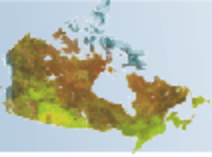
Mandy Lake, HBMS



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Case Studies and Post-Closure Management

List of Factors to Consider in ML/ARD Assessment and Mitigation (MEND 5.10E/F)

Case Studies in BC (MEND 9.1CD-ROM)

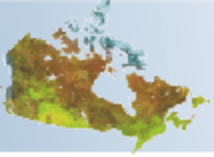
- Johnny Mountain Mine
- Snip Mine
- Sulphurets Mine

Near completion....

Case Study Assessment (SNC-Lavalin) CD

- Dona Lake, ON (Placer Dome)
- Heath Steele, NB (Falconbridge)
- Mandy Lake, MB (HBMS)
- East Kemptville (BHP Billiton)
- Mine Poirier (BHP Billiton)





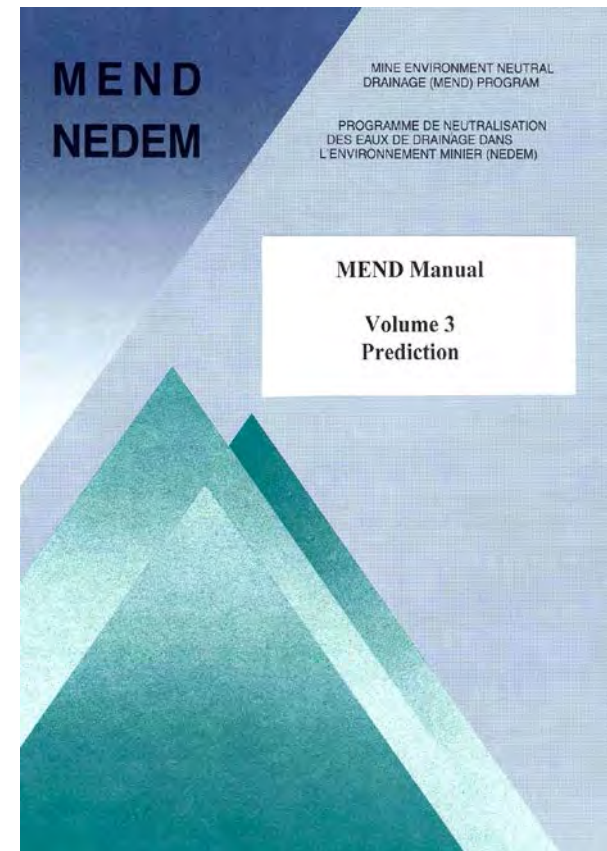
X-cutting - Guideline Documents

MEND Manual (MEND 5.4.2)

- Volume 1: Summary
- Volume 2: Sampling and Analyses
- Volume 3: Prediction
- Volume 4: Prevention and Control
- Volume 5: Treatment
- Volume 6: Monitoring

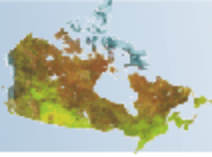
In Progress....

Prediction Manual - Update of the Draft “BC Prediction Manual” to be published as national document (NRCan)



Also available on CD





X-Cutting – Technology Transfer

The MEND Monitor Workshops (>30)

- Annual BC/MEND ARD/ML Workshops
 - 15th 2008: Tailings Management
- Sudbury (2004); Halifax 2006; Winnipeg 2008
- MEND Technology Transfer Workshops to Community Groups
- Symposium 2008 – Rouyn Noranda

MEND Website at: mend.nrcan.gc.ca

MEND Reports (>210)

MEND Manual

Global Alliance

- GARD Guide



June 2007

The MEND Monitor

The Mining Association of Canada (MAC)

The Mining Association of Canada (MAC) is the national organization of the Canadian mining industry. It comprises companies engaged in mineral exploration, mining, smelting, refining and semi-fabrication.

MAC's mission is to promote, through the collective action of its members, the growth and development of Canada's mining and mineral-processing industry, for the benefit of all Canadians. The Association works to promote the interests of the industry nationally and internationally, to work with governments on policies affecting minerals, to inform the public and to promote cooperation among members to solve common problems.

Canada is among the world's largest producers of minerals and metals. The industry contributes \$42 billion to Canada's annual gross domestic product and employs approximately 355,000 people in mineral extraction and in the value-added smelting, fabrication and manufacturing sectors.

MAC members understand that their license to operate must be earned through a demonstrated commitment to sustainable development. Accordingly, through the Association's Towards Sustainable Mining (TSM) initiative, MAC places a high priority on activities that promote excellence in environmental performance and protect employees, customers, communities of interest and the natural environment.

The Globe Foundation recently named MAC winner of 2005 Industry Association Award for Environmental Performance.

In many important ways, Canada is regarded as a global leader in collaborative environmental research and innovative approaches to best practices. Multi-stakeholder initiatives such as MEND, the National Orphaned/Abandoned Mines Initiative (NOAMI) and the Minerals and the Human Environment Research Network (MITHE-RN) are just a few of the programs in which MAC and its members are active participants.

For more information, please consult MAC's web site: www.mining.ca.

New! MEND Publications

MEND Report 1.61.5 - Update on Cold Temperature Effects on Geochemical Weathering: Effects of cold temperatures on mine wastes are examined, along with opportunities to mitigate mine drainage issues. Relevant case histories are reviewed and evaluated to better understand geochemical mechanisms - information gaps are discussed, and recommendations made for future work. Contractors: SPR Consulting/Hehling Environmental Management Inc.



13th BC MEND MLARD Workshop Proceedings The workshop was held November 29-30, 2006 in Vancouver. The focus of the presentations was on the challenges with open pits and underground workings. CD-ROM of the Proceedings can be ordered at: www.lbaon.ca or jacobk@lbaon.ca

Upcoming Events

31st British Columbia Mine Reclamation Symposium, September 17-20, 2007, Squamish, BC. The theme is Rejuvenation through Reclamation and Operating for Closure. The symposium will include a full day tour of the Britannia Mine. Visit www.brc.bc.ca for additional information on the technical program, fieldtrip and registration.

Sudbury 2007 Mining and the Environment Conference, October 23-27, 2007, Sudbury, ON. The conference will address mine rehabilitation and environmental protection issues with a focus on sustainability. (www.sudbury2007.ca)

14th BC MEND Workshop, November 29-30, 2007, Vancouver, BC. To be held in conjunction with the International Mine Water Association. This year's theme is Challenges in Collection and Treatment of Mine Drainage.

Symposium on Water, Air and Land: Sustainability Issues in Mineral and Metal Extraction, August 24-27, 2005, Winnipeg, MB. For additional information, visit www.mefco.com/con2005

To obtain information on MEND or its publications, please visit the web site at: <http://mend.nrcan.gc.ca> or send an e-mail to: mend_tecem@nrcan.gc.ca





SYMPOSIUM 2008 • ROUYN-NORANDA SUR L'ENVIRONNEMENT ET LES MINES MINES AND THE ENVIRONNEMENT

*DU 2 AU 5 NOVEMBRE 2008
NOVEMBER 2ND TO 5TH 2008*

Sunday, November 2: Short course

Monday and Tuesday, November 3 and 4: Technical program

- Tailings
- Backfill
- Waste Rocks
- Policies and Regulations in Mining in Society
- Contaminated Water
- Site Restoration
- New Trends

Tuesday, November 4: Plenary

Wednesday, November 5: Sites visit

Ressources naturelles
et Faune
Québec



Association minière du Québec



NEDEM - MEND



Chaire CRSNG Polytechnique – UQAT
en environnement et gestion des rejets miniers



URSTM

Unité de recherche et de service
en technologie minérale
de l'Abitibi-Témiscamingue



Info : http://www.cim.org/rouyn-noranda2008/index_B.cfm



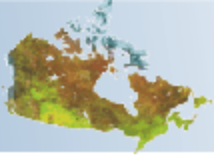
Université du Québec
en Abitibi-Témiscamingue



Natural Resources
Canada

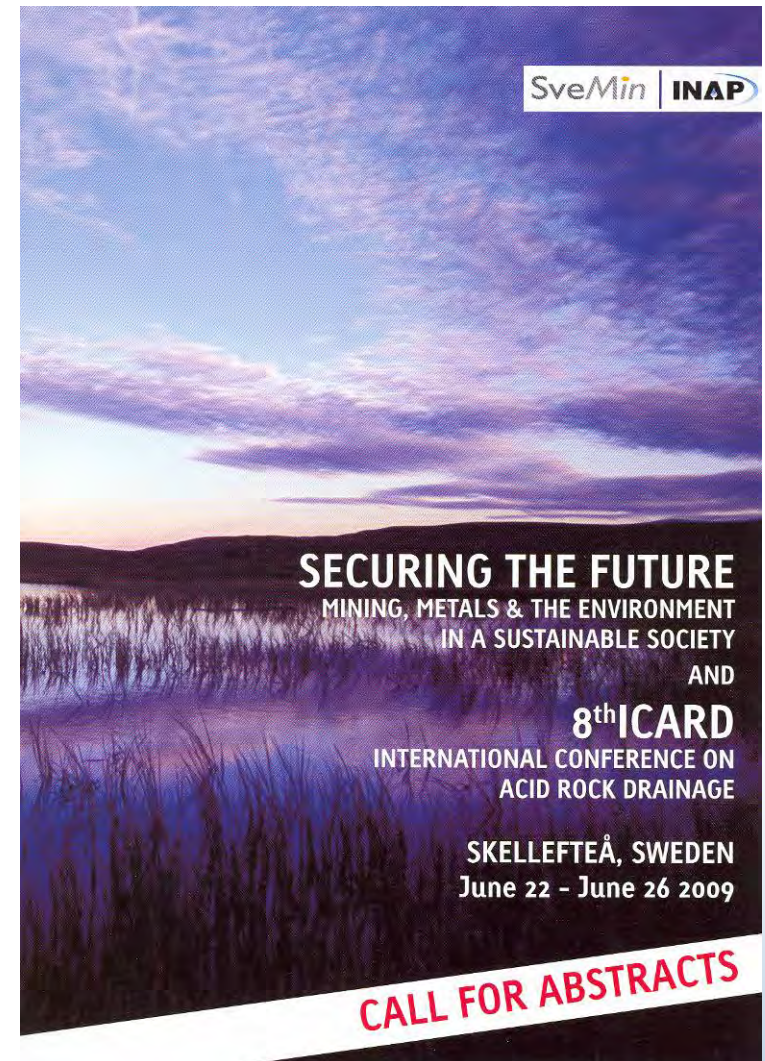
Ressources naturelles
Canada

Canada



8th International Conference on Acid Rock Drainage

Skellefteå, Sweden
June 22-26, 2009



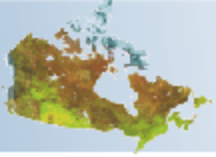
Abandoned Mines in Canada



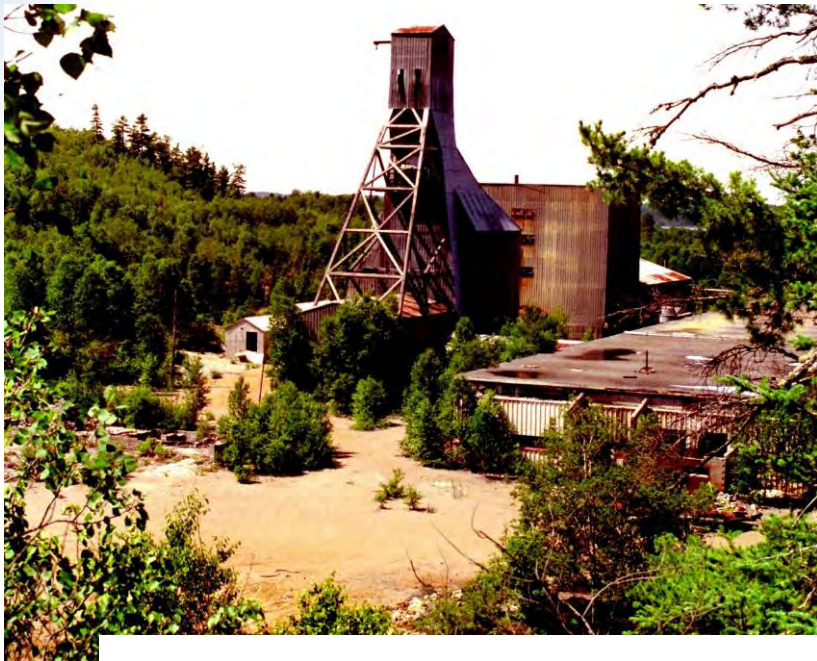
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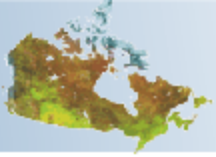


National Orphaned / Abandoned Mines Initiative - (NOAMI)



North Coldstream Mine - Burchell Lake, ON

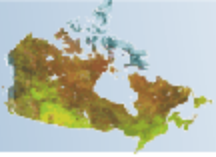




- Multistakeholder partnership
- Five task groups overseeing prioritized projects:
 - Information Gathering (Inventory)
 - Community Involvement
 - Barriers to Collaboration
 - Funding Approaches
 - Jurisdictional Legislative Review

www.abandoned-mines.org



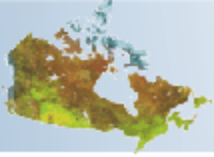


National Inventory



www.abandoned-mines-inventory.org

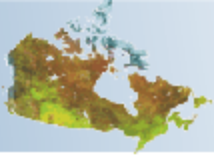




NOAMI Highlights

- **Workshop on Assessing Liabilities and Funding Options held (Ottawa, November, 2005)**
- **Report on Capacity Building for a National Inventory**
 - **Review of Canadian and international inventories**
- **Report on case studies examining issues related to community involvement and publication of guidelines (pamphlet) for meaningful community engagement**
- **Report, workshop and summary recommendations on legislative and institutional barriers to voluntary remediation**
- **Report and summary recommendations on funding approaches for orphaned/abandoned mines**





NOAMI Highlights 2006/07

- Workshop to Explore Best Practices held (Winnipeg, October, 2006). CD-ROM available.
- A Toolkit of Funding Options Report
- CD-ROM of report on the legislative, regulatory, and policy framework for all jurisdictions in Canada

Proceedings of the NOAMI Workshop

Winnipeg, Manitoba
October 26 & 27, 2006



Orphaned and Abandoned Mines:
A Workshop to Explore Best Practices

Release Date:
March 2007



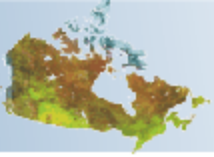
Jurisdictional Legislative Review



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

Release Date:
November 2007

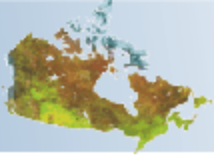




Looking Forward - NOAMI

- Six-year performance report underway
- A Workshop to Explore Perspectives on Risk Assessment (by invitation)
- Community “Pilot Project”
- Jurisdictional Legislative Review Toolkit





Mine Environment Neutral Drainage
(MEND)
mend.nrcan.gc.ca

National Orphaned/ Abandoned
Mines Initiative (NOAMI)
www.abandoned-mines.org

