



MEND Update - 2018

Patrick Chevalier and Charlene Hogan

MEND Secretariat

INAP Meeting

27 November, 2018

Mine Environment Neutral Drainage Program

- ▶ Established in 1989 (nearly 30 years old)
- ▶ National multi-stakeholder network
- ▶ ~\$21 million
- ▶ Annual research budget:
 - ▶ \$60 to 100K/year
- ▶ CanmetMINING provides Secretariat



MEND Study - In Progress



In-situ Application of In-pit Treatment for Water Management at Closed Mine Sites: Literature Review and Field Trial

- Contractor: EcoMetrix
- Research Partners: Goldcorp, McEwen Mining and Envirobay
- In-pit treatment of metals has been used at several mines in Canada
 - Highland Valley Copper, BC
 - Selbaie, Quebec
- Removal of arsenic with ferric sulphate has not yet been applied in situ
- Batch treatment of arsenic and other constituents in an open pit may represent a low-cost alternative to conventional treatment.

In-Pit Treatment



- Study underway at the Nighthawk Pit, ON
 - Volume: 100,000 m³
 - 0.6 mg/L As
- Bench-Scale studies are completed
 - Provided treatment efficiencies, reagent dosage
 - 20:1 molar ratio (Fe:As) to reduce As to 0.05 mg/L



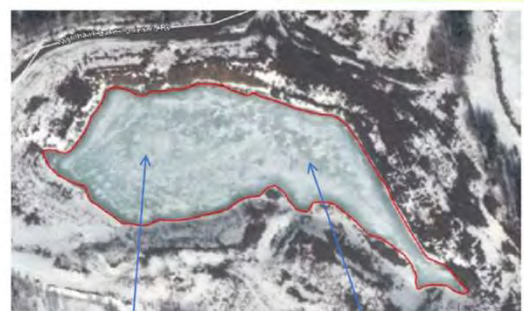
In-Pit Treatment *Field Trial*

- Field study completed mid-November
- Two water cannons used to apply dosage of ferric sulphate
- 10% of the pit volume was recirculated while applying a 20:1 dosage of ferric sulphate in the recirculated water.
- This approach required less time and smaller process equipment that will translate overall to less capital and operating costs when scaled to larger pits.



In-Pit Treatment *Next Steps*

- Waiting on laboratory results post-treatment
- Ongoing monitoring campaign
 - Goldcorp to sample profiles within the pit quarterly (2 Locations)
 - Will help to ascertain performance and batch frequency required based on the ongoing loadings to the pit.
- Sludge stability test work suggested as part of this follow-up as the treatment solids settle.



NHP2
(max depth 23 m)
(48°29'46.3"/80°58'05.6")
S (0.5 m)
M (10 m)
D (22 m)

NHP1
(max depth 18 m)
(48°29'46.4"/80°58'01.8")
S (0.5 m)
M (10 m)
D (17 m)

MEND - Completed Project



How to Assess Potential Biological Effects of Subaqueous Disposal of Mine Tailings: Literature Review and Recommended Tools and Methodologies (MEND 2.19.1)

Authors: Dr. Peter Campbell, Institut national de la recherche scientifique
Dr. W.A. Price, CanmetMINING, NRCan

Report provides update on previous literature reviews on biological aspects of SAD
▶ MEND 2.12.1a (1993) and MEND 2.11.2b (2009)

Information provided on:

- ▶ potential diagenetic changes in submerged tailings
- ▶ biogeochemical interactions between submerged tailings and overlying aquatic communities
- ▶ guidance regarding recommended tools and methodologies that could be used to predict and/or monitor the biological effects of submerged tailings.
- ▶ Now Available on the MEND website

MEND Report 2.19.1: Potential Biological Effects of SAD



Background:

- ▶ Most studies have focused on the initial physical and geochemical performance of SAD facilities and the resulting chemistry of the surface water.
- ▶ Longer-term aspects are not well known
 - i.e. progressive addition of natural organic matter on top of tailings
- ▶ Major gaps
 - biological colonization of these facilities,
 - health of the established biological communities
 - influence of those communities on water and sediment geochemistry.

Elements considered in review

- ▶ Cationic trace elements
 - ▶ Cd, Cu, Pb, Ni, Zn
 - ▶ Data-rich
 - ▶ Covered in previous reports
- ▶ Trace elements that form oxyanions and neutral polyhydroxy species:
 - ▶ As, Mo, Sb, Se
 - ▶ Not considered in previous reports

9

Approach

Studies on natural water bodies with elevated metal concentrations examined to understand behaviour of SAD facilities.

- ▶ Consider how **waterborne** and **diet-borne** metals interact with living organisms.
- ▶ Propose how to assess metal bioavailability in sediments and in submerged tailings.

10

How to assess metal “bioavailability”

- ▶ Geochemical approach
 - ▶ measure or calculate the free metal ion concentration in overlying water and submerged tailings
 - ▶ apply Biotic Ligand Model
- ▶ Biomonitoring approach
 - ▶ passive biomonitoring (compare indigenous fauna and flora with reference specimens)
 - ▶ active biomonitoring (introduce ‘naïve’ plants and animals into SAD facility and monitor their performance)



Biomonitors - Examples of Selection Criteria

Criterion	Explanation
associated with sediments	(none needed!)
limited home range (sedentary)	bioaccumulated metal related to a specific location
widespread (cosmopolitan)	ease of comparison of the biomonitor species among different sites
abundant (not threatened species)	sample collection will not affect species abundance
metal-tolerant	biomonitor species must be present in metal-rich environments or survive when introduced there

Examples of biomonitors

Type	Species	Metals
Benthic invertebrates	<i>Pyganodon grandis</i>	Cd, Cu, Ni, Pb, Zn
	<i>Physa gyrina</i>	Cu, Ni, Pb
	<i>Chaoborus sp.</i>	Cd, Ni, Se
	<i>Hexagenia limbata</i>	Cd, Hg
	<i>Hyalella sp.</i>	As, Cu, Ni, Sb, Se, ...
Benthic feeding fish	<i>Perca flavescens</i>	Cd, Cu, Ni
	<i>Catostomus commersonni</i>	Cd, Cu, Hg, Se
Rooted aquatic plants	<i>Nuphar variegatum</i>	Cu, Zn
	<i>Vallisneria americana</i>	Cd, Cu, Ni, Pb, Zn
Periphyton	-	Cd, Cu, Mn, Ni, Pb, Zn

13

Recommendations (1)

- ▶ Coordinated geochemical and biological measurements; phased approach
- ▶ Standardized methodologies (cf. AETE)
- ▶ Field trails for methods recommended for use in SAD facilities
- ▶ Focus on approaches that will yield estimates of free metal ion concentrations
- ▶ In the tailings, focus on upper strata (contact zone with benthic fauna and flora)
- ▶ Measure pore-water composition at different depths (fluxes across interface; biogeochemical processes governing contaminant mobility)

14

Recommendations (2)

- ▶ Within tailings, measure solid phases exerting geochemical controls on pore-water metal/oxyanion concentrations, and pH.
- ▶ Biomonitoring focus on plants and animals (i) in direct contact with the bottom sediments/tailings and (ii) for which there are already some biomonitoring data (in Canada)
- ▶ When feasible (e.g., in multicellular biomonitor organisms), focus on specific organs or tissues (e.g., liver, gills, gonads; roots, stems, leaves) rather than on the whole biomonitor organism

15

MEND - Future Work - Field Study

- ▶ Ecology of Subaqueous Tailings Storage Facility at Louvicourt
- ▶ Campbell & Price report to provide guidance on methodologies and tools to be used to assess biological effects of submerged tailings

Ecology of Subaqueous Tailings Storage Facility at Louvicourt



Field Study: To increase understanding of natural colonization of TSF

- Assess diversity and productivity of established flora and fauna
- Examine relationship between these communities and the sediment/water chemistry

Two stages:

1. Reconnaissance study to establish existence of vegetative growth and its spatial extent
2. Field study



Ecology of Subaqueous Tailings Storage Facility at Louvicourt



Reconnaissance Study (Spring 2019)

- Surface area TSF, 0.9 km²
- Bathymetric study
- Extent of coverage by submerged and emergent aquatic vegetation
- Identification of aquatic plants
- Document other relevant flora and fauna

Go or No-Go Decision (Spring 2019)

Field Study (Summer-Fall-Winter 2019/2020)

BC-MEND ML/ARD Workshop Proceedings



www.bc-mlard.ca

25th BC-MEND Workshop Proceeding to be posted in Spring 2019

BC MEND ML/ARD ANNUAL WORKSHOP

About / Workshop Proceedings / Upcoming Workshop / Other Workshops / Contact / Links

Workshop Proceedings

Our online database of workshop proceedings allows access to every presentation delivered at BC MEND ML/ARD workshops since our first workshop in 1995. You can browse by year or use the search functions to find the presentation you are looking for.

Equity Mine, photo courtesy of M.Azz

Canadian Green Mining Innovation Network

Developed to

- ▶ Improve organization and communication
- ▶ Optimize available resources
- ▶ Build a culture of innovation

<https://ami-aim.ca>

MEND now part of this digital network

ami

Canadian Green Mining Innovation Network

- ✓ Improving organization & communication
- ✓ Optimizing available resources
- ✓ Building a culture of Innovation

SEARCH ORGANIZATIONS JOIN THE NETWORK WHO WE ARE GET IN TOUCH


News

COREM and CDEM sign a Cooperation agreement
Dr. Magdi Habib, Director General of Gemmetek and Mr. Francis Fourrier, P

Follow us on Twitter

Tweets by @aimnetwork

Shane Bevan (@shanebevan) had a great time participating in the Mines Ministers of the Americas annual Conference at #Mines2018. & look forward to working



Mine Environment Neutral Drainage (MEND) Program

[Back to search results](#)

Areas of expertise

- Verification of fullscale mitigation technologies
- Mine closure management
- Early prediction and modeling
- Neutral and alkaline pH drainage
- Sludge management
- Passive treatment
- Cold temperature effects & climate change
- Monitoring
- Technology transfer and case studies

Key Projects, Programs and initiatives

Cold temperature effects & climate change Active

With the large number of mines opening in Northern Canada, the effect of cold temperature on various technologies is of increasing importance. The report *Cold Region Cover System Design Technical Guidance Document (MEND 1.81.5c, 2012)* outlines the current state-of-knowledge of soil cover system design in cold regions, best practices on how a cover system design should be conducted, and a summary of information that should be provided during the design process.

A high-level risk analysis on the risks that climate change poses to mining operations is provided in *Critical Change and Risk Linkages – Risk for the Canadian Mining Sector (MEND 1.81.7, 2011)*. Climate change risks related to acidic drainage arise from the impacts of a changing climate on water-management structures and activities, on waste-impoundment structures, and on the hydrologic / hydrogeologic conditions affecting the flow of water and contaminants at mine sites. The assessment examines the impacts for specific infrastructure elements and determines which are most probable and significant for mining operations and for society.

[Show Details](#)

Best management practices Active

The study to identify *BATEA (Best Management and Control of Effluent Quality from Mines) (MEND 2.50.1, 2014)* identified the best available technologies economically achievable (BATEA) to manage and control effluent from metal, uranium, and coal mines in Canada. Effluent management and treatment technologies employed at mine operations were described, and then screened against a set of criteria for consideration as BATEA.

Organization type

Multi-stakeholder partnership

48°24'08.77" N 75°42'21.81" W
View map

Address

355 Booth Street
Ottawa, ON, K1A 0G1

<http://mend-nedem.org>
patrick.chevalier@canada.ca

Primary contacts

Patrick Chevalier and Charlene Hogan
(MEND Secretariat)

Comparable Organizations

- Research Institute on Mines and the Environment (IRMI/IRBEE/UCAT - Polytechnique)
- Yukon Regeneration Centre - Yukon Bridge
- Hazards Assessment and Operations Branch - Large and Mining Sector, NRCCan

For more Information

- ▶ To download reports, newsletters, or workshop proceedings please visit:

Mine Environment Neutral Drainage (MEND)
www.mend-nedem.org

Contacts: MEND Secretariat
Patrick Chevalier
Patrick.Chevalier@canada.ca
613-992-4105

Charlene Hogan
Charlene.Hogan@canada.ca
613-996-7855