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# Review of Acid Rock Drainage & Metal Leaching in support of mine waste management

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CanmetMINING, Natural Resources Canada

Joint Review Panel Hearing for the Marathon PGM project

March 18<sup>th</sup>, 2022

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# Outline

- Mandate of CanmetMINING
- Description of acid rock drainage and metal leaching (ARD/ML)
- Current practice in ARD/ML predictions
- Role of ARD/ML predictions in water and mine waste management
- Main findings and recommendations



# Mandate of CanmetMINING

- Develop mining innovations to achieve sustainability across Canada
- Develop mine waste management strategies to limit impact of Acid Rock Drainage and Neutral Metal Leaching
- Develop mining effluent treatment technologies to improve best available treatment technologies economically achievable (BATEA) in Canada.

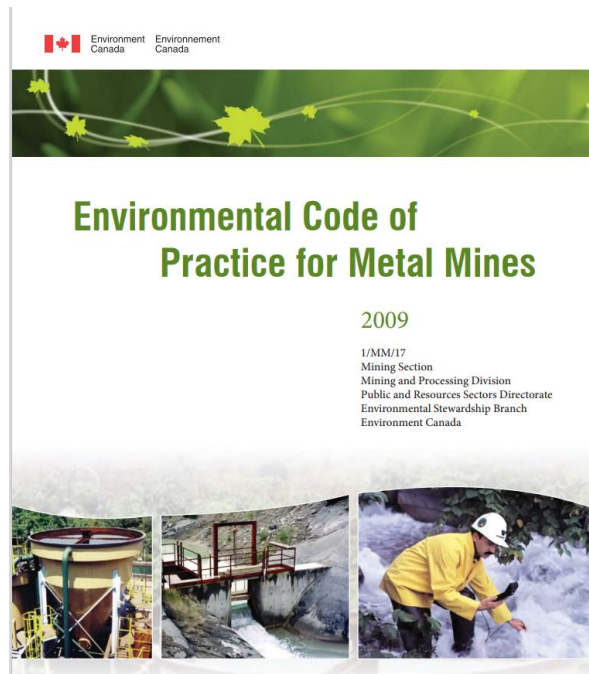


# Mine waste management guidance



## Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials

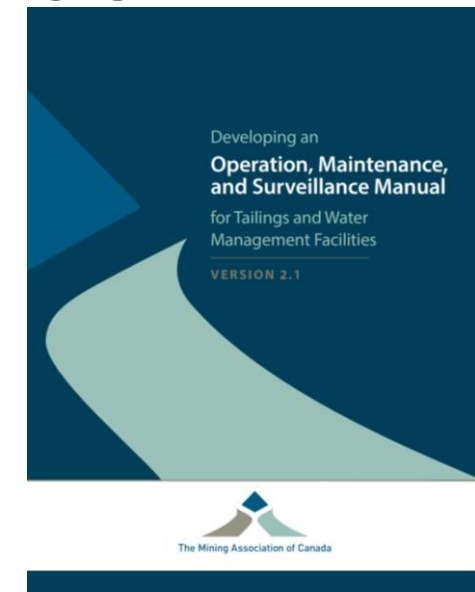
MEND Report 1.20.1



## Environmental Code of Practice for Metal Mines

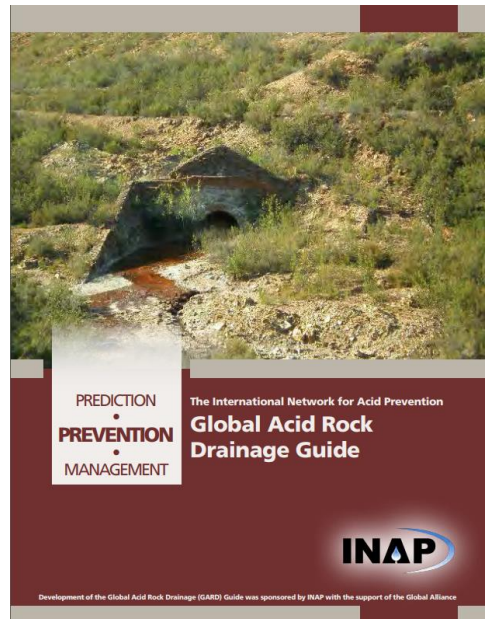
2009

1/MM/17  
Mining Section  
Mining and Processing Division  
Public and Resources Sectors Directorate  
Environmental Stewardship Branch  
Environment Canada



## Developing an Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities

VERSION 2.1

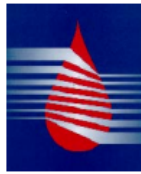


PREDICTION  
•  
PREVENTION  
•  
MANAGEMENT

The International Network for Acid Prevention  
**Global Acid Rock Drainage Guide**



Development of the Global Acid Rock Drainage (GARD) Guide was sponsored by INAP with the support of the Global Alliance



## Study to Identify BATEA for the Management and Control of Effluent Quality from Mines

MEND Report 3.50.1



### Guidelines for the assessment of alternatives for mine waste disposal

#### Disclaimer

For all purposes of interpreting and applying the law, users should consult:

- the [Acts as passed by Parliament](#), which are published in the "Assented to" Acts service, [Part III of the Canada Gazette](#) and the annual Statutes of Canada, and
- the regulations, as registered by the Clerk of the Privy Council and published in [Part II of the Canada Gazette](#).

The above-mentioned publications are available in most public libraries. Official versions of the Statutes and regulations can also be found at the Department of Justice [website](#). The law as stated in the above-mentioned publications will prevail should any inconsistencies be found in these guidelines.



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# Acid Rock Drainage (ARD)/ Metal Leaching (ML)

Pyrite + Oxygen + Water → Acid + Metals + Sulphate

Can impact water and sediment quality and be toxic to aquatic life

- *Environmental impact of these reactions depends upon exposure of mine waste to oxygen and water, and balance of acid and buffering minerals*
- *However, measures exist to limit impacts to aquatic life (i.e. placement of waste rock under water, etc...)*



Pyrite (left); Calcite (right)  
photos from mindat.org



# Geochemical Characterization to Assess ARD/ML Potential

Photos from MEND 1.20.1 and GARD guide



## 1. Sampling Program

- Mine rock, pit walls
- Process waste
- Representativeness

## 2. Analytical Program

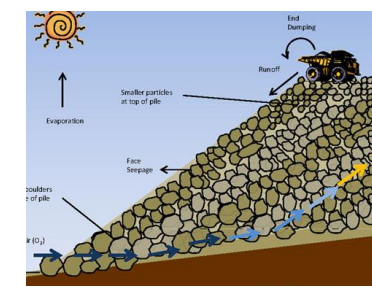
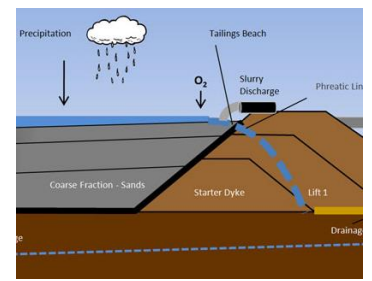
- Static tests (potential)
- Kinetic tests (timing, chemical load)

## 3. Waste Management Planning

- Mine plan / sequencing
- Operational testing / segregation
- Closure plan

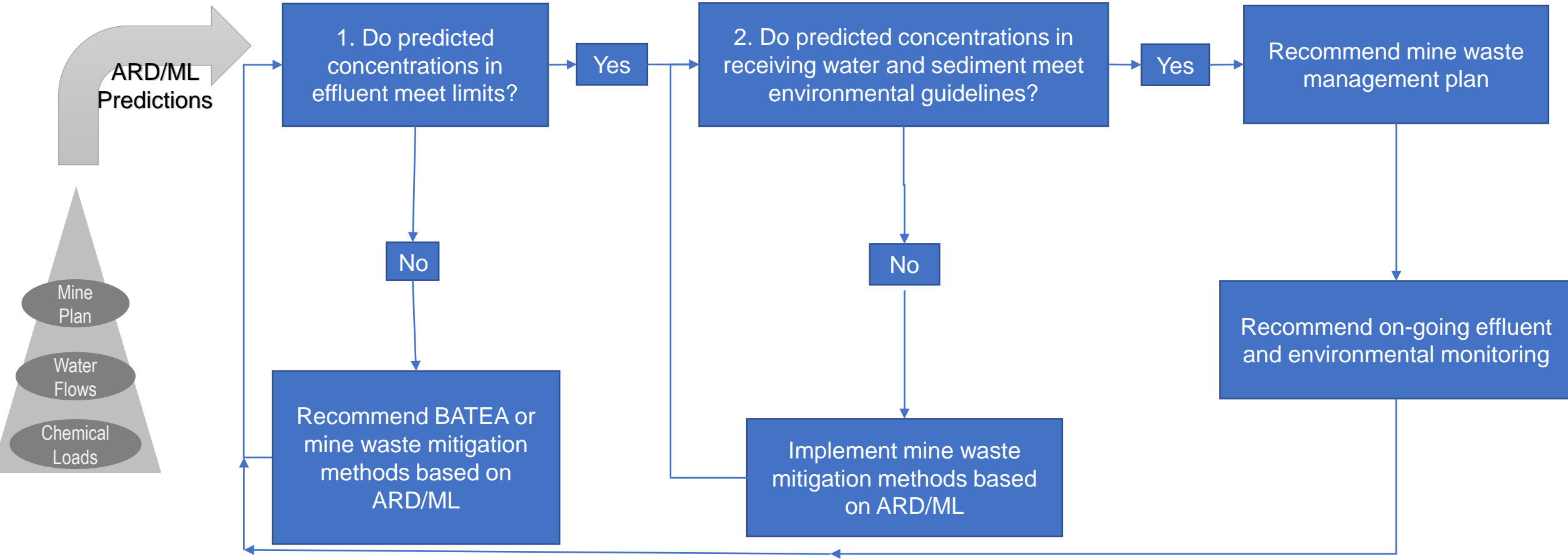
**Iterative Process**  
Address Data Gaps and Refine Management Plans

**Mine Water Quality Estimates**  
Chemistry + water flows + mine plan



# ARD/ML predictions and waste management recommendations

*Recommendations based on consultation with federal departments (i.e., ECCC, DFO, HC) and federal and provincial regulators (i.e., MECP, ECCC)*



# Main findings: Type 1 Rock Metal Leaching

## Findings

- Type 1 mine rock will be used for construction or stored in Mine Rock Storage Area (MRSA)
- Testing demonstrates some potential for neutral mine drainage
- Follow-up testing is proposed using run-of-mine rock in early operations

## Recommendations

- Evaluation of neutral leaching potential in the Mine Rock Segregation Program
- Follow-up monitoring and mitigation in the event that neutral mine drainage develop in MRSA

➤ *Could lead to local effects to groundwater quality and the aquatic environment if drainage is not appropriately captured*



# Main findings: Type 2 Mine Rock Volumes

## Findings

- Spatial gaps in mine rock sample distribution in all pits
- Potential for underestimation of Type 2 mine rock volumes

## Recommendations

- Mine Rock Segregation Program should include on-going:
  - testing to address data gaps
  - refinement of volume estimates
- Ensure adequate operational monitoring and adaptive management strategies are in place

➤ *Could lead to effects to groundwater quality and aquatic habitat if there is inadequate management of Type 2 rock*



# Main findings: Type 2 Mine Rock in MRSA

## Findings

- Imperfect segregation of Type 2 rock could result in its placement in MRSA
- Not considered as sensitivity analysis in water quality estimates

## Recommendations

- Complete water quality estimates considering Type 2 mine rock in MRSA for operations through post-closure
- Ensure adequate water treatment, mitigation, and monitoring measures are in place for operations through post-closure

➤ *Could have implications on seepage and runoff quality in operations, closure and post-closure that affects aquatic habitat*



# Main findings: Pit Lake Water Quality

## Findings

- Pit lake water quality estimates consider complete submergence of pit walls and backfilled Type 2 waste prior to acidification
- Faster reacting minerals present in the deposit could result in a shorter time to acidification than currently estimated

## Recommendations

- Complete additional kinetic testing of Type 2 mine rock to refine estimates of timing to acidification
- Update the water quality estimates with acidic loading rates and timing estimates

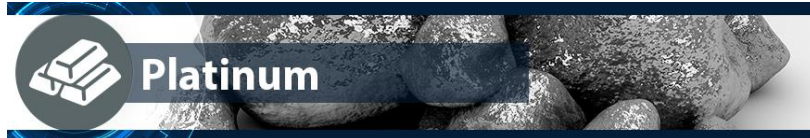
➤ *Overestimation of timing to potential ARD/ML could result in acidification prior to scheduled management and mitigation strategies*



# Main findings: Platinum Group Metals (PGMs)

## Findings

- PGMs are not of concern as there are no environmental quality guidelines
- Recent science suggest PGMs, are more soluble and toxic to aquatic life



## Recommendations

- Provide preliminary predictions of PGMs in effluent and receiving environment using exploration drill core data
- During construction, conduct additional testing to verify predictions of PGM release rates, their levels in effluent and the environment
- Use predictions or water quality criteria as compliance measures during environmental monitoring and adapt effluent and mine waste management if necessary

➤ *Ignoring PGMs could prevent the implementation of economically feasible effluent and waste management strategies and lead to effects to aquatic life*



# Conclusion

CanmetMINING is satisfied with the proposed mine waste management program but recommend that Marathon PGM:

- Continue refining its Segregation of Type 1 and 2 waste
- Continue refining the timing to acidification of Type 2 waste
- Update MRSA and pit lake water quality estimates considering acidification of Type 2 mine rock
- Provide estimate of PGMs release
- Adjust mitigation measures as appropriate

➤ *Overlooking these recommendations could lead to preventable effects to aquatic life*



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