Risk and Regulation in the Mining Industry

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Understanding the Impacts of Mining in the Western Lake Superior region (Minnesota, Wisconsin, and Michigan)
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Mining and Civilization

- Stone Age
- Bronze Age
- Iron Age
- Nuclear Age
- Age of Silicon
- Age of Rare Earth's?
Outline

• Mining Risk

• Environmental Regulation of Mining

• Mining Environmental Risk Assessment

• Example
Mining is a Risky Business

Magnitude of loss x Probability of loss = Risk
**Risk Assessment**

- What can go wrong?
- What is the likelihood that it would go wrong?
- What are the consequences?

**Risk Management**

- What can be done and what options are available?
- What are the associated tradeoffs in terms of all costs, benefits, and risks?
- What are the impacts of current management decisions on future options?

## Water Issues at Different Mining Stages

<table>
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<th>Stage</th>
<th>Potential Issues</th>
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| **Exploration/ Construction** (surveying, drilling, trench blasting, road construction) | • Sediment runoff, increased suspended sediment load to surface waters  
  • Spills of fuels and other contaminants |
| **Operation - Mining** (blasting, ore stockpiling, waste piling) | • Chemical contamination of surface and ground waters  
  • Toxicity impacts to organisms (terrestrial and aquatic plants and animals)  
  • Altered landscapes from mine workings (e.g., open pits, changes in stream morphology)  
  • Increased erosion and siltation  
  • Altered patterns of drainage and runoff  
  • Water consumption: dust suppression, mine camps, evaporative losses from clean water storage dams, water used to cool equipment  
  • Decreased groundwater resources due to dewatering pits  
  • Reliance on power from water-dependent sources (hydro and thermal) |
| **Processing** (smelting, refining) | • Discharge of chemicals and other wastes to surface and ground waters.  
  • Water consumption: water used in mineral separation and beneficitation.  
  • Reliance on power from water-dependent sources (hydro and thermal) |
| **Mine-Closure/Post-Closure** ( revegetation, fencing, monitoring, long-term water treatment) | • Persistent contaminants in surface and ground waters  
  • Expensive, long-term water treatment  
  • Persistent toxicity to organisms  
  • Permanent landscape changes |

Adapted from Miranda et al. 2003, Mining and Critical Ecosystems: Mapping the Risks. and Miranda et al. 2010 “Mine the Gap: Connecting Water Risks and Disclosure in the Mining Sector. World Resources Institute, Washington, DC
Mining Company’s Perspective on Risk

**Physical:**
- Production losses = Lost Revenues
- Lower mineral recovery = Lower Margins
- Degraded mineral quality = Lower Margins/Supply Chain
- Conflicts with communities = Disruption

**Regulatory & Legal:**
- Operating costs = Lower Margins
- Capital expenditures = Reduced Cash Flow
- Production losses = Lost Revenues
- Mine shut-downs = Lost Revenues/Value Destruction
- Closure liabilities = Valuation

**Reputational:**
- Operation disruptions = Lost Revenues
- Lost access to future reserves = Value Destruction
- Access to Capital = Cost of Capital
Another Mining Company Perspective

“Treating acid drainage once it has occurred, or mitigating environmental impact after it has occurred, is usually an admission that something has gone wrong either in the characterization, planning, design or operation of a mine.”

Paul Dowd, former Managing Director, Newmont Australia (Dowd, 2005) http://www.gardguide.com)
Quantifying Risk
(EPA perspective)

• In 2004 OIG identified 156 CERCLA sites with the potential cost from $7 - $24 billion

• NEPA documents for mining were not reliable in predicting water quality problems
  Maest and Kuipers, 2005

• EPA drafts new financial assurance regs
Environmental Regulation of Mining
U.S. EPA’s mission to protect human health and the environment
Fire, Earth, Air and Water

Comprehensive, Environmental Response, Compensation, and Liability Act (Superfund)

Clean Air Act

Resource, Conservation and Recovery Act

Clean Water Act

Safe Drinking Water Act
Primary laws administered by EPA related to metals

- NEPA - National Environmental Policy Act
- CWA - Clean Water Act - (NPS) Nonpoint Source
- EPCRA - Emergency Planning and Community Right to Know, TRI - Toxics Release Inventory
- SDWA - Safe Drinking Water Act
- CWA - Clean Water Act
- CAA - Clean Air Act
- CERCLA - Comprehensive Environmental Response, Compensation and Liability Act
- TSCA - Toxic Substances Control Act
EPA’s Continuum of Activities Based on Risk

- Permits
- Standards
- Certification/Registration
- Incentives
- Disincentives
- Information/Education
- Voluntary

Based on Risk

- Lower risk
- Higher risk

- Prohibition
- Mandatory Cleanup
- Permits
Risk continuum - Regulatory options and U.S. environmental laws

- Disincentives
- Certification/Registration
- Standards
- Permits
  - Mandatory Cleanup
  - Prohibition

Voluntary

- Information/Education

Lower risk

- GARD GUIDE
- NEPA
- CWA (NPS)
- EPCRA (TRI)
- SDWA

High risk

- TSCA
- CERCLA (Superfund)
- CWA & CAA
- CWA & CAA
Regulatory Hierarchy

Law or Statute

Regulation

Guidance

Policy

Drawing

By Frits Ahlefeldt
National Environmental Policy Act - NEPA

- “to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man” by providing information to the public
- Federal decision – evaluate alternatives
- EPA reviews environmental documents to determine if the environmental alternative chosen will impact the environment and to determine if the agency provided this information to the public
Safe Drinking Water Act - SDWA

- EPA sets legal limits on the levels of certain contaminants in drinking water 40CFR142 (note: compliance is at the tap for Public Drinking Water Systems)
- Based upon Maximum Contaminant Levels (MCLs)
- Labs must be certified
Clean Water Act - CWA

• 304a – EPA provides guidance to States and Tribes on the concentrations of metals that will not harm aquatic life or human health – Criteria (note: The States and Tribes set standards not EPA)

• 303d – Impaired waters and anti-degradation

• 402 and 404 permits
  – (NPDES and Fill permits)

• 401 certification by States or Tribes
EPCRA – Toxic Release Inventory - TRI

• The TRI requires reporting by the companies of metals discharged to the environment (note: these include permitted releases)

• Selecting chemicals for the Agency’s Toxicity Characteristic regulation (40 CFR 261.24) that defines hazardous wastes
Resource Conservation and Reclamation Act - RCRA

- Bevill Amendment restricts the application of RCRA to mining activities
- The Bevill Amendment does not apply to nonmining activities such as:
  - Laboratories
  - Machine shops
  - Electrical substations
Comprehensive Environmental Response, Compensation, and Liability Act - CERCLA

- EPA sets the concentrations of contaminants that can remain at Superfund sites (US Coe, 1980)
- These levels are based upon ARARs* and site specific risk assessments
- Background, baseline and ambient conditions

*Applicable or Relevant and Appropriate Requirements (ARARS)
Metals Assessments and Regulatory Framework

Site-Specific Assessments
- Screening-Level Analyses (CWA, CAA, CERCLA, RCRA)
- Complex Analyses (CWA, CAA, CERCLA, RCRA)

National Scale Assessments
- Criteria/Std (CAA, CWA, SDWA, CERCLA, RCRA)
- Chemical Reviews (TSCA, EPCRA)
- Ranking – Categorization (EPCRA, CERCLA, RCRA, TSCA, FIFRA, SDWA, CAA, CWA)

Adapted from U.S. EPA 2007  Framework for Metals Risk Assessment
Mining Environmental Risk Assessment
EPA Framework for Metals Risk Assessment 2007

• Metals are naturally occurring

• Metals often occur as mixtures

• Some metals are essential nutrients

• Metals are neither created nor destroyed
  – But can be transformed (valence states) or can be associated by bonding (compounds)

• Metals toxicity depends on many things

http://www.epa.gov/raf/metalframework/factsheet.htm
Risk Assessment

- **Source**
  - nature
  - extent

- **Pathway**
  - air
  - water
  - ingestion

- **Receptor**
  - people – children
  - animals – plants – endangered species
Receptors

Source

Pit, tunnel, waste piles tailings piles storage areas mechanical shops labs

Pathway

Mine or Mill

Water, surface or groundwater

Air - dust, precipitation

Soil, directly or indirectly

Biota

People

Animals

Invertebrates

Vegetation
Conceptual Model

Dave Christophersen
Crown Solutions
WATER BALANCE !!!
Cumulative Impacts
Metals Toxicity

Adapted from Smith and Huyck (1999)
Example – Tale of Two Projects

• Proposed mine
• Two T&E species in the area
• Most water data older than 20-years
• Water quality standards in question - 303d
• Limited access to obtain new data

• Mine expansion
• Good T&E evaluation no mitigation needed
• Up to date sampling and analysis
• Assisting in writing site specific standards
• Data provided by the local environmental group to support EIS
Mining Water Risk Assessment

• Does the company assess the water flows, usage, and water balance?
• Has the company evaluated the water risks within a local context?
• Does the risk-time period far exceed the potential life span of the mining company.
• Compliance with existing regulatory requirements may be exceeded by the legal risks long after the mine is closed.
**Table 2: WRI's Water Risk Framework for the Mining Sector**

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Surrounding environment</th>
<th>Type of commodity</th>
<th>Type of operation</th>
<th>Corporate Policy/Approach</th>
<th>Disclosure/Engagement</th>
<th>Regulatory Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Moderate rainfall, low seismic hazard</td>
<td>Cement, other industrial minerals, natural gas</td>
<td>Energy derived from renewable sources, old mine workings capped and covered, water risks have been measured and taken into account, company sets targets to reduce water footprint</td>
<td>Companydiscloses data on waste characteristics, flows, water risks, and seeks input and participation of stakeholders</td>
<td>Company is operating beyond compliance, zero discharge facility</td>
<td>Operating in countries with uncertain regulatory climate, water scarcity a major concern for policy makers, effluent releases and water withdrawals exceed permits</td>
</tr>
<tr>
<td>Medium</td>
<td>Moderate seismic hazard, moderate rainfall with distinct dry season</td>
<td>Coal, uranium, crude oil, lead, iron ore</td>
<td>Open pit above water table, dewatering water recycled, potentially acid generating material compacted and controlled, tailings stored in impoundment, energy derived from coal/natural gas, moderate water withdrawals, small mixing zone for discharges (1-2 miles)</td>
<td>Water balance, accounting at mine site, stated policy to reduce water consumption, developing additional water metrics</td>
<td>Reports some water indicators (e.g., GRI EN8, EN10, MM3), regularly consults with stakeholders at site and global levels</td>
<td>Company is taking steps to anticipate changes in regulations, effluent releases and water withdrawals are well within permits</td>
</tr>
<tr>
<td>High</td>
<td>Arid/semi-arid environments, presence of other competing uses (agriculture, ranching), high seismic hazard, very high rainfall and/or frequent, major storm events, high permeability aquifers</td>
<td>Low grade ore, precious metals, diamonds, copper, nickel, oil shale/sands</td>
<td>Open pit that reaches below water table, dewatering required, high acid drainage potential, tailings disposed in rivers, energy derived from hydropower, large water withdrawals, large mixing zone for discharges</td>
<td>No water accounting or footprint analysis, does not consider water risks</td>
<td>No reporting against existing frameworks (e.g., GRI), does not report tailings effluents, minimal engagement w/stakeholders</td>
<td>Operating in countries with uncertain regulatory climate, water scarcity a major concern for policy makers, effluent releases and water withdrawals exceed permits</td>
</tr>
</tbody>
</table>

Source: WRI.
Mining and Sustainability
References

• Acid Drainage Technology Initiative Workbooks prediction, mitigation, sampling and monitoring
• Good Practice Guidance for Mining and Biodiversity – CIMM
• GARD Guide
• CAFTA – EIA Technical Review Guideline: Non-Metal and Metal Mining Guía Técnica CAFTA-DR EIA - Minería