MAC TAILINGS MANAGEMENT INITIATIVES

Rick Meyers, PGeo
VP Technical & Northern Affairs
The Mining Association of Canada

State of Practice for Tailings Management
CIM Workshop, May 10th, 2015
Key drivers to MAC Tailings Management Initiatives

The MAC Guides (in brief)

Towards Sustainable Mining (TSM) and Tailings Management
  - TSM Performance Progress in tailings management

MAC Initiatives Towards Continual Improvement

Going Forward in Tailings Management
Tailings Storage Facilities
- Tend to follow convention, (dam-pond structures, some use of natural water bodies)
- Designed by consulting engineering specialists
- Design criteria influenced by local geography and material
- Long period of construction (~40-50 years)
- Unknown final height (until closure)
- Cannot be tested under maximum load conditions
- Use of filter, paste and dry stack technologies dependent on tailings characteristics

Management
- Managed by operators, with advice from consultants (some follow ‘best practices’, MAC, CDA and other guidelines)
- Expansions implemented jointly(?) by operator-consultant
- Increasing use of Independent Review Boards
- Size of operation/company may influence extent of Best Practice application
TAILINGS MANAGEMENT HAS BEEN A KEY DRIVER FOR TSM

Merriespruit, 1994
South Africa

Omai, 1995
Guyana

Marcopper, 1996
Philippines

Kolontar, 2010
Hungary

Obed Coal 2013
Alberta, Canada

Los Frailes, 1998
Spain

Mount Polley 2014
British Columbia, Canada

Mount Polley 2014
British Columbia, Canada
(Past 70 years - List incomplete - not all “major” failures)

- 2014 – BC (Mt. Polley)
- 2013 – Alberta (OBED)
- 2013 – BC (Basin Coal)
- 2012 – Newfoundland (Gullbridge)
- 1991 – BC (Sullivan)
- 1990 – Ontario (Matachewan)
- 1986 – BC (Mineral King)
- 1979 – BC (unidentified)
- 1975 – Saskatchewan (Rocanville)
- 1974 – Alberta (GCOS)
- 1970 – New Brunswick (Heath Steele)
- 1948 – BC (Sullivan)
- 1944 – Ontario (Hollinger)
81 reported significant tailings dam failures between 1961 and 2004

- 65 between 1961 and 1996
- 16 between 1997 and 2004

Including numerous causing loss of life (death toll ~ 670)

- El Cobre (Chile, 1965) - > 200 dead, town destroyed
- Mir (Bulgaria, 1966) - unquantified loss of life
- Bilbao (Spain, 1969) - unquantified loss of life
- Mufulira (Zambia, 1970) - 89 miners dead
- Bafokeng (S. Africa, 1974) - 12 miners dead
- Mochikoshi #1 (Japan, 1978) - 1 dead
- Arcturus (Zimbabwe, 1978) - 1 dead
- Stava (Italy, 1985) - 268 dead
- Jinduicheng (China, 1988) - 20 dead
- Merriespruit (S. Africa, 1994) - 17 dead
- Surigao del Norte (Philippines, 1995) - 12 dead
MAC Board Acknowledged tailings as a major business risk that needed better management by mine operators

- Established **Task Force** June 1996 to review tailings issues in light of major failures
- Task Force Confirmed that **engineering capability existed** to design safe tailings dams
  - Capability was being implemented by the Canadian mining industry equally at home and abroad
- BUT the **Management** of tailings systems required improvement
- **MAC Tailings Working Group** established 1996
## MAC TAILINGS MANAGEMENT INITIATIVES

<table>
<thead>
<tr>
<th>Year</th>
<th>Events</th>
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<tbody>
<tr>
<td>1996</td>
<td>- MAC Board establishes Tailings Task Force</td>
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<td></td>
<td>- MAC Tailings Working Group (TWG) formed</td>
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<tr>
<td></td>
<td>- Task Force/TWG initial Workshops</td>
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<td></td>
<td>- Management of Tailings &amp; Mine Rock; Tailings Risk Management</td>
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<td>- Identified need for a Guide to tailings management</td>
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<td>1997-98</td>
<td>- TWG developed <em>Guide to Management of Tailings Facilities</em></td>
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<td></td>
<td>- TWG workshops introducing the <em>Guide</em></td>
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<tr>
<td></td>
<td>- First publication (English, French, Spanish)</td>
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<td>1999-2002</td>
<td>- Workshops &amp; “Lesson’s Learned”</td>
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<tr>
<td></td>
<td>- Identified need for guide for OMS Manuals</td>
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<tr>
<td>2005</td>
<td>- “Lessons Learned II” – need for Audit and Assessment Guide</td>
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<td>2009</td>
<td>- <em>Guide to Audit &amp; Assessment of Tailings Facility Management</em></td>
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<td></td>
<td>- Published in 3 languages</td>
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Over the past 20+ years, the MAC **Tailings Working Group** has worked toward continual improvement in tailings management.

<table>
<thead>
<tr>
<th>Iain Bruce, BCG Engineering</th>
<th>Pat Landine, Cameco</th>
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<tbody>
<tr>
<td>Bob Butler, Noranda, Inc.</td>
<td>David Mchaina, Boliden Limited</td>
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<td>Mike Davies, AMEC</td>
<td>Jim Paynter, Newmont Canada</td>
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<tr>
<td>Elizabeth Gardiner, MAC</td>
<td>Philippe Poirier, SNC Lavalin</td>
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<tr>
<td>David Gladwin, Analysis Works</td>
<td>Greg Puro, Inco Limited</td>
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<tr>
<td>Karlis Jansons, Tetra Tech</td>
<td>Marty Puro, Inco Limited</td>
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<tr>
<td>Tom Kerr, Knight Piesold</td>
<td>Gary Remington, Inco Limited</td>
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<tr>
<td>Daniel Lang, Quebec Cartier Mining</td>
<td>Sam Saforo, Suncor Energy</td>
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<tr>
<td>Brian Lewis, BHP Billiton</td>
<td>Dal Scott, Highland Valley Copper</td>
</tr>
<tr>
<td>Beat List, Syncrude Canada</td>
<td>Rick Siwik, Noranda Inc.</td>
</tr>
<tr>
<td>Jim Maltby, Falconbridge Limited</td>
<td>Maciej Szymanski, AMEC</td>
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First Guide

- Developed as a management tool to help mining companies operate tailings facilities safely and responsibly

- Provides guidance to develop a Tailings Management Framework applicable throughout the life cycle of an operation – including closure

- To be adaptable to site-specific requirements and conditions at individual operations

- A management guide, Not a technical manual
MAC TAILINGS MANAGEMENT FRAMEWORK

- Policy and Commitment
- Management Review for Continual Improvement
- Planning
- Implementation
- Checking and Corrective Action
**Policy & Commitment**
- Confirm management accountability, responsibility and commitment to design, construct and safely operate in consultation with COI

**Planning**
- Defining roles and responsibilities, objectives to manage for compliance, manage risk and change, confirm resources and scheduling, emergency preparedness and response plans

**Implementation**
- Putting plans and procedures into actions for operational, and financial control, system documentation, communication; training to ensure awareness and competence

**Checking and Corrective Action**
- Proactive response to deficiencies by incorporating monitoring observations into the Framework

**Management Review**
- Reporting to the accountable executive to ensure performance improvement, adequacy of resources and fulfilment of commitments to Communities of Interest
  - Incorporate changes into “Policy & Commitment”
FRAMEWORK APPLIED THROUGHOUT THE OPERATION’S LIFE CYCLE

Policy and Commitment

Planning

Implementation

Management Review

Checking & Corrective Action

Operation

Decommissioning & Closing

Construction

Site Selection & Design

Policy and Commitment

Planning

Management Review

Checking & Corrective Action

Implementing the Plan

Operational Control

Checking and Corrective Action

Management Review

Decommissioning & Closing

Construct a facility

Operate a tailings facility

Decommission and close a facility

Policy and Commitment

Planning

Roles and Responsibilities

Objectives

Managing Risk

Implementation of the Plan

Operational Control

Checking & Corrective Action

Management Review

Decommissioning & Closing

Construct a facility

Operate a tailings facility

Decommission and close a facility

Policy and Commitment

Planning

Roles and Responsibilities

Objectives

Managing Risk

Site Selection & Design
## CHECKLISTS FOR MANAGING A TAILINGS FACILITY

### Management Action (Life Cycle)

- Construction
- Operation
- Decommissioning
- Closure

### Policy and Commitment

1. **Select a site and design a tailings facility in compliance with regulatory requirements and in conformance with sound engineering practice, company standards, the MAC TSM Guiding Principles, the MAC tailings management framework, and commitments to Communities of Interest.**

2. **Ensure that the tailings management framework is implemented through the actions of all employees working at the facility.**

3. **Consult with Communities of Interest, taking into account their considerations relating to the tailings facility site selection and design.**

4. **Establish an ongoing program of review and continual improvement to manage health, safety and environmental risks associated with tailings facilities.**

### Planning

2.1 **Roles and Responsibilities**

- Assign overall accountability for tailings management to an executive officer of the company (CEO or COO), with responsibility for putting in place an appropriate management structure and for providing assurance to the corporation and its Communities of Interest that tailings facilities are managed responsibly.

- Assign responsibility and budget authority for tailings management.

- Define the roles, responsibilities and reporting relationships for the site selection and design team, supported by job descriptions and organization charts.

### Identifying the Scheduling Requirements

- Including references as resources for the site and operations:
  - (design/construction history, company standards and procedures, policies, regulatory requirements, commitments to stakeholders)

### Assigning responsibility and authority for the management actions to individuals within the organization

- Determining relevant performance measures to ensure that objectives are tracked and met.
Second Guide

- Requires **management commitment**
- Details the **roles and responsibilities**
- Establishes **procedural requirements** for the facility so that it functions safely in accordance with design
- Meets **regulatory requirements**
- Identifies all **documentation** requirements:
- Defines procedures and processes for **managing risk** and **managing change**
- Predicated on **continual improvement**
- Prepared by site personnel**
OMS MANUAL WITHIN THE FRAMEWORK

Policy and Commitment

Management Review (Continual Improvement)

Planning

Implementing the Plan

Checking and Corrective Action

OMS Manual (Implementation)

Operation
Maintenance
Surveillance
Third Guide
The Audit & Assessment Guide incorporates two distinct, but complimentary protocols for the verification of tailings management systems

Audit
- Evaluates conformance or non-conformance with prescribed criteria for the facility
- Not based on opinion, not designed to determine cause of deficiencies, or evaluate management system effectiveness
- Leads to yes / no responses to pre-determined questions

Assessment
- Goes beyond Audit, incorporating professional judgement to evaluate performance
- Driven by focus on the quality of the management system
- Identifies deficiencies, determines causes and proposes a basis for improvement
TOWARDS SUSTAINABLE MINING (TSM) AND CORPORATE RESPONSIBILITY (CR)

TSM Established in 2004

- MAC’s commitment to responsible mining
- TSM core strengths are accountability, transparency and credibility
  - **Accountability** – Mandatory for all members to report at the facility level
  - **Transparency** – Public reporting with independent verification
  - **Credibility** – Guided by our Community of Interest Advisory panel

CR Facilitates

- Access to Capital and investor confidence
- Attracting a competent workforce
- Innovation and technology
- Public acceptance and earning a Social License to operate
TSM PROGRAM ARCHITECTURE

Guidance and Expectations

TSM Guiding Principles

Policy Frameworks

TSM Performance Protocols

Communities and People

- Aboriginal and Community Outreach
- Crisis Management Planning
- Safety and Health

Environmental Stewardship

- Tailings Management
- Biodiversity Conservation Management

Energy Efficiency

- Energy Use and GHG Emissions Management

23 Performance Indicators in 6 protocols

Assessment Protocols

Good Practice Guidance

Performance Measurement and Reporting System

External Verification

Public Reporting and 3rd Party Verification
Developed by the MAC Tailings Working Group

- Uses a different approach from other protocols
- Requires implementation of the MAC Guides, including developing a Tailings Management Framework and OMS Manual
- Assessment/verification team needs to use the Audit and Assessment guide to achieve levels “AA” or “AAA”
TSM GOVERNANCE

MAC Board of Directors

TSM Governance Team

TSM Initiative Leaders

Tailings Working Group

Energy Task Force

Public Affairs Committee

Biodiversity Task Force

Other MAC Committees/Taskforces/Working Groups

Community of Interest Advisory Panel

COI Advisory Panel Composition

Aboriginal peoples

Environmental NGO

Economic/community development

Social NGO including faith based groups

Finance/investment

International development

Labour/workplace

Media/communications

MAC Board of Directors

Junior Mining Company Representative
Tailings Management Assessments
Percent of Facilities at Level A or Higher
2006, 2012 & 2013
MAC Actions – *Two Parallel Initiatives underway*

1. **Independent Task Force Review of TSM**
   - A high-level review of MAC Tailings Management Protocol
   - To advise the MAC Board on possible actions for improvement in the MAC tailings management initiatives

2. **Tailings Working Group**
   - Detailed review of MAC Guides to assess what improvements can be made
   - Gap analysis of the Tailings Management Framework
   - Assessing whether and how technical/design components could be added
   - Incorporating ‘enhanced’ Risk Management into the Guides
Towards Sustainable Mining (TSM)

• What in TSM is missing?
  ➢ Is MAC enforcement of TSM adequate?
  ➢ Should there be stricter performance measures?
  ➢ Is ‘Level A’ is sufficient as a ‘best practice’ for tailings management?
  ➢ Are TSM external verification requirements sufficiently rigorous?

• Do companies support one another sufficiently?
  ➢ Particularly for new members?
  ➢ How to we extend our “Best Practices” to non-MAC companies?

• Should there be a linkage between TSM and Regulatory processes?

• **How can TSM process ensure confidence among our Communities of Interest in our tailings management systems?**
The MAC Tailings Management Guides

Do the Guides meet industry’s needs for responsible tailings management?
- Is the Tailings Management Framework adequate?
- Is there sufficient education on the Guides available?
- Are they being applied effectively and as intended?
- Are the right ‘incentives’ in place to encourage their use?
- What elements of the Guides could be “Risk-ranked” as Critical Controls that could lead to failure?

• Beyond Management…
  • Should TSM and the Guides go beyond Management to incorporate ‘standards’ or design elements
CONSIDERING TECHNICAL COMPONENTS

Linking Technical Components with Management Practices

“Best Design Practice”
- Safety factors
- Seismic parameters
- Flood control

“Best Management Practices”
- MAC Guides
- TSM Protocol
Scenario – Establishing a Tailings Standards Committee for the Canadian Mining Industry

Resources

- Experience and Expertise
- Major time commitment, corporate approval
- Technical writing experience

Main Players

- MAC (TWG, TSM)
- CDA, CIM
- Provincial Associations
- Regulators
- Professional Associations
- Legal advisors
- Communities of Interest