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MAC TAILINGS MANAGEMENT INITIATIVES

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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, 1995
South Africa



Obed Coal 2013
Alberta, Canada



Los Frailes, 1998
Spain



Omai, 1995
Guyana



Mount Polley 2014
British Columbia, Canada



Kolontar, 2010
Hungary

(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)

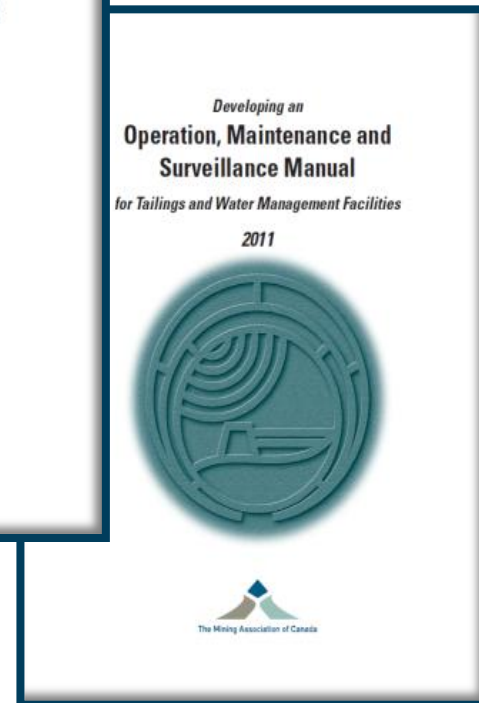
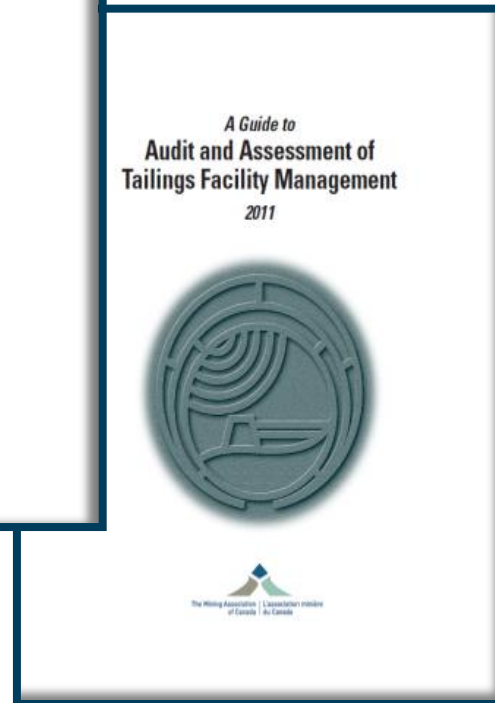
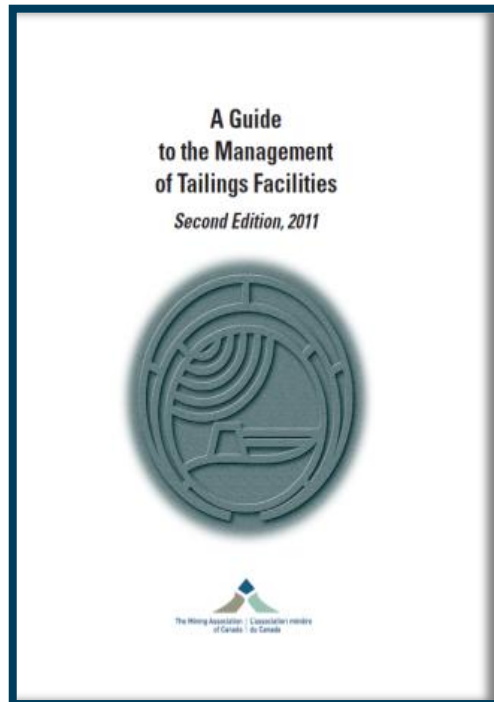
- El Cobre (Chile, 1965) - > 200 dead, town destroyed
- Mir (Bulgaria, 1966) - unquantified loss of life
- Bilbao (Spain, 1969) - unquantified loss of life
- Mfulira (Zambia, 1970) - 89 miners dead
- Bafokeng (S. Africa, 1974) - 12 miners dead
- Mochikoshi #1 (Japan, 1978) - 1 dead
- Arcturus (Zimbabwe, 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**



1996	<ul style="list-style-type: none"> ➤ MAC Board establishes Tailings Task Force ➤ MAC Tailings Working Group (TWG) formed ➤ Task Force/TWG initial Workshops <ul style="list-style-type: none"> • Management of Tailings & Mine Rock; Tailings Risk Management • Identified need for a Guide to tailings management
1997-98	<ul style="list-style-type: none"> ➤ TWG developed Guide to Management of Tailings Facilities <ul style="list-style-type: none"> • TWG workshops introducing the <i>Guide</i> ➤ First publication (English, French, Spanish)
1999-2002	<ul style="list-style-type: none"> ➤ Workshops & “Lesson’s Learned” <ul style="list-style-type: none"> • Identified need for guide for OMS Manuals
2003	<ul style="list-style-type: none"> ➤ Guide to Developing an OMS Manual published
2004-2007	<ul style="list-style-type: none"> ➤ TSM Tailings Management Performance Indicators
2005	<ul style="list-style-type: none"> ➤ “Lessons Learned II” – need for Audit and Assessment Guide
2009	<ul style="list-style-type: none"> ➤ Guide to Audit & Assessment of Tailings Facility Management <ul style="list-style-type: none"> • Published in 3 languages



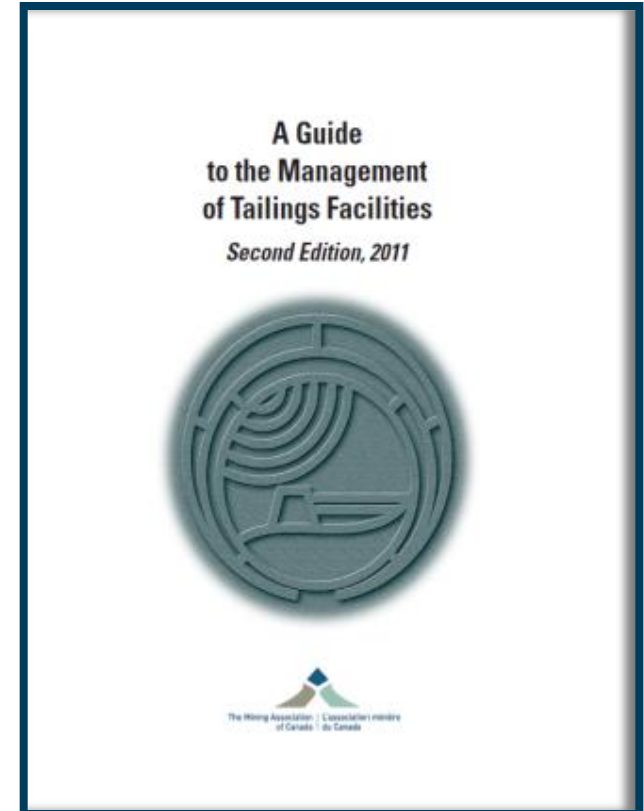
Over the past 20+ years, the MAC **Tailings Working Group** has worked toward continual improvement in tailings management.

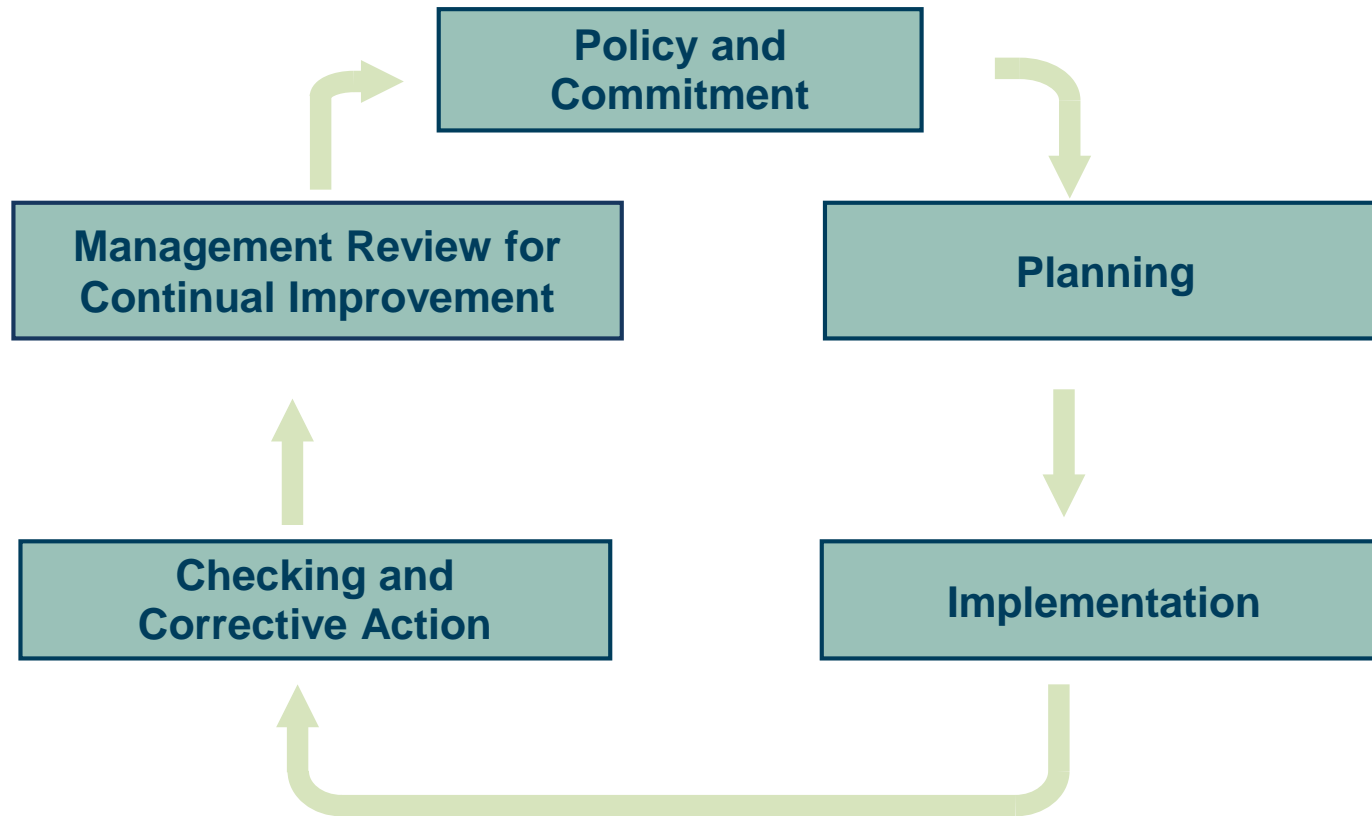
Iain Bruce, BCG Engineering
Bob Butler, Noranda, Inc.
Mike Davies, AMEC
Elizabeth Gardiner, MAC
David Gladwin, Analysis Works
Karlis Jansons, Tetra Tech
Tom Kerr, Knight Piesold
Daniel Lang, Quebec Cartier Mining
Brian Lewis, BHP Billiton
Beat List, Syncrude Canada
Jim Maltby, Falconbridge Limited

Pat Landine, Cameco
David Mchaina, Boliden Limited
Jim Paynter, Newmont Canada
Philippe Poirier, SNC Lavalin
Greg Puro, Inco Limited
Marty Puro, Inco Limited
Gary Remington, Inco Limited
Sam Saforo, Suncor Energy
Dal Scott, Highland Valley Copper
Rick Siwik, Noranda Inc.
Maciej Szymanski, AMEC

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





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

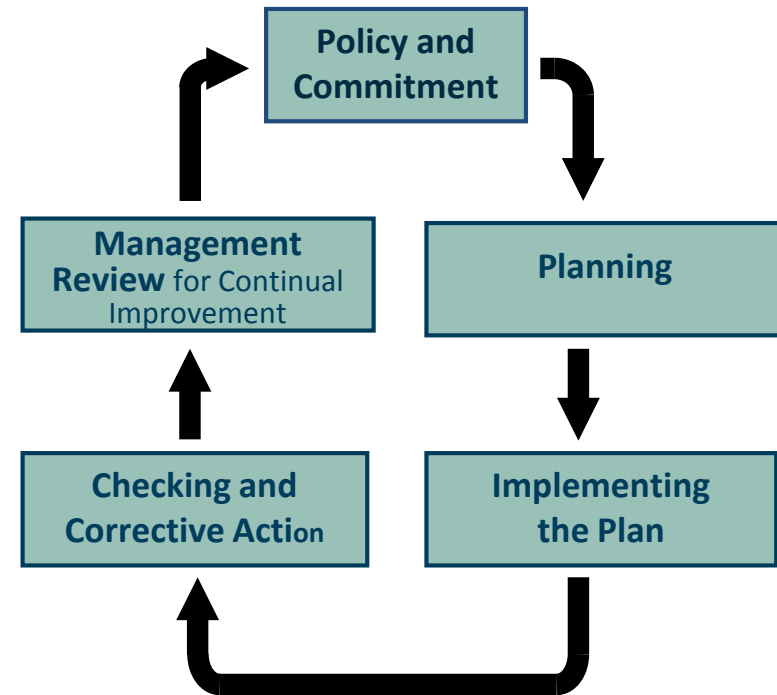
- Putting plans and procedures into actions for operational, and financial control, system documentation, communication; training to ensure awareness and competence

Checking and Corrective Action

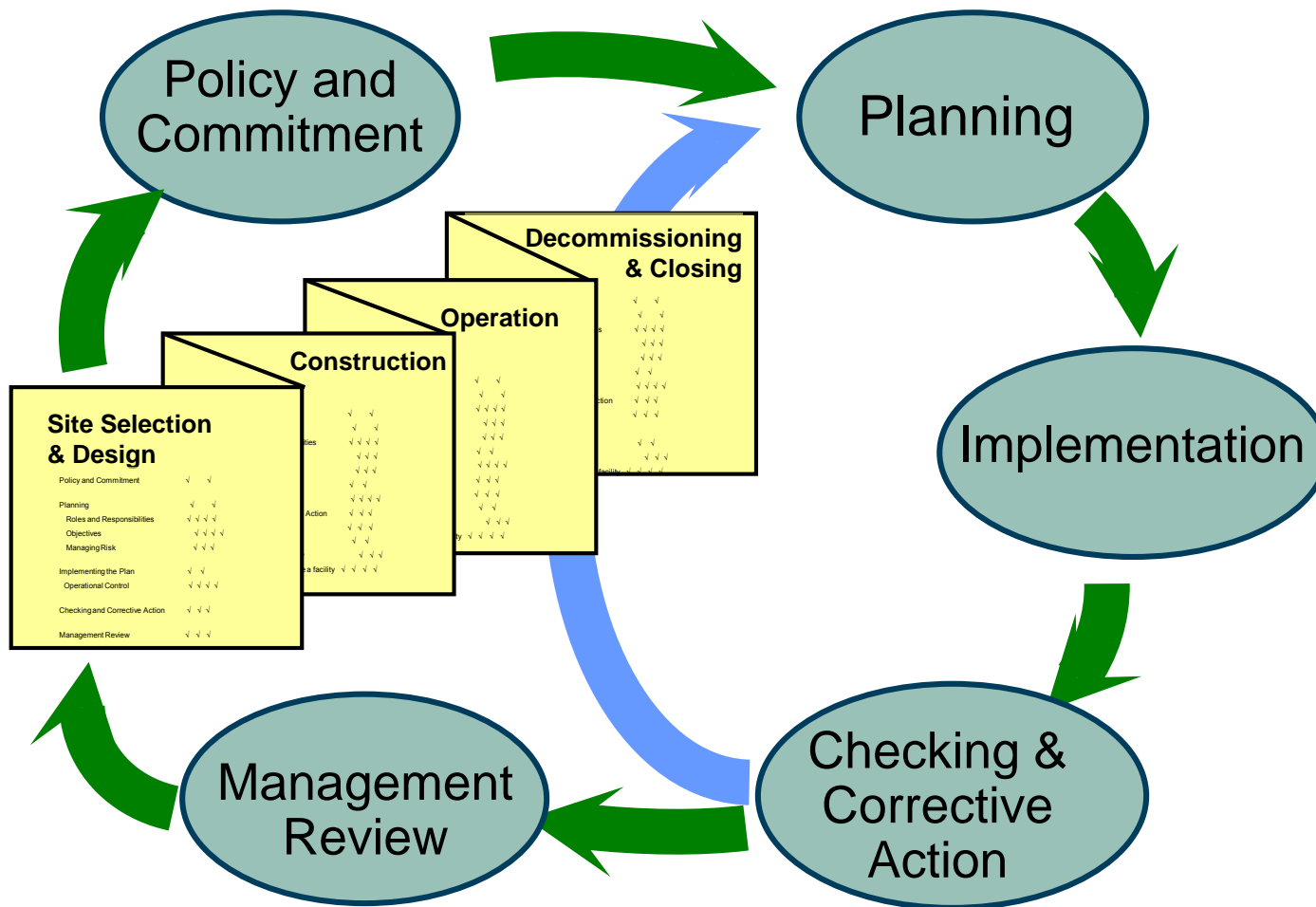
- Proactive response to deficiencies by incorporating monitoring observations into the Framework

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"

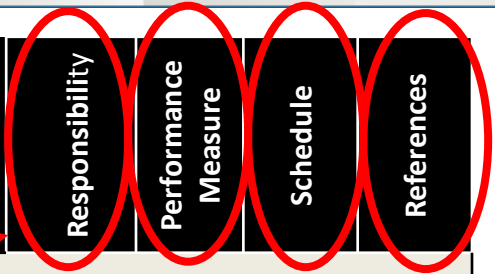


FRAMEWORK APPLIED THROUGHOUT THE OPERATION'S LIFE CYCLE



Management Action (Life Cycle)

- Construction
- Operation
- Decommissioning
- Closure



	Responsibility	Performance Measure	Schedule	References
POLICY AND COMMITMENT				
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				
Ensure that the tailings management framework is implemented through the actions of all employees working at the facility				
Consult with Communities of Interest, taking into account their considerations relating to the tailings facility site selection and design				
Establish an ongoing program of review and continual improvement to manage health, safety and environmental risks associated with tailings facilities				
2 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				

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

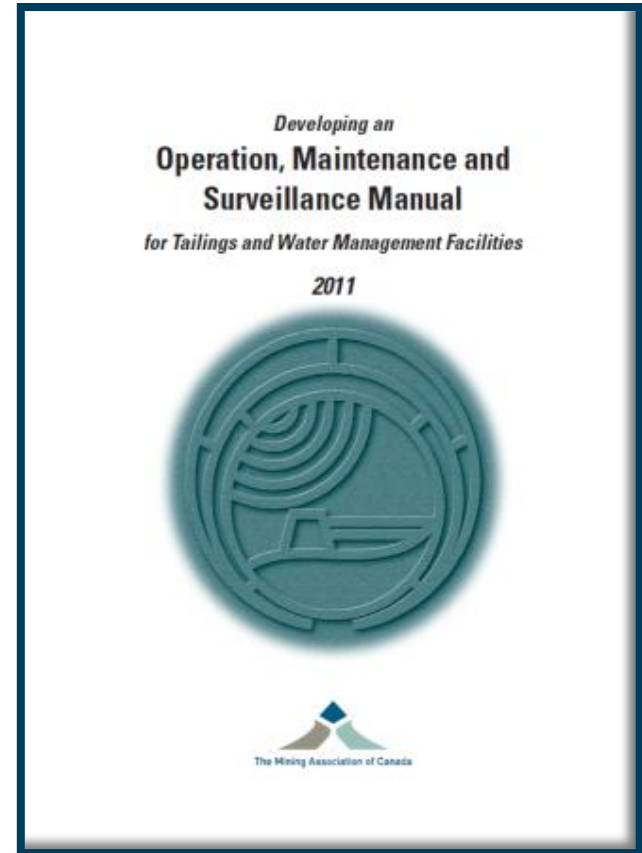
Determining relevant performance measures to ensure that objectives are tracked and met

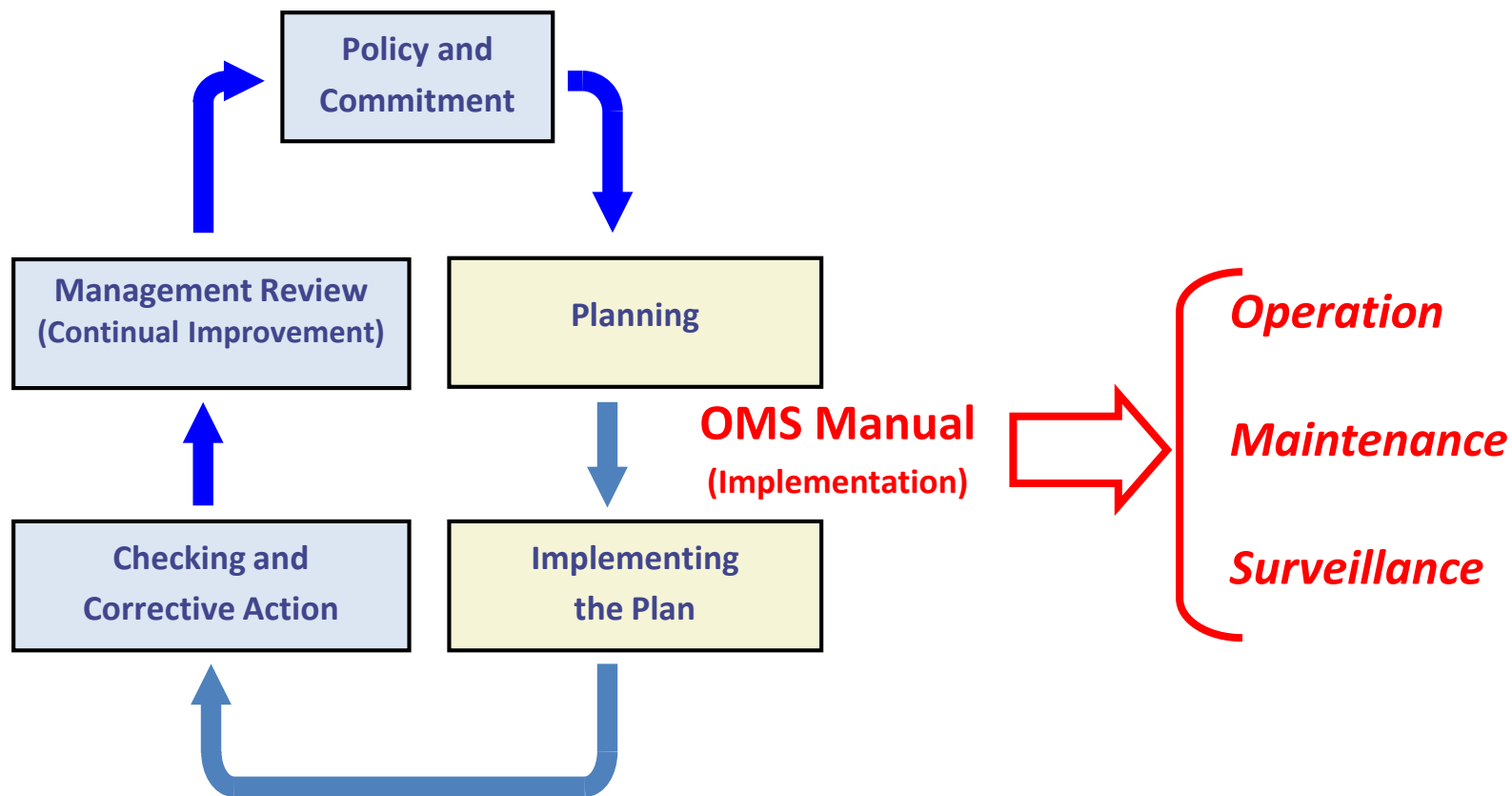
Identifying the scheduling requirements

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

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****





Third Guide

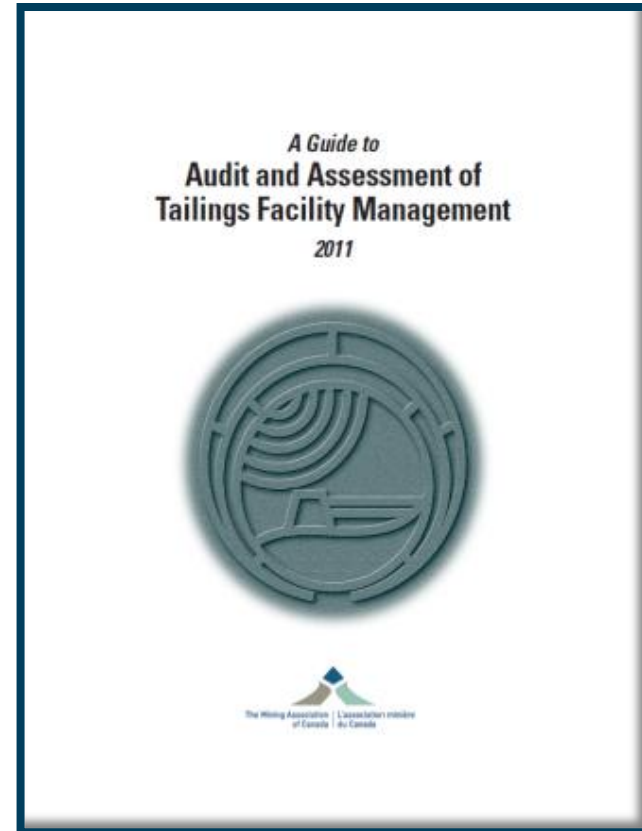
The Audit & Assessment Guide incorporates two distinct, but complimentary protocols for the verification of tailings management systems

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



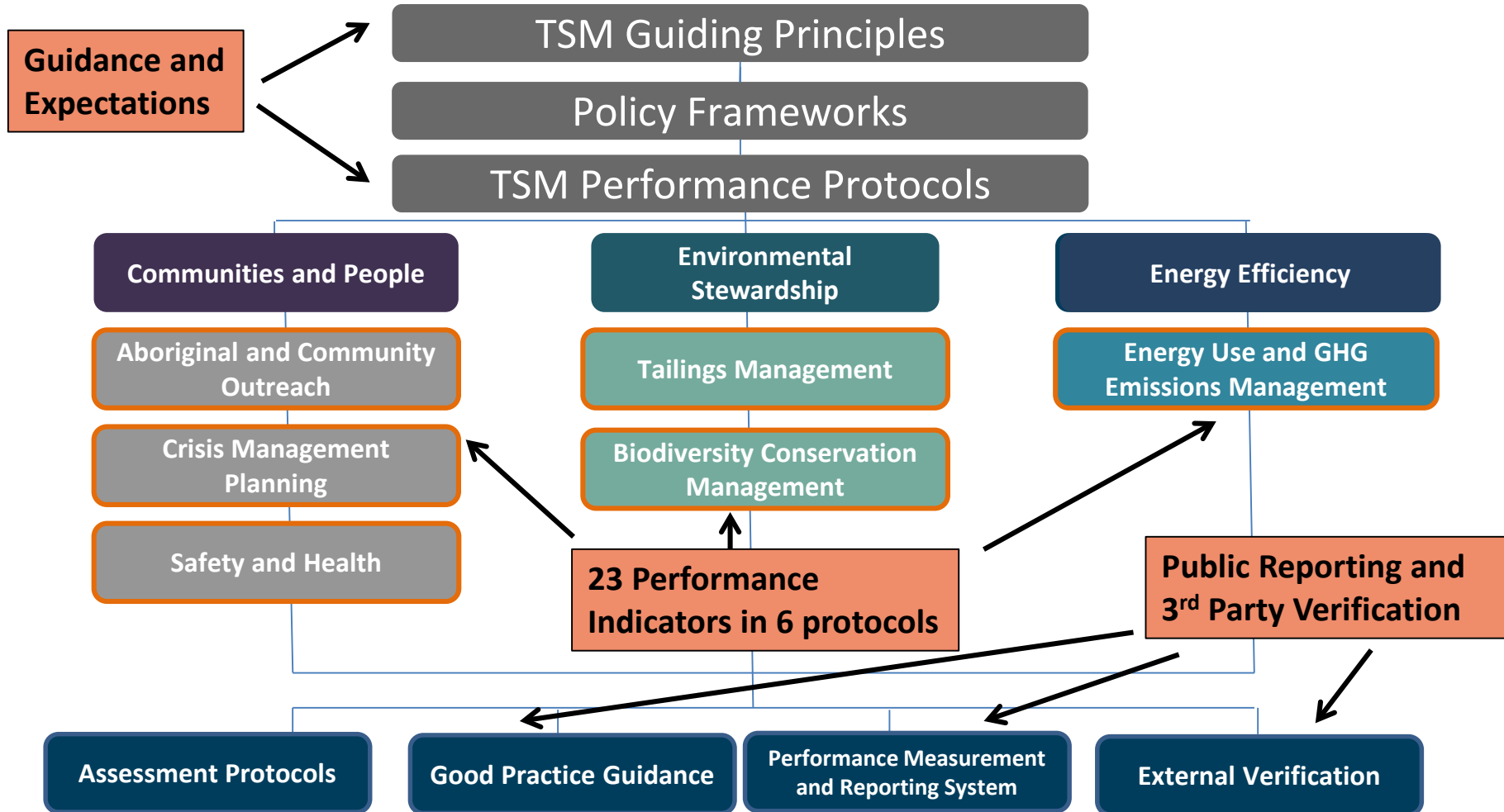


TSM Established in 2004

- 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



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”

Tailings Management Indicators

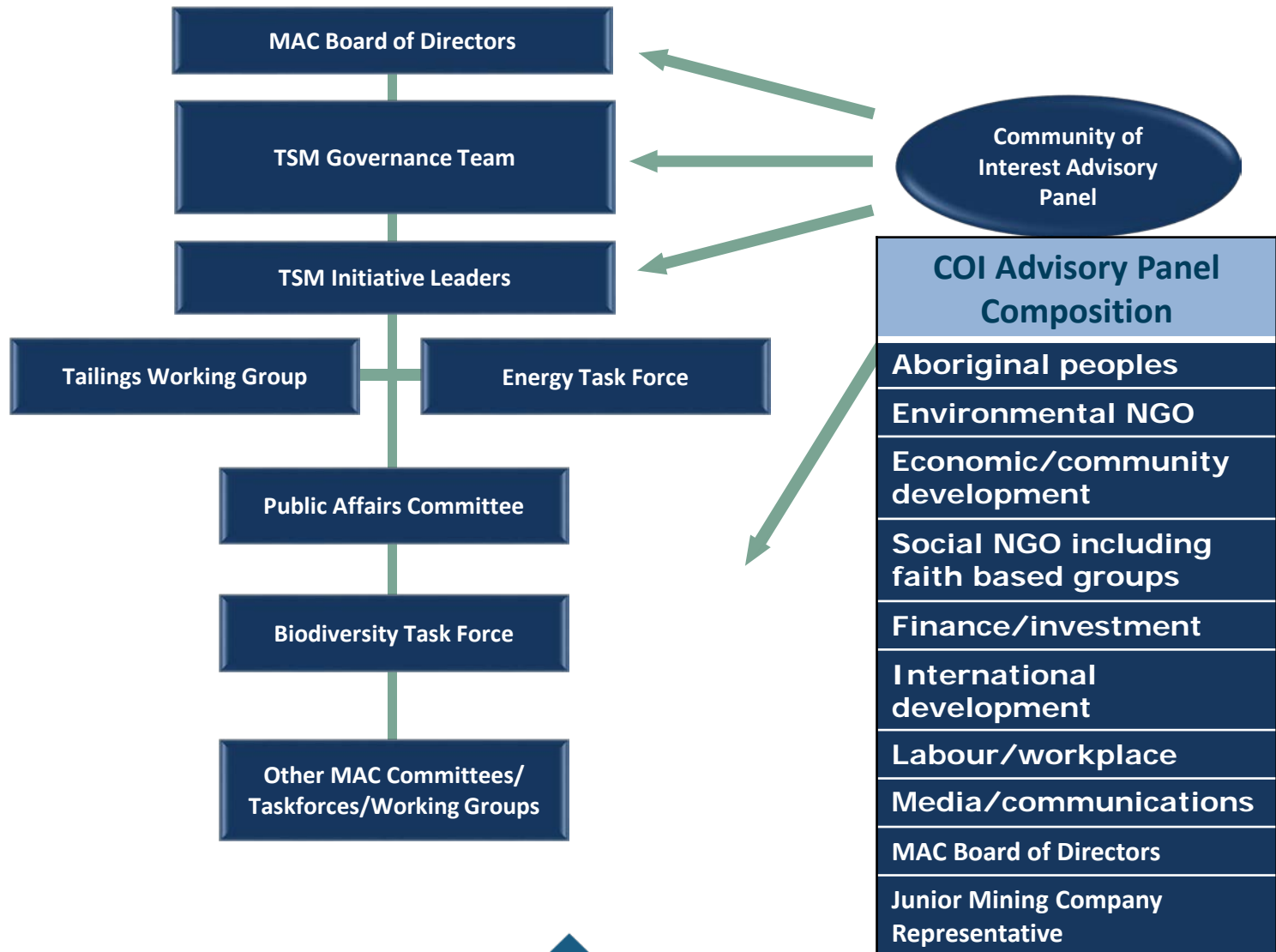
Tailings management policy and commitment

Tailings management system

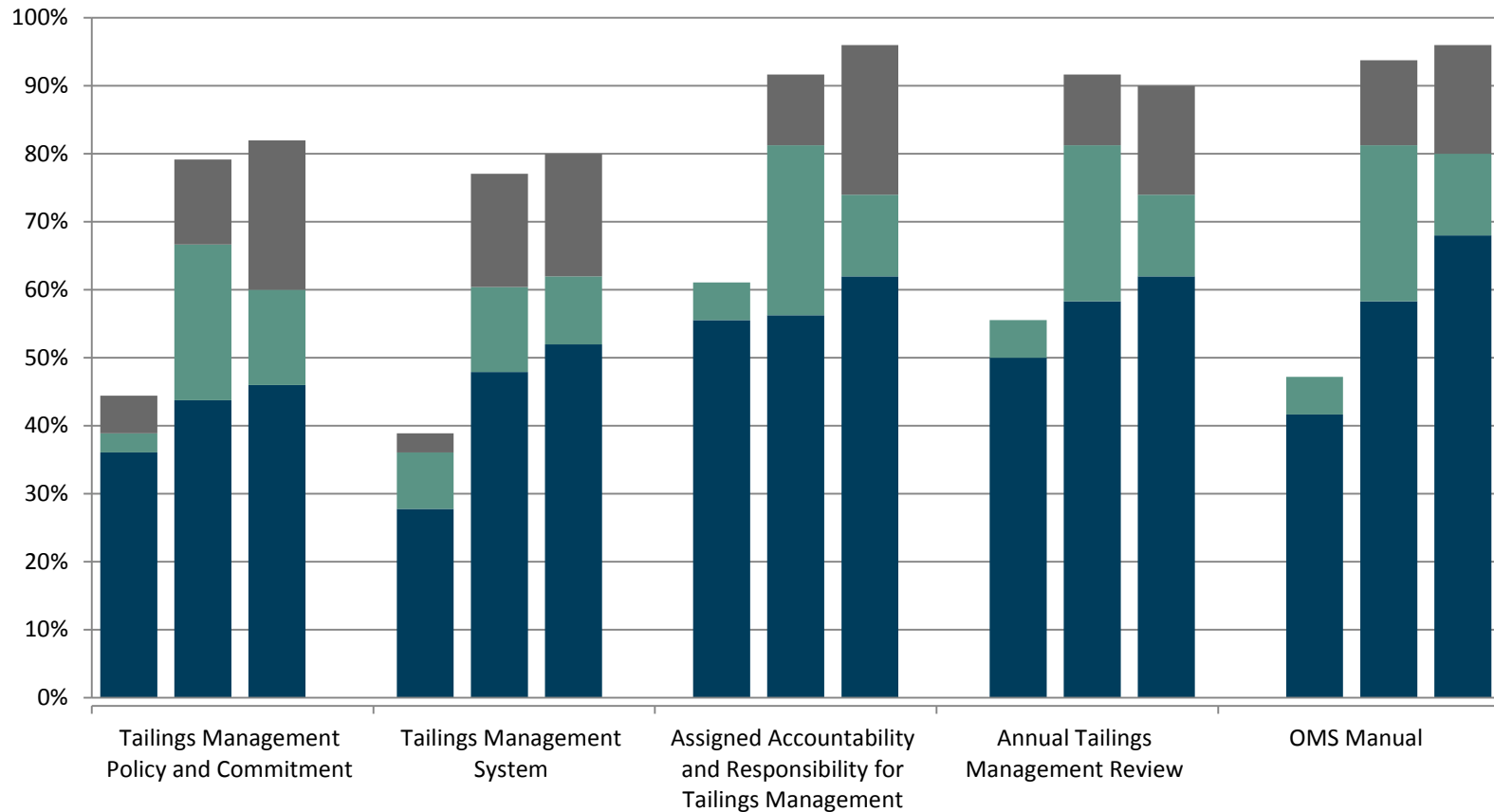
Assigned accountability and responsibility for tailings management

Annual tailings management review

Operation, maintenance and surveillance (OMS) manual



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?

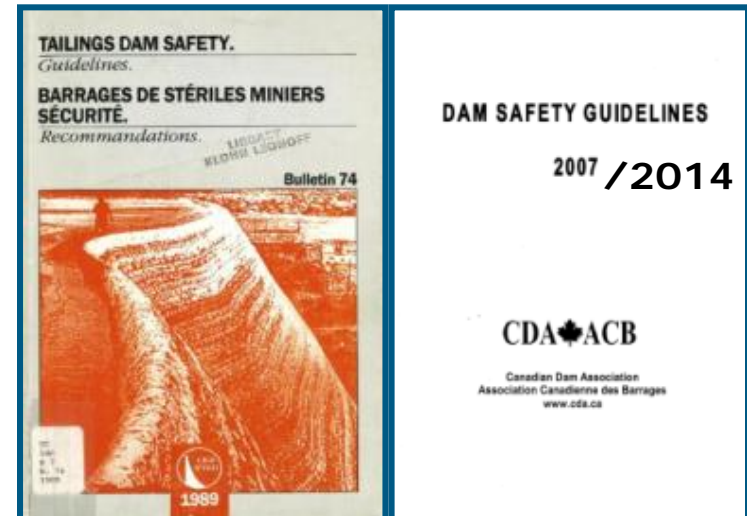
- Is the Tailings Management Framework adequate?
- Is there sufficient education on the Guides available?
- Are they being applied effectively and as intended?
- Are the right 'incentives' in place to encourage their use?
- What elements of the Guides could be "Risk-ranked" as **Critical Controls** that could lead to failure?
- **Beyond Management...**
 - Should TSM and the Guides go beyond Management to incorporate 'standards' or design elements



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