

DRAFT “GLOBAL TAILINGS STANDARD”

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The purpose of this submission is to comment on the draft Global Tailings Standard in general and to provide suggestions as to how it could be improved. In general, the draft contains many good ideas that have the potential to improve the design, construction management and closure of tailings facilities of tailings facilities. However, if the draft is adopted as currently organized and expressed, the full effect of these ideas will be lost and its credibility as an effective tool will be diminished.

1. Introductory Comments

- 1.1. **Corporate Responsibility:** As a general statement, the draft standard establishes two very important aspects that are critical to its success. The first is the recognition that the owners who have operating tailings dams must formally “...take responsibility for the safe and secure management of their tailings facilities, through all phases of the project lifecycle, including closure and post-closure.” I emphasize the use of the term “owners” as it is they, through their Board of Directors that must show their commitment, as a necessary precondition, to the integrity of their tailings dams. This must be shown through corporate risk management and tailings policies and Board oversight through their Risk and/or Sustainability committees. The term “Operator” is useful when formulating design and management principles for individual tailings operations but it does not give proper recognition to the importance of the owners and, in most cases, the boards of directors that act on their behalf at the top of the responsibility chain.

- 1.2. **Independent Assurance:** The second main point I would like to make is that the draft standard, as it has been presented, is not much more than some high sounding principles and generalized practices. For this work to be described as a standard, it is essential that “A system for credible and independent assurance of tailings facilities.” be an integral part of this initiative. An excellent outline of the requirements for such an assurance activity is presented in the background material on pages 4/5 of the draft document but not as part of the standard. The key to the Standard’s success will be the translation of the standard’s principles and best practice requirements into the detail required for the “Protocols for determining compliance and non-compliance with the Standard”. To do this, the Standard must go well beyond generalized requirements.

The Standard should have as one of its requirements that each owner/operator must seek and maintain accreditation under a yet to be named system (Tailings Code??). To do less would seriously undermine the effectiveness of the Standard and the credibility of the mining industry. As stated on pages 4/5 of the Standard the Code should provide:

- A guarantee of independence;
- Access to a multi-disciplinary team of experts to review implementation of the Standard;
- Protocols for determining compliance and non-compliance with the Standard;
- Procedures for seeking further information or agreeing an action plan should an Operator fail to meet requirements in the Standard;
- Resources to conduct compliance monitoring;
- A framework against which to assess the competency of reviewers;
- A process for approving or conditionally approving assurance;
- The power to revoke or suspend assurance where necessary;
- Procedures for ensuring transparency and public reporting; and
- Opportunities for meaningful public engagement in the process.

1.3. **Best Practices:** The challenge in creating an effective assurance scheme rests on the ability to provide detailed protocols that describe, in measureable or observable terms, the practices being judged. Just requiring “best practices” without the clear identification of key requirements provides nothing more than the current way of doing things that would be open to broad interpretation. Simply adopting the mantra of best practices has brought the mining industry to where it is now, which is too many tailings disasters.

The Standard must aspire to a higher standard than best practices and must explicitly define what is required to achieve the highest degree of risk protection possible. There are companies, consultants and regulators around the world that have a high level of commitment to tailings dam safety and have developed practices that have been instrumental in ensuring the safe operation of tailings dams by many companies in many countries. It is what these organizations are doing that should be looked at in defining what more needs and should be done to significantly improve on past backward looking best practices. What is needed is what I have defined as “Leading Practices” That is - Leading practice should be forward looking and defined as a practice that goes well beyond the norm, providing the highest degree of commitment and/or a significant improvement in risk reduction. The Standard needs to aspire to this level of attainment and each practice must be defined in a manner that supports the intent of the principle in a manner that can be verified. (See also a paper I written on this subject that is attached to this email.) As a further suggestion, I would recommend that the practices demanded by the Standard be described as “Required Practices” with so-called best practices being enhanced by those adopted by industry leaders. Standard of Practice as used in the Cyanide Code would also be a good choice thus portraying something better than the lowest common denominator.

Finally two comment about the definition of best practices included in the Glossary that states “A procedure that has been shown by research and experience to produce optimal results and

that is established or proposed as a standard suitable for widespread adoption.” First of all, if this were the case for all the references in the text then there should not be any problem in stating what these practices should be. Secondly, I do not believe that that many of the practices so referenced have passed the test of the definition above. Vale relied on such assurances by their external experts with disastrous results.

1.4. **Format:** The organization of the Principles and Requirements seems to have followed a format based more the writer’s perspective instead of that of the intended audience and prime users. It would seem to me as a retired executive and now as an external stakeholder that the most important topics, principles and associated requirements should start with formal corporate acceptance of responsibility followed by key corporate policy prescriptions and governance and management requirements. Only then should the standard continue with the specific topics dealing with design, construction, operation and closure.

1.5. **Risk:** In that the word risk is used in many contexts throughout the Standard, very little understanding is provided, apart from the consequence table, as to how it should be measured, assessed and managed. The terms greatest extent possible, robust design and minimize risk sound good but provide little guidance. The Standard’s focus on failure modes is appropriate but it does not provide the rigor needed for higher consequence tailings facilities. As pointed out in the 2019 MAC Tailings Guide “There are two basic approaches to risk assessment: identify the potential risks and determine the likelihood of a range of potential consequences of those risks; and determine credible failure modes and assess what potential conditions (hazards), and their likelihood, could result in those failure modes. Applying both of these approaches provides for a robust assessment of risks.”

To reflect to importance of risk identification, risk reduction and risk management to the credibility of the standard what the Standard needs is a separate principle governing the risk assessment and management , replacing the superficial requirements of Requirement 11.1. This section should address requirements for

- The use of risk assessment professionals to lead risk assessments for higher consequence facilities
- The quality of the assessment team
- The selection the appropriate risk assessment techniques
- The identification of critical control issues and critical control plans

1.6. **Meaningful Communication and Community Involvement:** This aspect is so important that it requires a stand-alone topic section with a principle that states that the public must be adequately informed of the nature and management of the risks relating to proposed and existing tailings facilities and that it can effectively participate, in a collaborative manner, in decisions that may interest or affect them.

2. **Specific Suggestions:** The following suggestions will be presented in the order I believe they should be addressed in the standard. No attempt will be made to be all inclusive and some suggestions will be presented as examples for broader application in the draft.

2.1. Topic I: Corporate Responsibility

The stated purpose of the Global Tailings Standard is to “compel” Operators to use specified measures and to implement best practices in all aspects of their tailings facilities. This being the case, the principles and requirements should be presented in a manner that reflects the structure of each legal entity and how it is organized to fulfill its mandate. On this basis, the first Topic should be Governance and its Principle should be;

Principle 1: The owners who have operating tailings dams must formally “...take responsibility for the safe and secure management of their tailings facilities, through all phases of the project lifecycle, including closure and post-closure.”

This principle should then be supported by Requirements that the Owners must, as represented by their Board of Directors (or as otherwise organized):

R 1.1: Establish a **corporate risk management** process equivalent to or compliant with ISO 31000 that will provide Board oversight of material, financial and operating risks including the consideration of loss of human life, environmental damage and public economic loss.

R 1.2: Establish a **Sustainability Committee** that would;

- Make recommendations to the board regarding the approval of corporate policies and standards for the management of material risks;
- Oversee the policies and management structure and processes used to manage the material sustainability risks of the corporation;
- Review and assess assurance reports to verify that corporate policies and standards have, in fact, been implemented;
- Review and assess management’s risk management strategies for new projects and report to the board as to their adequacy in the light of possible consequences;
- Assess the application of adequate corporate resources; and
- Review and assess verification reports pertaining to the management of material risks.

R 1.2: Approve a **Tailings Governance Policy** that would require that the corporate tailings governance policy include commitments to:

- Locate, design, construct, operate, and close tailings facilities in a manner that provides an acceptable level of protection for the safety, health, and welfare of the public and the environment;
- Implement a tailings governance framework management system based the ISO 14001 environmental management standard or equivalent;
- Utilize robust risk management systems and processes to identify and mitigate material risks;
- Ensure the public is meaningfully engaged and adequately informed of the nature of the risks relating to both proposed and existing tailings facilities and

can effectively influence, in a collaborative manner, decisions that may interest or affect them;

- Conduct an integrated tailings disposal method and site location selection process for new tailings dams based on a thorough understanding of the costs and consequences of failure of alternate methods and site locations;
- Implement comprehensive change management and emergency preparedness and response plans;
- Establish a comprehensive review and assurance program to verify that the commitments stated in the corporate governance policy are been met on a continuous basis
- Make the assurance protocols and reports available to the public.
- Notes: (1) Other key principles such as Knowledge Base could be added. (2) the detail presented above is an example of the items that need to be verified in an audit protocol addressed in a policy statement for it to meet required practice criteria.

2.2. Topic 2: Tailings Governance Framework

2.2.1. Principle 2.1: Leading practice would require that the executive office of a company respond to its Tailings policy requirements through the establishment of a framework that will define requirements for a management system, operating manuals, corporate standards, risk assessments and assurance activities.

2.2.1.1. Management Structure: I agree with the appointment of a person to be accountable at the executive level and a site-specific Responsible Tailings Facility Person but I do not agree with the reporting lines nor with the site person having to be an engineer. No valid reason has been presented to validate the move away from normal reporting relationships and more problems will be created than solved by this approach. Regarding the site, there is no compelling reason for this person to be an engineer. The main need is for a person skilled in managing a diverse range of activities ranging from engineering, construction management, personnel relations, operations manuals, EPRP, etc.

2.2.1.2. Engineer of Record: Requirements need to address

- Ethical conduct,
- EOR participation in all risk assessments, critical control determinations, assurance activities and the development of the operating manual.
- Annual Report - The duties of the EOR as stated in the Glossary primarily technical in nature but this person is also being asked to assess the functioning of the management system for the annual report. It must be recognized that the EOR will need management expertize support to adequately discharge this responsibility. Guidance on the content of this report is also required.

2.2.1.3. Risk Assessment & Management

- Stipulating the selection of in-depth risk assessment tools for the highest consequence risk events is crucial. Ref: Australian Leading Practices; Risk Management Publication.

2.2.1.4. Assurance and advisory requirements

2.2.1.4.1. **ITRB** – They should not be just a technical group. Required practice should dictate that an ITRB be formed for each TSF comprised of recognized industry geotechnical and management experts in the design and operation of TSFs. The purpose of an ITRB should be to provide a company with an annual assessment of the effectiveness of its Tailings Governance Framework and to offer its advice and comments on key matters such as the integrity of the dam structure, the identification and management of high consequence risks, the comprehensiveness of the assurance programs and the scope, depth and team qualifications for individual assurance activities.

2.2.1.4.2. **Dam Safety Reviews** – This is a key requirement and to be effective needs detailed guidance of the nature provided by the *Professional Practice Guidelines – Legislated. Dam Safety Reviews in BC*. It is noted that BHP has recognized this guideline as best practice. Also, it is noted that this is primarily a technically focussed document and it should be supported by the inclusion of a management systems professional and appropriate protocols relating to the TMS.

2.2.1.4.3. **External Codes** – A **required practice** should be that each legal entity must seek accreditation under a Code that meets the requirements as described in item 1.2 above, for the purpose of certifying its adherence to the requirements of the Standard.

2.2.1.5. **Meaningful Communication and Community Involvement:** - Required practice requires that;

- Stakeholders;
 - Be adequately informed of the nature of the risks relating to proposed and existing tailings facilities,
 - Can effectively participate, in a collaborative manner, in decisions that may interest or affect them.

- Project proponents not only have an obligation to consult and listen to stakeholder perspectives, but also have an obligation to take their perspectives into account.
- Owners/Operators have the obligation to publicly disclose, at a minimum, studies, audit protocols and reports pertaining to site and method selection, annual EOR reports, Dam Safety Reviews and industry certification activities.

2.2.1.6. Design, Construction, Operation & Closure Activities

2.2.1.6.1. Knowledge Base

R 1.2 **detailed site characterization** - Required practice should be based on the use of *Professional Practice Guidelines – Site Characterization for Dam Foundations in BC* or equivalent.

R 1.3 – **impacted stakeholders** – should also quantify projected socio-economic impacts

2.2.1.6.2. **Site & Method Selection** – Stating “minimize risk” in the principle is meaningless. The objective should be to minimize the risks to a level acceptable to all stakeholders or to demonstrate beyond reasonable doubt that risks will be managed within acceptable limits.

- R 2.1 needs a reference to establish required practices for the “formal, multi-criteria alternatives analysis”
- R 2.2 This should not just be a technical review. Those with management and stakeholder perspectives should be part of the ITRB team. A single technical reviewer should not be used.
- R2.3 Very good. Now have to describe what “meaningful engagement means”
 - At a minimum inundation studies, risk assessments and risk management plans should be made available to the public
- APPENDIX 3: ASSESSMENT OF ALTERNATIVES in the MAC Tailings Guide should be referenced as being minimum required practice

2.2.1.7. **Tailings Management System:** Leading practice with regard to management systems would require the use of ISO 14001 or equivalent for all environmental issues.

(Note: It should be stated that MAC’s tailings guide represents, at this time, best available practice at this time. Also, as an assurance mechanism, its protocols and verification reports should be publically available and conformance periods need to be shortened.)

2.2.1.8. Operating Manual: Unless better examples exist, the MAC OMS manual guide (or equivalent) should be stated as **required practice**.

Respectively Submitted

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BIOGRAPHICAL SUMMARY

Henry Brehaut has spent all his working life in the mining industry with experience in underground and open pit mining, mine and corporate development, environment and sustainable development and corporate management. As a corporate executive and director Henry has gained extensive experience in corporate governance and mine management, including chief operating responsibility for nine tailings dams.

Henry currently acts as an independent consultant on sustainability issues as President, Global Sustainability Services Inc. and has provided executive and board level advice on sustainable development issues to governments, multilateral organizations, mining companies and industry associations. In 1999 he received the Prospectors and Developers Association of Canada Environmental Award for “helping to bring environmental and sustainable development issues to the forefront in Canadian and international mining”. He has a B.Sc. in Mining Engineering from Queen’s University and a MBA from the University of British Columbia.

Catastrophic Tailings Dam Failures – Path Forward

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ABSTRACT: Recent dam failures have led to the identification of incremental improvements in the design, management and regulation of tailings dams that should be adopted on a global basis to reduce the likelihood and consequences of future catastrophic failures. The primary purpose of this paper is to identify further improvements that must also be implemented in order to achieve a significant reduction in the frequency of dam failures in general and the elimination of catastrophic failures in particular. While the initial the focus of this paper will be on what mining companies need to know and do, it will also examine the roles and responsibilities of other key players, including consultants, regulators, industry associations and standard setting bodies. All players need to up their game and the latest round of incremental improvements should be looked at as only the first step of a committed process leading to the highest standards of tailings dam design and management.

1 INTRODUCTION

The future success of the mining industry is dependent on its ability to gain the trust of a wide range of stakeholders in order to obtain its social license to develop and operate mines. While tailings management is only one of many major issues that must be addressed, recent history has shown that the mining industry has yet to achieve the level of performance required to eliminate catastrophic dam failures. However, there are companies, consultants and regulators around the world that have a high level of commitment to tailings dam safety and have developed practices that have been instrumental in ensuring the safe operation of tailings dams by many companies in many countries. The challenge is to use this experience as the starting point in the development of standards, practices and guidelines that must be used by all companies to establish higher levels of performance, by governments for effective oversight of the industry and to provide the basis for a high level of public trust.

While the initial focus of this paper will be on what mining companies need to know and do to achieve a significantly higher level of performance, it will also examine the roles and responsibilities of other key players, including consultants, regulators, industry associations and standard setting bodies. All players need to up their game and the latest round of incremental improvements should be looked at as only the first step of a committed process leading to the highest level of performance possible.

2 PAPER OUTLINE

This paper will focus primarily on the design and operating stages of the mining cycle. It is at the design stage when the highest consequences of failure need to be defined in relation to the

proposed deposition method and site location. It is during the operating stage where mining companies must strive for the lowest likelihood of failure. Closure plans and risks will only be discussed in sections of this paper pertaining to deposition method and site location alternatives.

The author will offer his perspectives based on experience gained working at the executive and board level of mining companies. This paper will not address matters pertaining to the geotechnical aspects of tailings dam design but will offer comments regarding the important roles of geotechnical engineers in support of corporate governance systems and government oversight.

Sections 3&4 will comment on some broader issues relating to the discussions to follow, including the definition of a framework to guide the examination of the interrelated nature of the activities that companies, governments and consultants must each perform in meeting their respective responsibilities. Sections 5-7 will examine the roles and responsibilities of each group with the objective of defining leading practices in each area. This will be followed in Section 8 by an overview of the contribution of other associations to the improved performance of their members. Section 9 will address two major issues, acceptable risk and corporate commitment, followed by Section 10 that will present ideas as to the path forward.

3 INITIAL OBSERVATIONS

The topics in this section of the paper are presented to provide a broader context for certain subjects discussed in this paper. The reader may or may not agree with what is stated but will, at least, better understand the basis of related statements or comments.

3.1 *Dam Safety*

For companies, engineers, and regulators, to portray, describe, or assess a tailings dam in terms of it being safe is misleading. All believe their tailings designs and facilities are safe. However, all dams are not created equal and some have failed. As stated by Freeze (2000);

“The owners and operators of large engineering facilities want the public to hear about the great benefits to be bestowed upon it by their facility, not about how likely it is to fall down, or what the probability is that it will pollute the environment”.

All communications, research, design and operating controls must be clearly focused on the likelihood and consequences of failure and the risk management strategies that are being or should be used to protect its employees, the public and the environment. The word safety will not be used in this paper other than when referring to the safety of employees, the public or the environment

3.2 *Prime responsibilities*

A complex relationship exists between mining companies, regulators and consultants with regard to ensuring that the highest standards of tailings dam management are identified and implemented. For the highest level of risk reduction to be achieved, the primary role of each group must be clearly defined primarily to avoid confusion as to what each group must do, but also to identify gaps that must be filled.

3.2.1 *Mining companies*

Mining companies must accept full responsibility for the location, design, construction, operation, decommissioning and closure of tailings facilities in a manner that ensures its risk management strategies provide an acceptable level of protection for the safety, health, and welfare of the public and the environment. They should discharge this responsibility and express their commitment to the highest standards of risk mitigation through the adoption of strong policy statements, the establishment of a comprehensive governance framework and the implementation of comprehensive assurance activities.

3.2.2 *Governments*

Governments must be responsible for the protection of employees, the public and the environment from undue impacts and risks arising out of or in connection with mining operations. They must discharge this responsibility primarily through the development of laws, regulations and guidances, by granting permits on the basis of a strong regulatory framework and public consultation and being responsible for an effective compliance and enforcement regime.

3.2.3 *Professional geotechnical engineers*

Professional geotechnical engineers should be responsible for the design of tailings facilities in accordance with the highest state of practice and applicable regulations, statutes, guidelines, codes and standards while fulfilling their professional obligations that, "...hold paramount the safety, health, and welfare of the public..."(APEGBC 2014)

3.3 *Risk Exposure*

All tailings dams have a likelihood of failure. Hazards related to natural causes are of primary concern through all phases of the design and mine life cycle. Risks specifically related to the tailings deposition method, dam design and site selection are equally important and must be identified as part of comprehensive approval process that is informed by a dam break analysis and inundation study. Mitigating strategies should be identified for inclusion in the design and management system and to provide the basis for strong management control and regulatory oversight. However, it should be noted that such approval rests on assumptions related to the interpretation of guidances supporting the design process, the effectiveness of a company's governance system and the effectiveness of regulatory oversight.

While the design process will address recognized natural hazards, it must be acknowledged that additional design risks could exist because of gaps in the knowledge base supporting current technical standards leading to a hazard not being recognized. Variations in the degree of professional experience, judgement and conduct may also be factors.

Management risks can arise because of low corporate commitment, economic feasibility pressures, and insufficient resources provided to support dam design and the implementation of management systems. Regulatory risks may be introduced as part of the permit approval process and through inadequate compliance and enforcement activities.

Another way of looking at how a tailings facility can be exposed to further risks is to consider the dynamics within each major participant. The term regulatory capture has been used by the Auditor General of British Columbia to describe the situation where the regulator, created to act in the public interest, may, in certain situations, serve instead the interests of a company or the industry (BC AG 2016). Using the same perspective for mining companies, economic capture could be described as the situation where short or long term economic factors are given precedence over sustainability commitments and permit obligations. For the geotechnical community, client capture could be used to describe situations where the engineer may be influenced by client pressures in the performance of their work.

3.4 *Commitment*

To meet the above responsibilities, a high degree of commitment to risk reduction and control is required by a company and all its employees, by government officials and by geotechnical consultants. In the case of a mining company, the existence of a tailings management policy means nothing in itself. Policies will vary in terms of commitment and actions taken will vary in terms of effectiveness. Recognizing the fact that some companies are more committed than others leads to two key observations. The first is that well documented governance, design and operating practices have been developed by some highly committed companies that go beyond what is generally called best practices. The second is that some companies may not have a high degree of commitment and it is these that need strong industry leadership, strong regulatory oversight and a high standard of professional ethics from the geotechnical profession.

3.5 *Quality designations*

The quality designation for an industry practice rests solely in the eye of the beholder which is most likely to be the person or organization that has developed it. Common terms are good, best and, less often, leading practice. Even the term emerging practice has recently been used to describe a practice that has been employed by some committed companies for over 20 years.

The concern with most of such designations stems from how they were developed. At the lowest level, it is a self-designation by an individual, company or an organization. Moving up the scale, a committee of experts, usually under the umbrella of a mining association, government or a professional body, is mandated to develop a set of practices or guidelines based on their collective experience. Such efforts require a consensus at the committee level and approval by the supporting organization. Because of varying degrees of commitment at both the committee and approval level, this inevitably leads to a less than aggressive pushing of the boundaries.

The next level of practice development occurs when other stakeholders are involved as it has been shown that the resulting practices lead to the inclusion of more demanding and detailed expectations such as more specific guidances and performance thresholds. The term best practice may be applicable to such situations.

Statements regarding leading practice often refer to instances where a practice exhibits a higher degree of commitment as compared to other companies, other associations or other political jurisdictions. Such definitions are essentially backward looking. While undoubtedly some aspects may represent a high degree of commitment for specific practices, many still fall short of what constitutes real leadership. Leading practice should be forward looking and defined as a practice that goes well beyond the norm, providing the highest degree of commitment and/or a significant improvement in risk reduction. In this paper, practices that the author has judged to be leading will be presented in a text box or be otherwise identified.

While an understanding as to how industry practices are developed and agreed upon is important, the real test is how they are defined. Prescriptions can range from a list of things to think about to detailed descriptions as to what is required. Without a detailed description of what each practice element requires, little guidance is provided for the both the practitioner and those that need to judge the level of commitment being applied. Again experience has shown that stakeholder involvement has helped identify the need for more detail.

The bottom line is that existing self-identified good and best practices have failed to prevent catastrophic dam failures and more progress is required. Furthermore, the more general the description of a practice, the easier it is for the less committed to claim they have adopted it.

4 STRATEGIC FOCUS

The continued occurrence of catastrophic dam failures suggests that the system attempting to prevent such occurrences is not yet fully developed. What some describe as a broken system is best described as a patchwork system with more patches to be added, gaps to be filled and overlaps to be removed.

Rather than identifying further steps that could be taken to fill existing shortcomings, the following sections of this paper will be based on a strategic approach to the improvement of tailings dam design and operation. Strategic planning is based on the premise that if you do not know where you are going, you will never get there. A strategic plan will provide the context for the definition of stretch goals and the establishment of a continuous improvement program. Waiting for the next dam failure to make further improvements is not good enough.

4.1 *Strategic Vision*

The ultimate goal should be that a future mining project should not be approved by a company's board of directors or by a government unless the proponent can demonstrate to itself, the government and the public, beyond reasonable doubt, that the proposed tailing dams can be managed in a manner that meets each party's definition of acceptable risk.

For a company, its strategic vision should be to gain the confidence of the government and the public for its tailings management plans through the demonstration of a commitment to

strong policies and practices that are capable of earning their trust and meeting their definition of acceptable risk.

For a government, its strategic vision should be to contribute to meet the economic, social and environmental goals of their jurisdiction through a balanced approval process and a strong compliance program while providing for the protection of employees, the public and the environment from undue impacts and risks arising out of or in connection with mining operations.

4.2 *Tailings Responsibility Framework*

The design, construction, operation and closure of any tailings dam is carried out within a complex system requiring high levels of expertise, commitment and diligence. A mining company, which must accept ultimate responsibility, may retain professional consultants to assist them in meeting their responsibilities and may rely on the regulatory system to add rigor through government permitting and compliance responsibilities. In situations where the regulatory system lacks substance, a company must internalize these aspects within their own system.

Larger multinational companies have realized the need to reduce their reliance on external services and standards and have taken on more responsibility internally. Smaller companies, which have fewer resources, are more dependent on outside to help in the development and implementation of high standards.

Whatever the situation, a complex relationship exists between mining companies, regulators and consultants with regard to ensuring that the highest standards of tailings dam design and management are identified and implemented. Many parts have to come together within a framework that examines the interrelated nature of the activities that each must perform in meeting their respective responsibilities. For the purposes of this paper it will be called the Tailings Responsibility Framework (TRF).

In sections 5-7 to follow, the roles and responsibilities of mining companies, governments and geotechnical consultants will be examined within the context of the TRF in order to identify those leading practices that are required to significantly reduce the consequences and likelihood of catastrophic dam failures. The prime focus will be of a strategic nature. That is to develop an outline of what is needed and to provide examples of the leading practices required to get there.

5 RESPONSIBILITY FRAMEWORK – MINING COMPANIES

5.1 *Corporate governance*

Mining companies must accept full responsibility for the location, design, construction, operation, and closure of tailings facilities in a manner that ensures its risk management strategies will provide an acceptable level of protection for the safety, health, and welfare of the public and the environment. It may be a company's objective to ensure dams are designed and operated to the highest standards but it is impossible for a company to ensure that its facilities will be risk free. They should discharge this responsibility and express their commitment to the highest standards of risk mitigation through the adoption of strong policy statements and require the establishment of a comprehensive governance system supported by the implementation of comprehensive assurance activities.

Board leadership is an absolute necessity for a company to achieve high levels of performance. A company's tailings management programs must be driven from the top. Without such support, those responsible for designing and operating a tailings facility will have more difficulty in gaining acceptance and receiving adequate resources for what needs to be studied and designed and then operated to the highest standards.

5.1.1 *Materiality*

From an internal perspective materiality for a corporation is primarily defined in financial terms. For a government, materiality is largely defined in non-economic terms considering possible loss of life, environmental damage and economic loss. For the public, materiality is primarily defined in terms of personal impact with their personal safety being paramount.

The potential economic losses to a company for even a partial failure of a tailings dam include loss of profits and costs related to dam reconstruction, environmental rehabilitation, law-

suits and government fines. Economic factors alone will usually dictate that tailings dams be considered a material risk for a corporation. In addition, a company must also consider potential impacts such as the loss of human life, environmental damage and public economic loss in its materiality ranking. When all potential impacts are considered, including a company's loss of public credibility, it is hard to visualize a company not considering the design and operation of any one of their tailing dams not to be a material risk issue. A large company may be able to rationalize that the economic risk of a single dam failure may not be material but, in situations where a tailings dam could put the local population at immediate risk, it would be cavalier not to recognize its materiality to the corporation.

5.1.2 *Board governance – Sustainability committees*

Corporate law requires directors to use their skill and experience to provide oversight of the business of a company. Directors have a duty to act honestly and in good faith with a view to the best interests of the company and to exercise the care, diligence and skill that a reasonably prudent person would in comparable circumstances. Duty of care responsibilities now requires the company's directors to provide oversight of the material risks of a corporation. Oversight of tailings dam risks is typically assigned to the board committee mandated to oversee sustainability issues.

The advantages that result from having a board committee oversee material risks are, firstly, that the company accepts overall responsibility at the highest level for ensuring that strong standards and management processes are established and that they continue to be effective on an ongoing basis. The second is that the directors will bring a higher level of review to the determination of acceptable risk. As stated by KingIII 2009, in making such assessments "...the board should be expected to take account of the legitimate interests and expectations of the company's stakeholders in making decisions in the best interests of the company." A third advantage is that by having the directors review and assess the risk management strategies for new projects the chances are better that any conflicts between economic and sustainability objectives within the company are identified and addressed.

5.1.2.1 Board governance leading practice would require that the terms of reference for the sustainability committee should, at a minimum, include responsibilities to:

- Make recommendations to the board regarding the approval of corporate policies and standards for the management of material risks;
- Oversee the policies and management processes used to manage the material sustainability risks of the corporation;
- Review and assess assurance reports to verify that corporate policies and standards have, in fact, been implemented;
- Review and assess management's risk management strategies for new projects and report to the board as to their adequacy in the light of possible consequences;
- Assess the application of adequate corporate resources; and
- Review and assess verification reports pertaining to the management of material risks.

5.1.3 *Tailings Governance Policy*

Leading practice requires that a company develop a tailings governance policy to be approved by its board of directors. General practice is for the Chief Executive Officer (CEO) of a company to develop the policy and submit it to the sustainability committee for review and assessment. Leading practice would then dictate that the policy, once found to be acceptable by the sustainability committee, be referred to the board for approval. The primary purpose of a tailings management policy should be to demonstrate corporate commitment to a meaningful set of objectives and actions that would serve as the basis for the design and management of tailings facilities and the development of risk management strategies.

5.1.3.1 Corporate tailings policy leading practice would require that the corporate tailings governance policy include commitments to:

- Locate, design, construct, operate, and close tailings facilities in a manner that provides an acceptable level of protection for the safety, health, and welfare of the public and the environment;

- Implement a tailings governance framework management system based the ISO 14001 environmental management standard or equivalent;
- Utilize robust risk management systems and processes to identify and mitigate material risks;
- Implement comprehensive change management and emergency preparedness and response plans;
- Conduct an integrated tailings disposal method and site location selection process for new tailings dams based on a thorough understanding of the costs and consequences of failure of alternate methods and site locations;
- Ensure the public is adequately informed of the nature of the risks relating to both proposed and existing tailings facilities and can effectively influence, in a collaborative manner, decisions that may interest or affect them;
- Establish a comprehensive review and assurance program to verify that the commitments stated in the corporate governance policy are been met on a continuing basis and to provide the foundation for continual improvement; and
- Make the assurance protocols and reports available to the public.

5.2 Tailings Governance Framework

The Chief Executive Officer is appointed by a company’s board of directors and is responsible for the execution of a company’s strategy and policies within the limits of the CEO’s delegated authority. With regard to tailings management, the CEO will be guided by corporate policies approved by the board. Corporate risk and sustainability policies will provide general guidance, but for material risks such as tailing management specific policies and standards will also be required.

To implement the requirements of the policies as they apply to tailings management, a CEO will assign responsibility for their development and implementation to key members of the company’s corporate office. In a large company this may include the chief operating officer, the risk management officer, the sustainability officer and the officer assigned responsibility for the internal audit function. The assignment of responsibilities on specific aspects may be a combination of individual and team efforts. However, what will make it all work will be the demonstrated commitment of the CEO and the executive team to high standards of performance at all levels of the organization and for all activities, not just tailings management.

A common corporate practice is for a company to organize its policy requirements within a tailings governance framework with the development of a management system as the core element. Other important aspects include the application of corporate risk management policies, the establishment of organizational, design and operating standards and requirements for assurance and reporting activities.

Tailings Governance Framework: Leading practice would require that the executive office of a company respond to its TSF policy requirements through the establishment of a framework that will define requirements for a management system, operating manuals, corporate standards, risk assessments and assurance activities.

5.2.1 Tailings Management System (TMS)

A management system provides the framework within which a company can organize the activities required by its policies and standards. An environmental management system, as defined by ISO 14001, helps organizations identify, manage, monitor and control their environmental issues in a holistic manner (ISO 14001 2015).

The Mining Association of Canada (MAC) in *The Guide to the Management of Tailings Facilities* (MAC Guide) describes a comprehensive tailings management system as “one that integrates technical and managerial aspects, and one that individual companies may adapt and implement under often widely ranging conditions.” MAC Guide 2011 also states that:

“The *Guide* is not a technical manual; technical guidance may be found in other publications. Nor does the *Guide* replace professional expertise or regulatory requirements. Mining companies should obtain professional and/or expert advice to be sure that each company’s specific needs are

addressed. Mining companies and tailings facility owners and operators are encouraged to adapt and extend the principles contained in this *Guide* to meet their own site, operational and community requirements, incorporating appropriate site-specific performance measures.”

To a great extent, the quality of a TMS will depend on the degree of input provided by a dam’s Engineer of Record (EOR) and other experts on specific issues. A mine’s management system only provides the framework for the documentation of the procedures required by the experts to do the job properly. It is important to recognize that a TMS is only a system. Its value is that it identifies and forces attention on all activities required to effectively respond to a company’s policy commitments. Issues and activities have to be defined; prime responsibilities have to be identified; objectives have to be agreed upon; measures have to be identified; procedures have to be established, monitoring and inspection programs have to be documented and reporting requirements established. A management system does not provide the answers. It only requires that they be answered by those fully qualified to do so.

With regard to the above, a leading practice for companies committed to high environmental standards is to require the adoption of ISO 14001 or its equivalent for all their environmental issues. This helps establish a high standard of care for such issues and creates a common performance culture within an organization. However, ISO 14001, because of its generic nature, is not mining specific and the application of the MAC Guide within an ISO 14001 system will add to the strength of a TMS. From another perspective the MAC Guide, which is based on ISO 14001, will have greater acceptance and speed of adoption if introduced within the strong performance culture established by ISO 14001

TMS: Leading practice with regard to management systems would require the use of ISO 14001 or equivalent for all environmental issues with guidance provided by the MAC Guide for tailings management systems.

5.2.2 Risk Management Framework

To develop robust risk management systems and processes to identify and mitigate material risks, some mining companies have adopted ISO 31000: 2009 Risk Management - Principles and Guidelines (ISO 31000) to provide a framework for the management of all corporate risks. The introduction to the standard states:

“...the adoption of consistent processes within a comprehensive framework can help to ensure that risk is managed effectively, efficiently and coherently across an organization. The generic approach described in this International Standard provides the principles and guidelines for managing any form of risk in a systematic, transparent and credible manner and within any scope and context.” (ISO 31000 2009)

The main value of this standard is to provide a structured basis for the integration of risk management processes and the establishment of a risk management culture. With regard to ISO 31000’s use by mining companies, it should be noted that this international standard is generic in nature and, for its effective application, expert advice will be required for its adaption and use.

Companies will need to establish a corporate standard for the identification, evaluation and management of TSF risks at each of their mine sites. In addition to the usual requirements of a corporate risk standard, the standard should also address the qualifications of the assessment team and require the implementation of critical control procedures.

In the position statement “Preventing catastrophic failure of tailings storage facilities” issued by the International Council on Mining & Metals (ICMM) it is stated that enhanced efforts are required to ensure that “Suitably qualified and experienced experts are involved in TSF risk identification and analysis, as well as in the development and review of effectiveness of the associated controls.”(ICMM 2016) Regarding qualifications, the Rio Tinto management system standard states “Qualitative and quantitative risk analysis must be facilitated by competent personnel and include personnel with adequate knowledge and experience for the risk being evaluated.” (Rio Tinto 2014)

One of the most important factors is that the lead assessor be fully qualified in the conduct such assessments. Expert knowledge in the design and operation of tailings storage facilities is

not required as the lead assessor is primarily required to lead the process, not be a factor in influencing the outcomes. With regard to the assessment team, it is important that a range of perspectives and experience be represented and includes the participation of the EOR. What should not be allowed by the lead assessor is for persons to pull rank or to dominate the discussions.

ICMM also stated in its position statement that performance criteria should be "...established for risk controls and their associated monitoring, internal reporting and verification activities." ICMM further suggests that "Critical control management has been identified as an approach to managing low probability, high impact events such as catastrophic failures of tailings storage facilities." The identification of those issues that will require the highest level of attention is a necessary outcome of any risk assessment.

Risk Management Framework: Leading practice would require that a company, working within the framework of ISO 31000, establish a corporate risk management standard that would include statements regarding the qualifications of audit assessment teams and require the identification of critical risks and their controls.

5.2.3 *Operating Manual*

One way of looking at a tailings management system is that it requires the documentation of the best way to do something, to write it down and to make sure it happens all the time. In response to this need, MAC has published the Developing an Operation, Maintenance and Surveillance Manual (OMS Manual) for Tailings and Water Management Facilities (MAC OMS Manual) that describes the rationale, organization and contents for an OMS Manual. (MAC Manual 2011).

Operating Manual: Leading practice would require:

- The preparation of a site specific operating manual based on the framework and detail provided by the MAC OMS Manual;
- The completion of an operating manual prior to the commissioning of a new mine.
- Audit protocols to verify the adequacy of the manual in general and that professional and/or expert advice has been obtained in the development of critical procedures.

As noted above, issues and activities have to be defined; prime responsibilities have to be identified, objectives have to be agreed upon, objectives and measures have to be determined, procedures, monitoring and inspection programs have to be documented and reporting requirements established. The operating manual should clearly identify the high consequence risks and ensure that the highest level attention is paid to the development and documentation of critical control measures. For more on the subject of critical controls, refer to ICMM's Health and Safety Critical Control Management – Good Practice Guide (ICMM 2015), which is being used by its members in applying the same principles to TSF management.

Operating Manual: Leading practice would require:

- The identification of high consequence risks with the highest level of attention being given to the development of appropriate critical control measures and procedures; and
- The involvement, including final sign-off, of the Engineer of Record and other experts in the identification and preparation of critical control measures and procedures.

Since the primary focus of an operating manual will be on dam stability, the Engineer of Record should be an active participant in its preparation and be requested to sign-off on the identification of issues requiring critical controls and the procedures for their management. Experts in other areas such as emergency planning and response should also be retained to sign-off on related plans and procedures. As stated in the MAC OMS Manual "This guide does not replace professional expertise. Professional advice should be obtained in order to ensure that site and operational requirements are addressed and all regulatory requirements are met."

5.2.4 Independent Tailings Board (ITB)

Whether a mine is part of a large company or a small one, a high level of technical and operating expertise is required to support each company's Tailings Governance Framework. For large mining companies, this expertise may be internalized in varying degrees with the creation of a dedicated head office team that is independent from the mine operations and the corporate project development team. Smaller companies will probably not have the resources to internalize all the expertise required and will need to seek external advice on a wide range of matters for each of their mine sites.

One approach would be to establish an independent tailings support mechanism for each TSF. Such practices have been adopted by some companies more than 20 years ago that started with a focus on the technical aspects of tailings dam designs. Practices have evolved over the years requiring, in BC for example, where government has mandated (BC Guide 2016) that a mine manager create an Independent Tailings Review Board (ITRB) of subject matter experts that, amongst other duties:

- “Provides an independent assessment to senior mine management and regulators whether the tailings storage facility is designed, constructed and operated appropriately, safely and effectively;
- Provides the site team with practical guidance, perspective, experiences and standard/best practices from other operations; and
- Reviews and comments on the planning and design process, monitoring programs, data analysis methodology and work performed by site team and/or contract consultants.”

The importance of having an independent review of this nature has been reinforced by MAC's Tailings Review Task Force (MAC TRTF 2015) that stated:

“Independent review provides an important layer of due diligence on both the Engineer-of-Record and the owner of the facility. As such, it should be viewed as being in addition to, rather than a replacement for, external audits or assessments, and the role of the Engineer-of-Record.”

With the proper terms of reference and composition, an ITB would add most value as the upper layer of an assurance program for a company. Its scope should be as broad as possible covering all aspect of the tailings governance framework. Its composition should include, as a minimum, two geotechnical experts with expertise related to the dam design being assessed and one expert with broad experience in the management of dams at a senior corporate level. Expertise in other subjects such as risk assessment and emergency preparedness could be considered but it is likely that the core members of an ITB would have the experience to identify concerns in such areas and recommend that they be addressed by management.

The ITB will have to review documents, studies, operating manuals, audits, reviews, assessments and other reports but not in a formal manner and its comments should be in the form of advice and suggestions. The ITB should not be expected to formally validate or commit to any statements regarding the “appropriate, safe and effective management” of a tailings dam. The ITB should only advise the company on improvements it should consider and its ability to make such statements. The term review should not be included in the name of the ITB.

Independent Tailings Board: Leading practice requires that an ITB be formed for each TSF comprised of recognized industry geotechnical and management experts in the design and operation of TSFs for the purpose of providing a company with an annual assessment of the effectiveness of its Tailings Governance Framework and to offer its advice and comments on key matters such as the integrity of the dam structure, the identification and management of high consequence risks, the comprehensiveness of the assurance programs and the scope, depth and team qualifications for individual assurance activities.

The value of the ITB will rest primarily on its ability to advise a company on those matters the company should undertake to improve the strength of its tailings governance framework and to advise the company on matters pertaining to their assurance program. The terms of reference for the ITB should also include a role for the board members to provide advice when needed on important matters such as the selection of geotechnical consultants, critical control measures and procedures and the terms of reference for assurance activities.

5.2.5 *Engineer of Record*

Common practice requires the appointment of an Engineer of Record (EOR) by a company for each TSF. It is also common practice for government to require the retention of an EOR by a company and to define certain roles and responsibilities expected of this position through the life-cycle of the facility.

From a corporate perspective, the EOR should have professional responsibility for the design of the TSF in a manner that is in compliance with applicable laws and regulations, is in accord with the highest standards of international practice and is capable of the meeting the risk tolerances of the client and the government. On an ongoing basis, through the life-cycle of the TSF, the EOR should be retained to provide professional design services for all modifications or changes to the original dam design. The EOR should also conduct annual validations of the integrity of the dam design and key operating parameters that go beyond the scope of the annual inspections that may be required by governments. In addition the EOR should, as appropriate, participate in or be expected to contribute to all risk assessments, critical control determinations, assurance activities and the development of the operating manual.

As an important part of a corporate assurance program, the annual validations by the EOR should focus on an evaluation the adequacy of design performance and operating procedures for the overall facility during the past year, the identification of deficiencies or opportunities for improvement and providing assurance that the current design and operating manual will continue to provide an acceptable level of protection in the coming year.

Engineer of Record: Leading practice requires the appointment of an EOR to have professional responsibility for the design of and changes to each TSF, to conduct annual validations of performance and to participate, as appropriate, in activities related to risk assessments, critical control measures and procedures, assurance activities.

5.2.6 *Assurance activities*

Assurance activities are a key component of a comprehensive tailings governance framework and are essential in ensuring that the designs and procedures adopted by a company enable it to meet the objectives of its policies and all legislative requirements. To be able to satisfy or assure a board of directors of a company, the government and the public that its tailings governance policy has been effectively implemented, a comprehensive and integrated program of audits, assessments and reviews is required.

A survey of corporate sustainability reports, corporate websites and government requirements has shown very little commonality regarding the use of such terms. The use of the term audit is generally clear although some audits rely on the use of judgement to a qualified extent while other instances an activity described as an audit is more of a review. The terms assessments and reviews, and sometimes evaluations, are used interchangeably and sometimes together. Some companies refer to formal reviews or periodic reviews, which sounds good but gives no evidence of the substance of the activity suggested.

Audits are typically described as the independent, formal, systematic and documented examination of an organization's or facility's performance with explicit, agreed, prescribed criteria. To be effective audits need detailed protocols that provide specific questions to which factual answers can be provided as proof of conformance with practice requirements.

Assessments and reviews differ from audits primarily to the extent that judgement, based on relevant levels of experience and professional qualifications, is used to evaluate the effectiveness of designs or practices in achieving desired outcomes. For the purposes of this paper, a review is defined as a formal examination of something with the objective of verifying attainment of a required performance level and, if not so, identifying the need for improvement. In this context, assessment is defined as the process of making a judgment about something. Assessment is primarily a tool to judge progress or lack thereof against an objective although possibilities for improvement can also be a valuable outcome.

While the terminology used to describe a company's assurance activities needs better clarity, the effectiveness of any one activity depends on the establishment of a clear understanding of what is expected, what the main issues are and what qualifications are needed from the audit, review or assessment team. The judgement and experience of a team must be matched with the

objectives of the assurance activity. Judgement and experience levels will increase in inverse proportion to the availability of detailed protocols. Judgment and experience levels will be especially important when examining critical control procedures and practices related to high consequence risks. The quality of any given verification activity will always depend on the experience and judgement of the verifier and the quality of the verification protocol.

Assurance Activities: Leading practices requires that each assurance activity have a well-defined terms of reference that describes the scope, depth of evaluation, the appropriate judgement and experience levels required in the assessment team and the protocols or appropriate professional standards of practice to guide their work

Mining companies vary considerably in their approach to assurance activities. Larger companies have started to internalize some of their requirements for assurance through the establishment of corporate internal audit functions that are described as being independent. Such companies may also internalize technical and operating expertise for the development of corporate standards, to provide support for individual operations and to provide support for and be involved in internal assurance programs.

Smaller companies, that do not have the resources to establish a corporate internal audit function or to provide technical and operating guidance, must rely on external providers to meet their policy requirements. For example, assurances related to an ISO 14001 management system are available from professional auditors and assurances related to technical design can be provided by geotechnical engineers. MAC members benefit from the assurance protocols and providers as part of their Towards Sustainable Mining (MAC TSM 2017) program.

Technical dam reviews on a periodic basis are generally required by governments and are also essential parts of a comprehensive corporate assurance program. One feature of the Legislated Dam Safety Reviews guideline published in British Columbia (BC) (APEGBC 2014) is its recognition that the level of assurance should depend on a number of site specific circumstances such as consequence rating, dam type and use. It also requires an assessment of “the operations, maintenance and surveillance practices at the *dam* including the assessment of the overall *dam* safety management system and identification of any non-conformances;” without providing any guidance relating the conduct this part of the dam review. This just one example of the need to examine all assurance activities test for overlap and gaps as well as to the suitability of the supporting protocols and guidances.

The main challenge for all companies in the establishment of a comprehensive and effective assurance program is to ensure a high level of technical and operating expertise is available, internally or externally, to assist in the development of the scope, terms of reference and the selection of suitably qualified professionals for each assurance activity. The second challenge is to ensure that adequate assurance protocols and guidances are available to meet the objectives of the assurance activity. The third challenge is to ensure that their assurance activities also assess the quality of site-specific operating, monitoring, surveillance, maintenance and reporting procedures as described in the operating manual and audit their implementation and conformance in practice.

Assurance scope: Leading practice would require that a site’s operating manual be assessed by qualified experts as to the quality of its procedures and its application be audited regarding site conformance with its requirements.

5.2.7 Meaningful Communication and Engagement

“Trust us” no longer works. The social licence to receive a permit to construct and operate a tailings facility now depends on a company’s willingness to engage in meaningful communication with the public with the objective of gaining their trust. This view is supported by the Australian Government (AG TMH 2016), which states that;

“A key challenge for mining companies is to earn the trust of the communities in which they operate and to gain the support and approval of stakeholders to carry out the business of mining. A ‘social licence to operate’ can only be earned and preserved if mining projects are planned, imple-

mented and operated by incorporating meaningful consultation with stakeholders, in particular with the host communities. The decision-making process, including where possible the technical design process, should involve relevant interest groups, from the initial stages of project conceptualisation right through the mine's life and beyond."

Stakeholder consultation, information sharing and dialogue should occur throughout the TSF design, operation and closure phases, so viewpoints, concerns and expectations can be identified and considered. Regular, meaningful engagement between the company and affected communities is particularly important for developing trust and preventing conflict.

It should be noted that the term consultation is only one aspect of a meaningful communicating program by a company. According to The International Association for Public Participation (IAP2), community engagement consists of a spectrum of approaches described as follows;

- inform (provide information),
- consult (obtain feedback),
- involve (act on what we hear),
- collaborate (public participates in decision-making process but company makes the final decision)
- empower (public decides)

The fourth level, "collaboration", closely parallels one of MAC's "leadership" level requirements as part of its Towards Sustainable Mining initiative. In its Aboriginal and Community Outreach Protocol (MAC Outreach 2015) one of the requirements at their leadership level is that formal mechanisms are in place to ensure that the public "...can effectively participate in issues and influence decisions that may interest or affect them."

Meaningful Engagement: Leading Practice requires that the public is adequately informed of the nature of the risks relating to proposed and existing tailings facilities and can effectively participate, in a collaborative manner, in decisions that may interest or affect them.

Meaningful communication also requires that a company demonstrate its commitment by making its assessment protocols and results publically available. In addition to helping to drive internal improvement, this practice will go a long way towards earning public trust by showing the comprehensive nature of the standards of practice being used and the efforts being made to ensure that they provide ongoing protection for the public and the environment.

Meaningful Communication: Leading practice requires that a company make its assessment protocols and reports available to the public.

5.2.8 *Deposition Method and Site Selection*

In response to government and public expectations there is an increasing requirement for the assessment of alternate deposition methods for the purpose of reducing site specific risks and impacts. As stated in the Australian Government Tailings Management (AG TMH 2016) publication,

"Regulators nowadays expect all TSF design submissions to demonstrate beyond reasonable doubt that sustainable outcomes will be achieved during operations and after closure by the application of leading practice risk-based design that:

- Fully assesses the risks associated with tailings storage at a particular site;
- Compares the suitability of all available tailings storage methods, in particular those that involve tailings dewatering and/or eliminate the requirement for the damming of surplus water within the TSF;
- Demonstrates that the tailings storage method selected will manage all risks to within acceptable levels and as low as reasonably practicable (ICOLD 2013)."

To demonstrate to government and the public beyond reasonable doubt that the proposed site selection and deposition method provides an acceptable level of risk protection, a company must fully disclose the nature of the risks and convince the government and the public that its risk

management strategies and its commitment to a strong governance framework will adequately address their concerns.

This will require that the results of a dam breach and inundation study be disclosed and its risk mitigation measures be described. It will require that information be provided that supports the selection of the proposed alternative based on operating and closure requirements. Furthermore, as recommended in BC Guide 2106, “Selection indicators for large projects should be conducted in consultation with local communities, First Nations, and stakeholders in order to maintain a transparent, defensible evaluation.”

There are two main benefits of a meaningful communication process. The first is that by listening to and collaborating with the public regarding their concerns, a company will have a better appreciation of the risk mitigation measures it should adopt. The second is that a company will gain the opportunity to demonstrate its commitment to high governance and risk management standards in a constructive manner and, if done right, set the basis for it to earn the social license to operate.

Deposition Method and Site Selection: Leading practice requires that an integrated tailings disposal method and site location selection process be conducted for new tailings dams that:

- Is based on a thorough understanding of the costs and consequences of alternate deposition and storage methods and their consequence ratings;
- Considers alternatives that reduce or eliminate water stored within the containment facility;
- Considers closure requirements and its associated risks;
- That demonstrates beyond reasonable doubt that risks will be managed within acceptable limits; and
- That enables the public to participate in a collaborative manner in the examination of alternate deposition methods and their related risk management strategies.

For new alternatives to be credible they must be supported by a high level of design, operating and closure expertise similar to that currently available for slurry deposition. They must also receive the highest level of corporate governance as the new technologies will present their own challenges and require greater attention to design assumptions and operating controls.

6 RESPONSIBILITY FRAMEWORK - GOVERNMENTS

Governments must be responsible for the protection of employees, the public and the environment from undue impacts and risks arising out of or in connection with mining operations. They must discharge this responsibility primarily through the development of laws, regulations and guidances, by granting permits on the basis of a strong regulatory framework and public consultation and by being responsible for an effective compliance and enforcement system. To meet their responsibilities, some governments are responding with a higher level of oversight through a more rigorous permit approval process, expanded tailings management oversight, improved compliance and enforcement activities and increased transparency.

The leading practices put forward in this section of the paper are important for two reasons. The first is that most of them are necessary to deal with mining companies that are not fully committed to the highest standards of tailings dam design and management. The second is that these practices will help to define the principles and practices that a company will have to internalize for mines in countries without a high level of capacity or willingness to regulate the industry.

6.1 *Permit Approval Process*

Governments are now putting the onus on companies to put forward alternate disposal methods as part of the permitting process, with a particular emphasis on those that reduce or eliminate water within the TSF. A supporting stipulation, as described in BC Guide 2016, requires that “a dam breach and inundation study or a run-out analysis conformant to CDA guidelines be conducted” and that a dam consequence rating be assigned to each alternative. This will provide

government with the information it needs to make a balanced decision regarding the approval of a mine project and will help force companies to pay greater attention to risk reduction in their selection of the tailings disposal method and the location of the disposal area.

The alternatives submitted for the approval of a TSF should be based on very specific operating parameters and risk mitigating measures. These will provide the basis for the consequence classifications which in turn will provide the basis for regulatory review and public comment. Public engagement is a necessary part of the approval process so that it can become adequately informed and be able to express its views as to the acceptability of any given proposal or alternatives. For a permit to be granted, a government's decision to approve a particular design will depend on its determination that the dam design, with its risk mitigating strategies, will provide an acceptable level of protection for the safety, health, and welfare of the public and the environment.

Permit approval process: Leading government practice requires that a company engage in a meaningful manner with the public regarding its TSF alternatives with the objective of providing government with an understanding of the issues it must consider in approving a particular proposal or alternative.

When and if a permit is approved it must be granted with the requirement that critical design operating parameters and risk mitigating strategies are strictly adhered to. One example is the requirement, as stated in the BC Guide, to include measurable monitoring parameters that are identified and required to be maintained within predetermined limits for a tailings storage facility. This subject was also addressed in a report by the Auditor General of BC (BC AG 2016) that stated that permits should be written with enforceable language.

Permit conditions: Leading practice requires that permits and permit amendments be granted on the basis of strict conditions related to critical operating parameters and risk mitigating strategies and that they be measurable and enforceable.

6.2 *Permit Amendments*

Companies should be required to provide notification of any proposed changes to the permitted deposition method, dam design or operating conditions for government review and approval. Such notifications and supporting material should be accompanied by the results of a risk assessment that clearly identifies any consequence or likelihood changes. If there is any doubt as to the acceptability of the revised risk profile, governments should require a public review as part of its approval process. Governments, at any time, should also establish the right to compel companies to provide an independent opinion on any proposed changes based on terms of reference approved by government.

Permit amendments: Leading government practice requires that companies be directed to submit any proposed changes to permit conditions for approval and that government institute a public review process if there is any doubt as to the acceptability of the revised risk profile.

6.3 *Government Oversight*

Government oversight in general should include requirements for regulatory inspections, annual company performance reports, third party annual inspections and periodic integrity reviews. Further requirements must also be considered, either in a permit or as a general requirement of all companies, particularly if a government has concerns about the industry's commitment to or its understanding of what is needed to adequately manage its TSFs. Examples are ITBs and operating manuals. When such actions are taken it is important that specific direction be given as to what is expected and to insist that assurance be provided to verify that, as a minimum, that industry standards of practice have in fact been achieved.

The BC Guide notes that:

- “Several bodies provide guidance of how to develop a tailings management system, including:
- The Mining Association of Canada (MAC). A Guide to the Management of Tailings Facilities, Second Edition, 2011.
 - The International Organization for Standardization (ISO 14000).
 - Governments of Australia and New Zealand.”

Permit approval process: Leading government practice would require companies to put forward alternate tailings disposal methods considering the reduction or elimination of water within the disposal area and that a dam breach and inundation study be conducted in support of each alternative.

The guidance document goes on to state that tailings management system should complement a mine’s environmental management system, which “...is expected to have been developed in conformance with ISO14001.”

In the case of operating manuals, the BC Guide requires that “...mines develop and implement operational procedures, maintenance procedures and a surveillance and monitoring program...and be formally documented in an Operations Maintenance and Surveillance (OMS) manual.” The Dam Safety Guidelines of the Canadian Dam Association and the MAC OMS Manual are referenced as providing guidance as to industry standards of practice.

The need for government to mandate the use of high management standards is not because they do not exist. It is that they have not been fully adopted by all companies. Just as governments require and rely on independent reviews and assessments for technical matters, the same holds true for managements systems. Using the operating manual as an example, once a government has mandated its development and use, it should require third party verification that it meets prescribed standards. As a further precaution it should also require the completion of the operating manual prior to commissioning of a TSF.

Government oversight: Leading practice requires that governments dictate the adoption of specified management standards and that assurance be provided that they have been implemented in keeping with prescribed standards.

6.4 *Compliance & enforcement*

As stated by the Auditor General of British Columbia in the report, An Audit of Compliance and Enforcement of the Mining Sector:

“Enforcement is the backbone to any compliance program. It is the final line of defence against environmental degradation. According to good practice, strategies involving education, assistance, incentives, monitoring and inspections are effective only if backed by a credible threat of enforcement sanctions. To be effective, enforcement programs must involve: swift and predictable responses to violations and responses that include appropriate sanctions.”

6.4.1 *Compliance & enforcement effectiveness*

Regulatory effectiveness: Leading practice would require that governments establish an integrated and coordinated regulatory approach with the objective of ensuring the effectiveness of its compliance and enforcement activities.

In response to the published BC AG 2016 report, the BC Government “...committed to establish a Mining Compliance and Enforcement Board...to oversee an integrated and coordinated regulatory approach to mining in the province of B.C.” The multistakeholder Board was given the mandate to oversee the development of “...strategic improvements that enhance compliance and enforcement effectiveness through integration and coordination of planning, training, policies, procedures, tools, evaluation and public reporting for mines in British Columbia.” One of its deliverables is to identify “...the necessary capacity, tools, training and expertise required to achieve goals and objectives.” (BC C&E 2016)

6.4.2 Administrative Monetary Penalties

In 2016, British Columbia amended its Mines Act to establish key components for administrative monetary penalties (AMP), such as the authority to make findings of contravention or non-compliance and to impose AMPs. The BC Code states that a person who commits an offence is liable to a fine of not more than \$1,000,000 or to imprisonment for not more than 3 years or both. It goes on to state that “If a corporation commits an offense, a director or officer of the corporation who authorized, permitted or acquiesced in the offence...” is also liable to the penalty limits stated above.

The recognition that a corporation, not just the mine manager, may be at fault is important as it relieves the mine manager from being ultimately accountable for all aspects of a TSF’s operation. It recognizes the fact that the original design would have been developed under the guidance of the corporate office, that the corporation is responsible for the provision of adequate resources and that the corporate office may be complicit in any decisions that result in an increase in risk levels.

As stated in the discussion paper BC AMP 2016, “An AMP is a financial penalty that can be imposed on individuals or companies who fail to comply with a particular provision of a statute, regulation, an order or a requirement, or the terms and conditions of a permit.” AMPs provide an effective enforcement mechanism for a wide range of contraventions and will allow governments to match the penalty with the severity of the non-compliance. By reserving its authority to shut a mine down for only the most severe cases of non-compliance, governments will have a more effective system for forcing compliance.

The ability and willingness of government regulators to apply AMPs can be powerful tool in ensuring compliance with the conditions of a permit. With removal of the shut-down alternative as the only choice, there is no excuse not to apply a penalty for non-compliant situations that result in increased risk.

Regulatory Enforcement: Leading practice would require that a full range of administrative tools, including an AMP program, be developed to support the enforcement of permit conditions.

6.4.3 Deferred Action

Other effective strategies to promote compliance include education, assistance, incentives, monitoring and inspections. Another practice that is used at times is to defer enforcement action in order to provide a company time to rectify non-compliant situations based on the rationale that such action would compel the shut-down of the mine. This approach is not unreasonable as long as the risk level of the TSF has not been raised significantly in the interim. When action is deferred on any TSF permit condition, each instance should be documented by the regulatory authority supported by a clear determination that the non-compliant condition will not significantly change the risk profile of the TSF.

Regulatory Enforcement: Leading practice would require the documentation and publication of deferred regulatory action and provide justification for such action including a statement regarding any change in risk level.

6.5 Transparency - website

One of the newer ideas to appear in response to recent catastrophic dam failures has been the establishment of the BC Mine Information web platform (BC Info) by the Ministry of Energy and Mines in British Columbia to make information on permitted mines more accessible to interested parties. The information posted to date relating to the 15 active mining operations in BC and, to date, includes:

- Authorizations – permits and amendments;
- Compliance Oversight – inspections; and
- Other Documents – 2014 & 2015 Annual Dam Safety Inspection reports.

The stated plan is to continue developing the use of this web platform with particular reference the Other Documents section.

The value of such a website is that it will add to the transparency and accountability of both government and industry which in turn will help to establish a higher degree of trust through the demonstration of the commitment of both government and industry to protect the public interest. Further benefits can be achieved by posting, for each mining site, the Annual Manager's Report, Periodic Safety Reviews and enforcement activities, particularly those instances pertaining to deferred enforcement action.

Transparency: Leading practice would require that governments create and maintain a website for the posting of permit authorizations, compliance and enforcement reports and other documents relating to operating and closed TSFs in their jurisdiction.

7 RESPONSIBILITY FRAMEWORK - GEOTECHNICAL CONSULTANTS

Professional geotechnical engineers should be responsible for the design of tailings facilities in accordance with the highest state of practice and applicable regulations, statutes, guidelines, codes and standards while fulfilling their professional obligations that "...hold paramount the safety, health, and welfare of the public...". However, it is understood that lawyers will argue that generally accepted professional standards should be defined as work performed in keeping with the prevailing level of care, skill and diligence ordinarily exercised by others who perform similar services under comparable circumstances. This is not a leading practice.

7.1 *Design team selection*

The selection of the qualified professional engineer (QPE) or engineering firm for the design of a TSF should be based on their qualifications, availability and local knowledge. Basic qualifications relate to having the appropriate level of education, training and experience. A more detailed listing requires ensuring that the QPE is knowledgeable in alternate deposition methods and key technical areas related to a particular site. An added qualification is the need for good judgement when dealing with the many uncertainties encountered in the design of a TSF. Furthermore, because of the complexity of tailings dams, a company needs to assess not only the lead engineer but also the composition and members of the design team. Companies should use their ITB to assist in the selection of the design consultant. In cases when the ITB may not be fully formed, the early appointment of its chair person would add significant value to the selection process.

On the other hand, it is the responsibility of the lead professional engineer or professional geoscientist to determine whether he/she is qualified by training and/or experience to undertake and accept responsibility. The professional engineer should only take responsibility for design and field review activities related to the design and construction of a dam that are consistent with his/her training and experience.

Geotechnical services: Leading company practice requires that a company carefully select their design team based a knowledgeable assessment of the design team's qualifications utilizing the experience of their ITB or other experts.

7.2 *Client assessment*

Not only should a mining company assess geotechnical qualifications in the selection of a design team, but geotechnical consultants also need to assess the company with regard to its commitment to high design standards and the implementation of a comprehensive tailings governance framework. Why would any self-respecting geotechnical consultant work for a company that may not provide adequate resources for site characterization, may not be willing to implement a strong management system and may not be willing to extend design services to include a role in the development of an operating manual?

Client assessment: Leading consulting practice requires that services are only provided to clients that demonstrate a high level of commitment to the design and operation of TSFs

8 OTHER ORGANIZATIONS

8.1 *Professional engineering associations*

The role of professional engineering associations in providing the technical guidelines and professional standards required for the design of TSFs have been and will continue to be very important in the design of tailings dams that, in conjunction with a strong management commitment and government oversight, can provide an acceptable level of protection for the safety, health, and welfare of the public and the environment.

8.1.1 *Technical guidelines*

Guidelines provided by ICOLD, CDA and ANCOLD are of a high standard and are widely used. ANCOLD, in their website have stated that their Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure (ANCOLD 2012) provide:

“...engineering detail that can be accepted by all relevant government authorities, and national and international companies involved in tailings dam development, allowing them to undertake design and construction consistent with leading industry practice. ANCOLD guidelines are not a design, construction or operation code and practitioners must apply their own considerations, judgements and professional skills when designing, operating and managing dams. As time goes on there will be improvement in contemporary dam practice and it is intended that ANCOLD guidelines will be updated as circumstances dictate.”

While recognizing the value of these guidelines, it is important not be complacent about their value. Statements that the technical guidance exists to prevent catastrophic dam failures are largely self-serving. Any body of science that relies on safety factors as a main design parameter has room for improvement in their technical understanding of underlying conditions and the application of new technologies. Furthermore, the application of the current set of technical guidelines requires judgement and interpretation, indicating the need for better guidance for critical areas of uncertainty. This has been illustrated by the recognition by the Association of Professional Engineers and Geoscientists of BC (APEGBC) that, in response to the Mount Polley tailings dam failure, developed “guidelines that would lead to improved site characterization for tailings dams with respect to the geological, geomorphological, hydrogeological and possibly seismotectonic characteristics.” (APEGBC 2016)

Whenever there is uncertainty in any design element or the need for judgement or interpretation, there is need for improvement in the underlying science or technology. Having the protection of a safety factor is no excuse not to have an aggressive initiative by the geotechnical profession and the mining industry to identify and then support work on standards of practice for those subject areas that would benefit from improved guidance.

It must be noted, however, that existing guidelines for mining dams have been largely created as an extension or add-on to guidelines for water reservoir dams. Consideration must now be given for their further extension to cover alternate deposition and storage methods. The mining industry, governments and the geotechnical profession must jointly support efforts that, for each potential alternative, will bring together the body of knowledge developed to date, identify and support the need for further study and support the development of the technical guidances and leading practices equal to those for slurry deposition methods.

8.1.2 *Professional practice guidelines*

Two professional practice guidelines, Site Characterization for Dam Foundations (SCDF) in BC (APEGBC 2016) and Legislated Dam Safety Reviews (LDSR) in BC (APEGBC 2014), have been issued by the Association of Professional Engineers and Geoscientists in British Columbia (APEGBC) and both are available on its website.

With regard to SCDF, important features from a management as well as an assurance perspective are:

- The provision of an assurance statement whereby the design engineer verifies that defined activities have been conducted according to the guideline and that the work of supporting professionals has reviewed and accepted; and
- The identification of uncertainties in the site characterization program so that they can be dealt with the design, construction, and operation of the dam through additional investigations, instrumentation, and contingency plans.

An important aspect of the LSDR guideline is the recognition that the terms of reference for any review be appropriate for its intended purpose. The guideline recognizes that:

“The types of dam safety review can be broadly considered to cover a spectrum ranging from an audit-type review to a comprehensive and detailed design and performance review. The qualified professional engineer should recommend an approach to the dam safety review that will cause the result of the dam safety review to be appropriate for its intended purpose.”

It is important for a company to fully understand what level of review is needed for the consequence classification of each dam and to understand how its scope fits with other corporate assurance activities. In the case of the BC dam safety reviews, it is noted that a LSDR will also review operating manuals, confirm proper functioning of management and environmental control systems and identify the magnitude of deficiencies in the dam management system. Of concern in this regard would be the availability of adequate standards of practice and/or protocols and the level of experience and judgement needed to adequately assess the functioning of the tailings governance system at a mine.

8.2 *Mining Association of Canada*

MAC’s tailings management program is one of the six key focus areas of their Towards Sustainable Mining program (MAC TSM 2017). MAC describes TSM “... an award-winning performance system that helps mining companies evaluate and manage their environmental and social responsibilities. It is a set of tools and indicators to drive performance and ensure that key mining risks are managed responsibly at participating mining and metallurgical facilities.” Members of the Quebec and British Columbia provincial mining associations, the Finnish Mining Association, The Argentinean Chamber of Mining Entrepreneurs and the Botswana Chamber of Mines have also adopted TSM for their members.

Commitment to the TSM program is mandatory for all MAC members’ Canadian-based operations requiring self-assessment of performance annually and external verification of self-assessed results every three years. Performance rankings are based on a five point scale (C, B, A, AA, and AAA), with distinct criteria needing to be met at each level before a facility can move to the next one. MAC defines Level A as “good practice” and attaining at least a Level A is a goal for every MAC member site. Level AAA represents “Excellence and Leadership”. Each operation’s performance ranking for each indicator is reported annually on MAC’s website. The supporting auditing and assessment protocols are also made available on their website.

The key elements of MAC’s tailings management program are its publications (1) A Guide to the Management of Tailings Facilities (MAC Guide 2011), (2) Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities (MAC Manual 2013) and (3) A Guide to Audit and Assessment of Tailings Facility Management (MAC Audit 2011). These publications have, together, been very effective in improving the overall quality of tailings management, particularly with regard to management systems and operating manuals. MAC is careful to point out that these guides are not technical in nature, do not replace professional expertise and that “...professional advice should be obtained in order to be sure that site and operational requirements are addressed and all regulatory requirements are met.”

In 2015, MAC formed an independent TSM Tailings Review Task Force to perform an external review of the guides and tailings protocol to provide advice on potential improvements. The task force submitted 29 recommendations, all of which were accepted by MAC’s Board of Directors. The most important of the recommendations were related to:

- Policy endorsement at the governance or board level;
- Improving timelines for the achievement of the A performance level;

- Requiring an independent review mechanism (ITB) to provide additional oversight and advice, including guidance as to its appropriate scope and mandate;
- Providing guidance on the assessment and selection of best available deposition technologies and practices for TSFs.;
- Providing greater guidance for the development of emergency preparedness and response plans;
- Providing more specific technical guidance related to site selection and design; and
- Posting good practice examples of actual OMS manuals on the MAC website.

The implementation of these recommendations will signal a shift from the MAC Guide being primarily a management system guide to one that also includes more specific technical guidance. This will be consistent with MAC's stated desire to be seen as demonstrating leadership worldwide and these improvements should be viewed as a step in the evolution of TSM towards a more comprehensive framework for the management of TSFs.

8.3 *International Council on Mining & Metals (ICMM)*

The ICMM website describes itself as follows:

- "ICMM is an international organisation dedicated to a safe, fair and sustainable mining industry.
- Bringing together 23 mining and metals companies and over 30 regional and commodities associations we strengthen environmental and social performance.
- We serve as a catalyst for change; enhancing mining's contribution to society."

As a catalyst for change it has mounted comprehensive initiatives on issues such as biodiversity, water, climate change, community development and employee safety. It has shared its position papers, good practice guides, practical guides and toolkits through its website so that the whole mining industry could benefit from its leadership.

With regard to tailings management, it has only published to date a position statement (ICMM PS) that its members are using to review their tailings governance frameworks. No indication has been given yet as to its intentions to prepare a good practice guide or toolkit that could be made available for the benefit of the mining industry. The position paper describes member commitments to enhanced focus on six briefly described key elements as follows.

8.3.1 *Accountability, responsibility and competency*

This is primarily an outline of a good management system with added emphasis on critical control management. Critical control management is a leading practice developed by ICMM and used by its members to drive progress on safety in the workplace. The adaption of this good practice guide for environmental issues, including TSF management, would be a useful contribution to overall industry performance.

8.3.2 *Planning and resourcing*

This commitment addresses the need for ensuring that adequate human and financial resources are available to support a company's tailings governance framework.

8.3.3 *Risk management*

In addition to committing to a comprehensive risk assessment program, members have committed to ensuring that "Suitably qualified and experienced experts are involved in TSF risk identification and analysis, as well as in the development and review of effectiveness of the associated controls" and that "Performance criteria are established for risk controls and their associated monitoring, internal reporting and verification activities".

8.3.4 *Change management*

Members have committed to the practice that "Risks associated with potential changes are assessed, controlled and communicated to avoid inadvertently compromising TSF integrity"

8.3.5 *Emergency preparedness and response*

This commitment includes the requirement that “Processes are in place to recognize and respond to impending failure of TSFs and mitigate the potential impacts arising from a potentially catastrophic failure.” In 2005 ICMM and UNEP jointly published a “good practice in emergency preparedness and response” document (ICMM 2005) that provides excellent guidance on this subject.

8.3.6 *Review and assurance*

This commitment requires that “Internal and external review and assurance processes are in place so that controls for TSF risks can be comprehensively assessed and continually improved”. Specific requirements are:

- “Internal performance monitoring and inspections and internal and external reviews and assurance are conducted commensurate with consequences of TSF failure to evaluate and to continually improve the effectiveness of risk controls;
- Outcomes and actions arising from TSF review and assurance processes are recorded, reviewed, closed-out and communicated; and
- Performance of risk management programs for TSFs is reported to executive management on a regular basis.”

8.4 *Australia*

The Australia Government has prepared a series of handbooks as part of their Leading Practice Sustainable Development Program for the Mining Industry. The handbooks are designed “to share Australia’s world-leading experience and expertise in mine management and planning”. The handbooks provide practical guidance on environmental, economic and social aspects through all phases of mineral extraction, from exploration to mine construction, operation and closure.

The primary audience for their Tailings Management Handbook (TMH) is stated to be onsite mine management, the primary level for implementing practices at mining operations. The TMH covers all phases of the mining cycle with particular attention to the selection of a suitable disposal method. In this regard, the handbook (AG TMH 2016) states:

“Regulators now expect all TSF design submissions to demonstrate beyond reasonable doubt that sustainable outcomes will be achieved by the application of leading practice risk-based design that:

- fully assesses the risks associated with tailings storage at the particular site;
- compares the suitability of all available storage methods, in particular those that dewater tailings before disposal and/or eliminate the requirement for the damming of surplus water within the TSF; and
- demonstrates that the selected tailings storage method will manage all risks to within acceptable levels and as low as reasonably practicable.”

To assist in the selection process, the handbook has a good description of alternate disposal and storage methods including a description of the advantages and disadvantages of each. The handbooks also support the adoption of AS/NZS ISO 31000 Risk management standard and the critical control management approach as developed by ICMM.

8.5 *Cyanide Code*

The Cyanide Code is introduced here for two reasons. The first is that its existence is primarily due to the efforts of The Gold Institute, an association of gold producers in the United States, that provided the lead in putting forward the idea for a management code following the Baia Mare tailings dam failure that occurred Jan 30, 2000 and then raised the funds and provided the leadership to make it happen.

The “International Gold Cyanide Management Code For the Manufacture, Transport, and Use of Cyanide In the Production of Gold” (Cyanide Code 2017) was developed under the guidance of a multi-stakeholder Steering Committee formed under the umbrella of the United Nations Environmental Program (UNEP) and the then International Council on Metals and the Environ-

ment (ICME). The steering committee members represented 8 gold mining companies, 5 governments, 3 NGOs and 2 cyanide producers.

When the code was introduced in 2005 by The International Cyanide Management Institute as an independent organization, nine gold mining, two cyanide producers and three transport companies were the original signatories. At the end of 2016, the Cyanide Code had 46 signatory mining companies covering 102 mining operations, 28 cyanide producers and 139 transporters. Signatory operations are located in 51 countries on 6 continents.

The second reason for its presentation in this paper is that its success may offer guidance in meeting the challenges of gaining public trust in the design and operation of TSFs. The risk associated with the manufacture, transportation and use of cyanide can be equally high in terms of consequence and has required a committed effort to maintain its social licence as an acceptable reagent.

The Cyanide Code commits signatories to manage cyanide in a responsible manner and provides the standards of practice and third party audits to make it happen. The Cyanide Code covers nine key areas: cyanide production, transportation of cyanide to the mine site, handling and storage of reagent cyanide, on-site use and management of cyanide at mining operations, decommissioning of facilities, worker safety, emergency response, training, and communications with the public. The main distinguishing feature of the Cyanide Code is its focus on the adequacy of an operation's plans, procedures and systems and verifying the actual adherence to those requirements in the workplace.

Detailed verification protocols are provided for use by qualified auditors at three year intervals at each mine site. Summary audit reports, usually 30 to 40 pages long, are posted to the Cyanide Code website with the basis for the audit finding for each standard of practice stated in the report.

The verification protocols and the posting of audit results and action plans are considered to be success factors in achieving high performance standards and in earning public trust. The manner in which certification is granted and maintained has also added to the credibility of the Cyanide Code. A company can join the program by agreeing to bring their designated gold mining operations into compliance with the Cyanide Code within three years. Certified operations found in substantial but not full compliance with the Cyanide Code are conditionally certified and must develop and implement a corrective action plan to achieve full compliance, which is also posted on their website. Those operations that fail to substantially meet the requirements of the Cyanide Code have their certification withdrawn.

As a confirmation as to the success of the Cyanide Code, it has been identified by the Australian Government, as part of its Leading Practice program, in its Cyanide Management Handbook as a leading practice. As stated in the handbook (AG CMH 2016):

“Managing cyanide to minimise risks to human and environmental health represents one of the key challenges that continues to face the mining industry. In order to assist the global mining industry to improve its management of cyanide, the Code was developed by a multi stakeholder steering committee and is today managed by the International Cyanide Management Institute (ICMI 2006) to provide a risk-based management process by which the mining industry is able to implement and demonstrate that it can meet leading practice for cyanide management.”

9 ACCEPTABLE RISK & CORPORATE COMMITMENT

The tailings responsibility framework, as described in this paper, has two major themes that will be discussed in more detail in this section. In particular, the concept of acceptable risk as it relates to the deposition method and site selection approval process is very important. The need for demonstrated commitment is an equally important part of the approval process and is linked to the effectiveness of the assurance activities at each operating mine.

9.1 *Acceptable risk*

What constitutes acceptable risk depends on the perspectives of the organizations or persons involved. A family or community living in the dam breach inundation zone will have different

perspectives than the mining companies whose executives have been told that their designs and risk management practices have been based on best practices. The level of risk deemed acceptable to a corporation is not necessarily what may be considered acceptable to government or the public even if it is based on a collaborative engagement process. The acceptability of risk also has to be considered in terms of closure implications as well as the broad benefits to society that flow from economic development.

9.1.1 *Corporate perspective*

In addition to the potential financial impacts of dam failure a company must also consider potential external impacts such as the loss of human life, environmental damage and public economic loss in what it believes to be an acceptable level of risk protection for its proposed deposition method. The challenge for a company will be to separately consider the costs, consequences and likelihood of failure for each alternative and then make a balanced decision based on a meaningful public engagement process and its own risk tolerances.

From a corporate perspective, the financial consequences of a slurry dam failure or the possible malfunctioning of thickened, filtered or paste alternatives all carry significant financial risks. The problem is that the possible alternatives to slurry deposition have not yet established the same body of knowledge that could support development of professional guidances and professional protocols of a quality equal to that for slurry deposition.

While the public consequences resulting from dam failure may be lower, the financial consequences related to any form of storage facility malfunction will still be material. With the added complexity presented by closure considerations, a company's definition of acceptable risk may lead it to rule out certain alternative storage methods.

9.1.2 *Public perspective*

From a public perspective, what defines acceptable risk is not found in the results of a dam safety review report. As an example, the guideline Legislated Dam Safety Reviews (APEGBC 2014) states:

“The determination of what is the acceptable level of risk or safety for the various elements which are identified as being at risk is not the role of the qualified professional engineer and is outside the scope of the dam safety analysis. The acceptable level of risk must be established and adopted by the regulatory authority in consultation with the dam owner. However, an assessment of the various elements at risk, through the dam failure consequences classification established by the relevant regulatory authority will guide the qualified professional engineer's dam safety analysis.”

What this basically states is that a government's or regulatory authority's approval of a design, based on an acceptance of its identified risks, defines what constitutes an acceptable level of risk. The assurance statement required as part of the Dam Safety Review Report verifying that “the dam is reasonably safe” means nothing more than the dam's level of risk is no worse than that level of risk previously approved by the government. Clearly the government is the final arbiter as to the determination of acceptable risk on a case by case situation.

The ideal outcome is to have all parties agree, based on informed opinions, that the risks, and their mitigating measures, for a proposed mine plan are acceptable. Informed opinions are only possible when all parties, particularly the public, have been provided with:

- The opportunity to participate in a meaningful communication and engagement process;
- The consequence rating of the proposed dam, including the results of a dam breach and inundation study;
- Information that supports the selection of the deposition method and site location;
- Information that demonstrates beyond reasonable doubt that the owner is committed to the management of the dam and its critical risks through the establishment of a comprehensive management framework and assurance program; and
- Information that demonstrates that the government has established and will be committed to an effective compliance and enforcement regime.

9.1.3 *Government perspective*

If all parties agree, government has the mandate to proceed with the approval of a TSF plan as proposed. If a government has continuing concerns related to any of the above factors, it has the responsibility to request additional information, specify certain conditions or, if not fully satisfied, refuse to approve the proposed TSF plan. In making a decision to approve or not approve a TSF plan, government also must consider its responsibility for the protection of employees, the public and the environment from undue impacts and risks arising out of or in connection with mining operations. Obtaining and considering public input is an integral aspect of the decision making process that a government must adopt when considering the approval of a TSF plan. The value of economic activity to society should not be an over-riding factor in its decisions.

Once a decision has been made by a government to approve or not approve a TSF plan, it should make its decision public in a manner that addresses any outstanding public concerns and explains why the acknowledged risks have been judged to be acceptable in the specific circumstances of the mining operation and its TSF plan.

9.1.4 *Approval Process*

It is believed that, by having a process that requires a high degree of engagement and transparency, trust in the actions of both mining companies and governments will be increased and the risks related to TSFs will be reduced. The consequences of failure will be more apparent, forcing companies to address the potential risks through the development of improved deposition methods and the use of more committed management frameworks. Using the consequences of failure to drive risk reduction will be more effective than dictating the use of best available technologies. Perhaps in this context, the main reference should be to acceptable consequences. The use of the term risk only serves to confuse or mask the issues.

In situations where governments lack the capacity or the will to properly address the issue of acceptable risk, company directors will have to be extra diligent in their review and approval of new projects. In this regard, full consideration must be given to the potential consequences of failure in order to be sensitive to the independent perspectives that would normally be provided by strong governments and informed public opinion. One idea would be to have the CEO justify in writing the acceptability of a TSF proposal having given full consideration to the consequences of failure.

9.2 *Demonstrated Corporate Commitment*

A high degree of corporate commitment serves two purposes. First of all, it addresses a material corporate risk. Secondly, it provides the basis for earning the trust and acceptance of the government and its public stakeholders.

9.2.1 *Commitment*

Leading practice requires that corporate directors of a company recognize that the management of its TSFs is a material risk and show commitment through a strong governance and oversight program that requires its approval of a corporate tailings management policy and, through its sustainable development committee, requiring assurance that the policy commitments are implemented and maintained on an ongoing basis.

With committed leadership being provided by its board of directors, the chief executive officer becomes accountable for the implementation of the company's tailings management policy. This will require the establishment of a tailings governance framework that will include the development of a TSF management system, operating manuals, corporate standards, risk assessments and assurance activities. All these requirements will have to be well documented for them to be effective and to provide the basis for assuring both the directors and the stakeholders of a company that it is capable of managing its TSFs within the limits of acceptable risk.

Corporate commitment is easy to state but more difficult to instill in an organization. Board and CEO leadership is a significant contributor to the establishment of a committed culture. However, the real test is what happens at different mines and at the working level. With regard to commitment, employee surveys have proven to be a useful tool in the assessment of commitment. One survey the author is aware of measured employee perceptions of safety leadership at two different mines in the same country. One mine clearly was recognized as having a higher

level of leadership but still ranked just above median on the “ensure rule compliance” sub-measure. In another case, a corporate employee survey showed differences in perception as to commitment to safety and environmental management between mines and regions. From another perspective, an analysis of fatalities, major accidents and near-misses at a mine over a five year period showed the main contributing factors to be no or inadequate procedures and the lack of enforcement of existing procedures. This supports the belief that the real tests of commitment during the mine operating stage are to be found in the adequacy of and actual adherence to documented operating procedures at the working level. It then follows that it is the implementation level that should be a major focus of a company’s assurance program.

9.2.2 *Demonstrated Commitment*

Demonstrated commitment is required at the stage of project approval and on a continuing basis by:

- Company’s directors who need to be assured that their policies have been implemented;
- Employees who need to believe in the importance of what they are asked to do;
- Regulatory authorities who need to have confidence in what they are asked to approve; and
- The public that is expected to accept corporate commitments on the basis of trust.

All seek assurance that a company has or will establish high performance standards and that they have been fully implemented. Such assurance is now being provided in many ways. Governments carry out inspections and require annual manager reports, annual EOR reports and periodic dam safety reviews. BC has also required the establishment of independent tailings review boards to provide advice and assurance to fill in some of the gaps that exist in current assurance coverage, a practice that some companies adopted at least 20 years ago. Major companies have established assurance capabilities within their internal audit functions. Member companies of MAC are required to undergo an audit of tailings management systems and qualitative assessments of certain elements every three years.

Whether or not these assurance activities are sufficient to ensure a high level of performance across all aspects of a tailings governance framework is an open question. Gaps and half-measures still exist. Geotechnical experts are asked to review management systems without the aid of detailed protocols. Requirements that operating manuals be prepared prior to commencement of operations are not supported by audit protocols to verify their quality. Management system audits do not address the qualitative aspects of procedures, particularly those of a critical nature.

Further assurance is required to prove that appropriate professional and/or expert advice has been obtained and that site-specific procedures and performance measures are of the highest standard. One way this could be provided is by extending management system audits to verify that adequate professional and/or expert advice has in fact been obtained, included in the operating manual and carried out in practice. Another approach would be to formally require that the EOR’s annual reports include not just a review of critical control measures but also the verification that their requirements have been adhered to over the full year under review.

The final and most important step in demonstrating commitment is to prove that all the words contained in policies, standards, management systems and operating manuals actually result in meaningful action in practice. Assurance is required to ensure that site-specific operating, monitoring, surveillance, maintenance and reporting procedures have been fully implemented and are being adhered to on a continuing basis. This requires an approach similar to that adopted for the Cyanide Code. That is, stated principles, standards of practice, detailed verification protocols, independent third-party audits, public posting of audits and strict certification standards.

9.3 *Public Trust*

Acceptable risk and corporate commitment are inextricably linked. A company that is able to demonstrate its commitment to the public through the application of a strong tailings governance framework will stand a better chance of having its proposed tailings plans accepted by the public. A company that is able to demonstrate its commitment to its own employees will more likely develop a lower risk proposal. A company that is able to demonstrate its commitment to the regulatory authorities and the public will find the permitting process much easier to navigate. A

company that has done all these things will also stand an excellent chance of not having a catastrophic dam failure.

10 PATH FORWARD

The strategic intent for the mining industry must be to eliminate tailings dam failures and incidents. The leading practices identified above, within the context of a comprehensive responsibility framework, will, if adopted, significantly contribute to a reduction in the frequency of dam failures in general, a reduction of the consequences of failure and the reduction of catastrophic failures in particular. However, any framework based on safety factors, unpredictable natural events, judgement, human errors and varying levels of commitment will always be less than perfect requiring a continuing focus on the reduction of the consequences of failure.

For new tailings dams, a rigorous deposition method and site selection process must be used to ensure that the consequence rating of the approved method does not exceed an acceptable level. Existing operations must seek ways to reduce risks related to the original design. More importantly, companies, governments and geotechnical professionals must look to their own commitment and embrace the leading practices suggested in this paper with the objective of providing the highest standard of risk management for their tailings dams.

In the short term, action should be taken to reduce the risks posed by using tailings impoundments to store water. For climates where water storage is inevitable, design requirements regarding freeboards, beach lengths and phreatic lines should be clearly identified and strictly enforced by both corporate management and regulatory authorities. The use of tailings impoundments as polishing ponds to reduce contaminant levels and to handle run-off and excess pit water must be stopped as such practices only add to the risk level of a dam. Regulatory approvals for new tailings storage facilities must require the consideration of alternatives based on the minimization or elimination of water storage within the impoundment.

To support the consideration and adoption of lower consequence alternatives, a process must be initiated for the purpose of:

- Bringing together the body of knowledge developed globally for each alternative deposition method;
- Identifying and funding areas requiring further research or study; and
- Developing technical guidances and leading practices for their design and operation.

For the longer term, it is difficult to identify what organization or what group of organizations that will accept the challenge of moving aggressively towards the development of a comprehensive and leading edge Tailings Responsibility Framework. Unfortunately, this may have to wait for the next catastrophic failure. To prepare for that eventuality, useful progress could be made on focused priorities, which should be to:

- Define the principles and standards of practice to be expected of a company's board of directors and provide appropriate protocols to guide and measure their implementation;
- Prepare a guidance document to support the application of critical control methodology to the identification and management of critical tailings dam risks;
- Define the principles, standards of practice and protocols required to guide an annual validation of the integrity of a tailings dam design, the adherence of the company to its regulatory and internal requirements and the implementation and maintenance of its critical control procedures; and
- Develop a model of a comprehensive and integrated assurance and reporting program that supports the needs of companies, governments and public.

Work must now start on the next round of incremental changes. It is hoped that this paper will have dispelled any complacencies that the current situation is satisfactory. Waiting for the next catastrophic dam failure is not good enough. It is also hoped that many of you will work towards the further development and implementation of some of the ideas within your own organization and the associations to which your organization belongs.

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REFERENCES

- APEGBC 2014. *Professional Practice Guidelines – Legislated. Dam Safety Reviews in BC V2.0*. The Association of Professional Engineers and Geoscientists of British Columbia.
<https://www.apeg.bc.ca/For-Members/Professional-Practice/Professional-Practice-Guidelines>
- APEGBC 2016.. *Professional Practice Guidelines – Site Characterization for Dam Foundations in BC. V1.0*. The Association of Professional Engineers and Geoscientists of British Columbia.
<https://www.apeg.bc.ca/For-Members/Professional-Practice/Professional-Practice-Guidelines>
- Ancold 2012. *Guidelines on Tailings Dams – Planning, Design, Construction, Operation and Closure (May 2012)*. ANCOLD. https://www.ancold.org.au/?page_id=334
<http://www.bcauditor.com/pubs/2016/audit-compliance-and-enforcement-mining-sector>
- AG CMH 2016. *Cyanide Management*. Australian Government.
<https://www.industry.gov.au/resource/Programs/LPSD/Pages/LPSDhandbooks.aspx#>
- AG TMH 2016. *Tailings Management*. Australian Government.
<https://www.industry.gov.au/resource/Programs/LPSD/Pages/LPSDhandbooks.aspx#>
- BC AG 2016. 2016. *An Audit of Compliance and Enforcement of the Mining Sector*. Auditor General of British Columbia. www.bcauditor.com
- BC AMP 2016. *Administrative Monetary Penalties Discussion Paper*. BC Mines and Mineral Resources Division.
<http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/compliance-enforcement/amp>
- BC C&E 2016. *Deputy Ministers Mining Compliance and Enforcement (C&E) Board*. BC Government.
<http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/compliance-enforcement/board>
- BC Code 2017. *Health, Safety and Reclamation Code for Mines in British Columbia*. BC Ministry of Energy and Mines.
<http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia>
- BC Guide. 2106. *Guidance Document - Health, Safety and Reclamation Code for Mines in British Columbia Version 1.0*.
<http://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/health-safety/health-safety-and-reclamation-code-for-mines-in-british-columbia>
- BC Info 2107. *BC Mine Information website*. <http://mines.nrs.gov.bc.ca/>
- Cyanide Code 2017. *International Gold Cyanide Management Code For the Manufacture, Transport, and Use of Cyanide In the Production of Gold*. <http://www.cyanidecode.org/>
- Freeze, R. Allan, 2000. *The Environmental Pendulum*. Berkeley: University of California Press
- IAP2. *IAP2 Spectrum of Public Participation*. The International Association for Public Participation.
<http://iap2canada.ca/page-1856323>
- ICMM. International Council on Mining & Metals. <http://www.icmm.com/en-gb/about-us>
- ICMM 2005. *Good practice in emergency preparedness and response*. ICMM & UNEP.
<http://www.icmm.com/en-gb/search?q=emergency+response>
- ICMM 2015. *Health and safety critical control management: good practice guide*. ICMM.
<http://www.icmm.com/en-gb/environment/tailings>
- ICMM 2106. *Position statement on preventing catastrophic failure of tailings storage facilities*. ICMM.
<http://www.icmm.com/en-gb/environment/tailings>
- KingIII 2009. *King Report on Governance for South Africa*. The Institute of Directors in Southern Africa.
<http://www.iodsa.co.za/?kingIII>

- ISO 14001 2015. *ISO 14001:2015 Environmental Management Standard*. International Standards Organization. <https://www.iso.org/obp/ui/#iso:std:iso:14001:ed-3:v1:en>
- ISO 31000. 2009. *ISO 31000:2009, Risk Management - Principles and Guidelines*. International Standards Organization. <https://www.iso.org/iso-31000-risk-management.html>
- MAC Audit 2011. *A Guide to Audit and Assessment of Tailings Facility Management*. MAC. <http://mining.ca/towards-sustainable-mining/protocols-frameworks/tailings-management>
- MAC Guide 2011. *The Guide to the Management of Tailings Facilities*. <http://mining.ca/towards-sustainable-mining/protocols-frameworks/tailings-management>
- MAC Manual 2013. *Developing an Operation, Maintenance and Surveillance Manual (OMS Manual) for Tailings and Water Management Facilities*. MAC. <http://mining.ca/documents/developing-operation-maintenance-and-surveillance-manual-tailings-and-water-management>
- MAC Outreach 2015. *Towards Sustainable Mining Aboriginal and Community Outreach Protocol*. MAC. <http://mining.ca/towards-sustainable-mining/protocols-frameworks/aboriginal-and-community-outreach>
- MAC TRF 2015. *Report of the TSM Tailings Review Task Force*. MAC. <http://mining.ca/towards-sustainable-mining/protocols-frameworks/tailings-management>
- MAC TSM 2017. *Towards Sustainable Mining 101: A Primer*. MAC. <http://mining.ca/towards-sustainable-mining>
- Mount Polley Report. 2015. *Report on Mount Polley Tailings Storage Facility Breach. Independent Expert Engineering Investigation and Review Panel*. Province of British Columbia. <https://www.mountpolleyreviewpanel.ca/final-report>
- Rio Tinto 2014. *Standard – Rio Tinto management system.2014*. Rio Tinto. <http://mining.ca/towards-sustainable-mining/protocols-frameworks/tailings-management>
- WA 2013. *Code of practice: Tailings storage facilities in Western Australia*. Government of Western Australia. http://www.dmp.wa.gov.au/Documents/Environment/MSH_COP_TailingsStorageFacilities.pdf

BIBLIOGRAPHY

- Golder Associates. 2016. *REVIEW OF TAILINGS MANAGEMENT GUIDELINES AND RECOMMENDATIONS FOR IMPROVEMENT*. <http://www.icmm.com/tailings-report>
- Wilson, G. Ward & Robertson, Andrew MacG. 2015. *The Value of Failure*. Geotechnical News, June 2015.