APPLICATION OF IRMA CHAPTER 4.1–WASTE AND MATERIALS MANAGEMENT **TO BRINE EXTRACTION OPERATIONS (2022)**

Background

As its title suggests, **Chapter 4.1—Waste and Materials Management** addresses both the management of waste materials (which in the chapter are separated into "mine wastes" and other wastes) and the management of other substances or materials such as chemicals or fuels that if not managed well could have impacts on the environment or people.

A request has been made to provide clarification regarding the application of the requirements in this chapter to lithium or other types of brine extraction operations, which typically do not have the same type or scale of mine waste facilities as hardrock mining sites. Also, unlike hardrock tailings impoundments, brine waste/storage facilities generally do not tend to be associated with a high risk of catastrophic failure that could lead to significant impacts on human health, safety or the environment.

However, an analog can be drawn between an ore body and a minerals-rich brine. In both cases, the target minerals/elements extracted comprise a small fraction of the material removed from the earth. As the target minerals/elements are removed/recovered, what remains behind can be considered "waste" and must be adequately managed and/or disposed. In the case of brine operations, wastes may include liquids contained in brine evaporation ponds or other process ponds as well as salts, sludges or residues. These waste materials, if discharged or not addressed properly during operations and closure, could pose chemical or physical risks and potentially cause harm humans or the environment.

Definitions

The simplest way to clarify the intent of this chapter is to revise the definitions of some of the existing terms to incorporate brines and any residues resulting from their processing, and incorporate the facilities used to hold and process the brines and resultant waste products.

Although there is no official definition of "mine wastes", the footnote for requirement 4.1.2.1., says:

> "For the purposes of this chapter, **mine wastes** include tailings, waste rock, spent ore from heap leaches, wastes generated during mineral processing (e.g., residues and used processing fluids, wastes from thermal processing – including mercury wastes in Chapter 4.8). It does not include chemicals that go into mineral processing that have not been used."

For lithium or other brine extraction operations, it should be assumed that **mine wastes** also include:

- brines or process solutions from which minerals are/have been extracted, salts, residues or other materials that are not recovered as a valued commodity.

The current definition of **mine waste facilities** is:

> Facilities that contain, store, are constructed of, or come in contact with wastes that are generated or created during mining (e.g., waste rock, pit walls, pit floors or underground workings, runoff or discharge from exposed mined areas) and mineral processing (e.g., tailings, spent ore, effluent). These facilities include, but are not limited to open pits, underground mine workings and subsidence areas, waste rock facilities, tailings storage facilities, heap leach facilities, process water facilities, stormwater facilities, borrow areas for construction and/or reclamation, water treatment facilities, and water supply dams/impoundments.

For lithium or other brine extraction operations, in addition to the current definition, it should be assumed that **mine waste facilities** include:

- ponds, tanks or other facilities containing mine wastes, including brines, salts, residues or process solutions from which minerals are extracted

Guidance for auditing lithium and other brine operations

The first lithium brine operations are being audited against the IRMA Standard for Responsible Mining. This guidance will apply to these first operations. Based on those first audits, it is possible that we will further revise the Guidance, and if that occurs, those operations may be subject to additional Guidance at future audits.

Table 1 includes the original Explanatory Notes for typical mining operations, as well as added notes that provide details on how certain requirements in Chapter 4.1 should be interpreted and applied to lithium or other brine extraction operations).

For the most part, all requirements in this chapter could be applicable to brine operations. However, the table also includes a column identifying why a certain requirement might not be relevant to those operations. Further details are provided in the Explanatory Notes.

Table 1. Guidance for Hardrock Mining versus Brine Extraction Operations

Requirement	Relevant for brine operations?	Existing Explanatory Note for hardrock mining operations	Supplementary Note for brine extraction operations
4.1.1. Policy and Governance 4.1.1.1. The operating company shall develop a policy for managing waste materials and mine waste facilities in a manner that eliminates, if practicable, and otherwise minimizes risks to human health, safety, the environment and communities.	Yes	Explanatory Note for 4.1.1.2: A policy for managing waste materials and mine waste facilities does not need to be long or overly detailed, but should provide overall guidance for the management of wastes. It might look something like the following: "It is the policy of _________ to store all mine waste in a manner that will protect the human and natural environment, avoid pollutants from migrating beyond the mine site, and be protective of mine workers in placing this waste at its interim and final storage locations. Wastes will be recycled to the maximum extent possible. Hazardous wastes will be managed to minimize worker exposure and to maximize protection of the human and natural environment in the long-term." Note that "natural environment" also includes the subsurface environment, e.g., protection of groundwater resources, so the policy could be even more explicit in this regard if desired.	Mine waste facility should be interpreted to include ponds, tanks or other facilities containing brines, salts, residues or process solutions from which minerals are or have been extracted.
4.1.1.2. The operating company shall demonstrate its commitment to the effective implementation of the policy by, at minimum: a. Having the policy approved by senior management and endorsed at the Director/Governance level of the company; b. Communicating the policy to employees; c. Having a process in place to ensure that relevant employees understand the policy to a degree appropriate to their level	Yes	Explanatory Note for 4.1.1.2: Re: 4.1.1.2.a, senior management would be the mine manager, or a manager that reports directly to the mine manager, and to whom the mine manager has designated, in writing, the responsibility for overseeing all mine waste management at the mine. Director/Governance Level may be the CEO, Board of Directors or other high-level body (e.g., a subcommittee of the Board of Directors tasked with oversight of waste management activities). Re: 4.1.1.2.b, communicating this policy to relevant employees (i.e., those who have waste management responsibilities) should be done during initial employee training, and on a regular basis afterward. It should be explained verbally to relevant employees, not just presented in written documents or wall placards. The verbal explanation could be included with annual safety training	Existing guidance is applicable.

of responsibility and function, and that they have the competencies necessary to fulfill their responsibilities; d. Having procedures and/or protocols in place to implement the policy; and e. Allocating a sufficient budget to enable the effective implementation of the policy.		requirements, since much of the waste management policy is ultimately safety oriented. Re: 4.1.1.2.c and d, procedures and protocols should include a risk management program, with responsible persons assigned and an implemented training program; an Operations, Maintenance and Surveillance (OMS) manual (see 4 1.5.5), with staff adequately trained on its use; a change management system; protocols to elevate all relevant findings of mine managers, consultants and independent reviewers to senior management team, above the general manager level; and an independent review panel or board, with clearly defined scope (see 4.1.6). Design engineers or Engineer of Record should be in place, and be qualified licensed professional engineers with sound technical knowledge. Other employees should have either formal education or sufficient training and experience to carry out tasks such as construction, maintenance, surveillance, monitoring, emergency response, etc.). Re: 4.1.1.2.d, budgets should include mine waste facility capital and operating costs, and costs related to human resources necessary to carry out the work and implement the waste policy. The budget should include schedules of activities that integrate the required resources related to waste management. Examples of activities to be scheduled include timing of construction, access to construction material, reviews, inspections, and any other item critical to successfully implementing the waste management system.	
4.1.2. Safe Management of Materials Other Than Mine Wastes 4.1.2.1. The operating company shall: a. Identify all materials, substances and wastes (other than mine wastes) associated with the mining project that have the potential to cause impacts on human health, safety, the environment or communities; and	Yes	Explanatory Note for 4.1.2.1: Requirement 4.1.2.1 applies to materials, substances and wastes that are not considered mine wastes. These may include used and unused chemicals, old tires, unused explosives, septic system wastes, cleaning fluids, solvents, fuels and any other materials, substances and wastes that may pose a risk to human health, safety the environment if not managed well. For the purposes of this chapter, "mine wastes" include tailings, waste rock, spent ore from heap leaches, wastes generated during mineral processing (e.g., residues and used processing fluids, wastes from thermal processing – including mercury	This requirement is not applicable to brines (we are considering brines to be “mine wastes” – see explanation below). But the requirement is relevant for brine operations, because those operations will use other materials and produce other wastes that if not adequately managed could harm people or the environment. As stated in the Explanatory Note for 4.1.1.1, “mine wastes” include tailings, waste rock, spent ore from heap leaches, and wastes generated during mineral processing. Mine wastes should also be interpreted to include any brines or process solutions from which minerals are or have been extracted, as

b. Document and implement procedures for the safe transport, handling, storage and disposal of those materials, substances and wastes.		wastes in Chapter 4.8). It does not include chemicals that go into mineral processing that have not been used (those belong in the category of wastes that are not considered "mine wastes", above). Mine wastes are the primary focus of this chapter (see criteria 4.1.1 and 4.1.3 to 4.1.6). Re: 4.1.2.1.a, identifying and tracking these materials is standard procedure at most mines. Material Safety Data Sheets should be available at the mine for all or most of these materials. Some of these materials and substances may be included in an Emergency Preparedness and Response Plan (see IRMA Chapter 2.5). For example, that plan should include measures to prevent accidents and respond to incidents that might occur during transport of hazardous chemicals through communities or in close proximity to water courses that flow through communities. In addition to implementing procedures for the safe use or disposal of certain waste materials, the beneficial (re)use and recycling of some wastes may also be investigated. For example, some companies are looking at composting technologies for organic wastes to assist in remediation of areas with elevated metals, as well as general site rehabilitation efforts, especially where there is a limited availability of good quality topsoil.[1] Other companies are implementing recycling programs for tires and other "waste" materials.	well as salts, residues or other materials that are not recovered as a valued commodity during brine processing.
4.1.3. Mine Waste Source Characterization and Impact Prediction 4.1.3.1. The operating company shall identify all existing and/or proposed mine waste facilities that have the potential to be associated with waste discharges or incidents, including catastrophic failures, that could lead to impacts on human health, safety, the environment or communities.	Yes	Explanatory Note for 4.1.3.1: "Mine waste facilities" are those that contain, store, are constructed of, or come in contact with wastes that are generated or created during mining (e.g., waste rock, pit walls, pit floors or underground workings, runoff or discharge from exposed mined areas) and mineral processing (e.g., tailings, spent ore, effluent). These facilities may include, but are not necessarily limited to: open pits, pit lakes, underground mine workings, subsidence areas, waste rock facilities, tailings storage facilities, heap leach facilities, process water facilities, stormwater facilities, borrow	Mine waste facility should be interpreted to include ponds, tanks or other facilities containing brines, salts, residues or process solutions from which minerals are or have been extracted. This requirement is relevant if there are mine waste facilities (see expanded definition) that could be associated with any waste discharge or incident (i.e., does not need to be from a catastrophic failure of the facility). Waste discharges could be due to human error, precipitation events, malfunctioning of equipment, etc.

[1] For example, see US Environmental Protection Agency website: "Abandoned Mine Lands: Technical Resources. Composting at Mine Sites." https://www.epa.gov/superfund/abandoned-mine-lands-technical-resources

		areas for construction and/or reclamation, roads or impoundments constructed from waste rock, water treatment facilities, etc.	
4.1.3.2. The operating company shall perform a detailed characterization for each mine waste facility that has associated chemical risks. Characterization shall include:[2] a. A detailed description of the facility that includes geology, hydrogeology and hydrology, climate change projections, and all potential sources of mining impacted water (MIW);[3] b. Source material characterization using industry best practice to determine potential for acid rock drainage (ARD) or metals leaching (ML). This shall include: i. Analysis of petrology, mineralogy, and mineralization; ii. Identification of geochemical test units; iii. Estimation of an appropriate number of samples for each geochemical test unit; and iv. Performance of comprehensive geochemical testing on all samples from each geochemical test unit. c. A conceptual model that describes what is known about	Yes	Explanatory Note for 4.1.3.2: 4.1.3.2 addresses chemical risks, while 4.1.3.3 addresses physical risks. Chemical risks associated with mine waste facilities refer to risks related to the chemical composition of mined materials and wastes. Risks include the potential for materials to leach contaminants to the environment. Chemical risks also include hazardous constituents (e.g., constituents that may be toxic, harmful or irritating to humans or biota, carcinogenic, mutagenic, affect reproduction, be corrosive, explosive, or otherwise dangerous to the environment) if there is the potential that these constituents may be mobilized and enter the environment. If a particular mine waste facility has no associated chemical risks (e.g., the facility is not constructed from materials that will leach contaminants into the environment, and does not contain or store hazardous constituents that will mobilize to the environment), then it does not need to undergo the detailed characterization in 4.1.3.2. The operating company, however, should be able to provide evidence in the form of geochemical characterization that wastes and facility construction materials are not chemically reactive. Re: 4.1.3.2.a, "mining impacted water," also referred to as mining influenced water or MIW, includes acid rock drainage (ARD), neutral mine drainage, saline drainage, and metallurgical process waters of potential concern. In Australia, the term acid and metalliferous drainage (AMD) is used as a synonym for ARD. A key characteristic of most of these waters is that they contain elevated metals that have leached from surrounding solids (e.g., waste rock, tailings, mine surfaces, or mineral surfaces in their	This entire requirement is relevant, with the following clarifications: In 4.1.3.2 a, mining Impacted water (MIW) includes brines and process solutions. For 4.1.3.2.b, the requirements for "b" are relevant for brines and process solutions but the requirement should be read/interpreted as follows: b. Brine or process solution facility characterization using industry best practice to determine potential sources of contaminants. This shall include: i. Brine or process solution chemistry including any added chemicals (i.e., whole solution chemistry for all dissolved constituents), and range of expected variation; ii. Elemental contents in solid precipitates, sludges or other residues, and use Toxic Characteristic Leach Procedure (TCLP) or equivalent to determine leachability of the wastes.

[2] See also IRMA Chapter 4.2, criteria 4.2.2

[3] Mining impacted water, also referred to as mining influenced water or MIW, includes acid rock drainage (ARD), neutral mine drainage, saline drainage, and metallurgical process waters of potential concern. In Australia, the term acid and metalliferous drainage (AMD) is used as a synonym for ARD. A key characteristic of most of these waters is that they contain elevated metals that have leached from surrounding solids (e.g., waste rock, tailings, mine surfaces, or mineral surfaces in their pathways). This fact is commonly acknowledged by the phrase "metal leaching" (ML), frequently resulting in acronyms such as ARD/ML.

release, transport and fate of contaminants and includes all sources, pathways and receptors for each facility;[4] d. Water balance and chemistry mass balance models for each facility;[5] e. Identification of contaminants of concern for the facility/source materials, and the potential resources at risk from those contaminants.[6]		pathways). This fact is commonly acknowledged by the phrase "metals leaching" (ML), frequently resulting in acronyms such as ARD/ML. Re: 4.1.3.2.b, source material characterization should include the analyses listed in 4.1.3.1.b.i through iv (for more information, see chapter 4 of the Global Acid Rock Drainage (GARD) Guide issued by the International Network for Acid Prevention[7]). Petrology would explain the type of rocks, mineralogy the minerals that make up the rocks. Geochemical test units typically align with different rock types, but there can be exceptions. Each geochemical test unit should be sampled and tested. The GARD Guide gives guidance on how many samples are needed per geochemical unit, and what tests should be performed. The tests required are driven in large part by the mineralogy of the geochemical unit. If the GARD guidelines are not followed, the operating company should be able to technically justify why some other procedure was followed. Results of source material characterization should be presented for each geochemical unit, with some analysis or technical explanation of the results provided. Construction materials should be included in the analysis if mine waste materials are proposed to be used or have been used to build roads or other structures. Re: 4.1.3.2.c, a conceptual model, in this case, is a qualitative description of what is known about the sources, release, transport and fate of contaminants related to a particular facility. A Conceptual Site Model (CSM) should be developed for each facility that may be associated with adverse chemical (i.e., contamination) impacts. This should include both a visual schematic and an accompanying narrative report. This	

[4] This information will feed into the Conceptual Site Model required in IRMA Chapter 4.2, requirement 4.2.2.3.
[5] This information should feed into the site-wide water balance model in IRMA Chapter 4.2, requirement 4.2.2.3.
[6] This should be done using the results from 4.1.3.2.a-d and also hydro-geochemical/hydrogeological modeling as per IRMA Chapter 4.2, if relevant. (See Chapter 4.2, requirements 4.2.2.3.b).
[7] International Network for Acid Prevention (INAP). Global Acid Rock Drainage (GARD) Guide. http://www.gardguide.com/

		information will feed into the Conceptual Site Model required in IRMA Chapter 4.2, requirement 4.2.2.3. Re: 4.1.3.2.d, water must be controlled to gain access to the mine workings and is typically required in ore extraction processes. The chemical quality and quantity of mine effluents must also be managed since this water may affect the receiving environment and water users. Water and mass balance models are frequently used in the mining industry to explore water management alternatives and assess the uncertainty underlying current and future water management scenarios. A simple deterministic water and mass balance model built on linked Excel spreadsheets, along with sound engineering judgment, may be adequate to provide a basic understanding of flows and effluent water quality over a given range of operating and climatic conditions. The mass balance calculation should include all contaminants of concern (see 4.1.3.1.e), and should document their flow through the mine's processing and waste storage systems. Greater model complexity will likely be required to assess more complex mining project conditions. Ultimately, simulation software should be used to develop dynamic flow models and predict long term contaminant loadings and environmental performance over the entire life of a mine using precedent precipitation data. Water chemistry parameters, contaminant loadings and rates of contaminant decay can be input into such models.[8] Re: 4.1.3.2.e, contaminants of concern should include those predicted to be released at levels that contravene host country standards or IRMA Water Quality Criteria in IRMA Chapter 4.2, or those that could be released in excess of air quality standards in IRMA Chapter 4.3.	

[8] Golder Associates. 2011. Guidance Document on Water and Mass Balance Models for the Mining Industry. (Report submitted to Yukon Government) http://www.env.gov.yk.ca/publications-maps/documents/mine_water_balance.pdf

4.1.3.3. The operating company shall identify the potential physical risks related to tailings storage facilities and all other mine waste facilities where the potential exists for catastrophic failure resulting in impacts on human health, safety, the environment or communities. Evaluations shall be informed by the following: a. Detailed engineering reports, including site investigations, seepage and stability analyses; b. Independent technical review (See 4.1.5.9); c. Facility classification based on risk level or consequence of a failure, and size of the structure/impoundment; d. Descriptions of facility design criteria; e. Design report(s); f. Short-term and long-term placement plans and schedule for tailings and waste rock or other facilities subject to stability concerns; g. Master tailings placement plan (based on life of mine); h. Internal and external inspection reports and audits), including, if	Maybe	Explanatory Note for 4.1.3.3: Tailings dams, tailings impoundments, waste rock piles and heap leach facilities are all large enough to pose potential physical risks. Not only might they fail during earthquake or flood events, they are also capable of collapsing under their own weight if not properly designed. Re: 4.1.3.3.a, detailed engineering reports, based on site investigations, seepage and stability analyses, should be provided for all relevant site facilities. This information should be used as the basis for facility classification (see 4.1.3.3.c). The level of detail should be based on the project status ranging from 30-70% completion during initial design and project permitting, 90% for projects prior to construction, and based on construction and as-built reports for existing structures. Re: 4.1.3.3.b, independent review required only for facilities identified as high-consequence as per 4.1.3.3.c. Re: 4.1.3.3.c, facility classification should be performed consistent with applicable regulatory requirements. However, if they are not similar to or consistent with various recognized guidelines for example, Australian National Committee on Large Dams (ANCOLD, 2012),[9, 10] Canadian Dam Association (CDA, 2014)[11] or similar recognized documents prepared by the International Commission on Large Dams (ICOLD)[12] or its member national organizations, then the operator should have an independent classification performed consistent with these requirements. Re: 4.1.3.3.d, facility design criteria should be identified as a section and/or table in the detailed engineering reports/design reports, and be signed off by the Engineer of Record (EoR).	As mentioned previously, mine waste facility should be interpreted to include ponds, tanks or other facilities containing brines, salts, residues or process solutions from which minerals are or have been extracted. Brine-holding and evaporation ponds, process solution ponds, and water storage ponds with large storage volume, particularly those located aboveground, may have the potential for catastrophic failure or breach, where runout of the contents could lead to significant impacts. Companies are expected to provide to auditors a reasonable science-based justification (e.g., credible failure analysis) for why the failure of a pond or impoundment would not pose a potentially significant impacts to people or the environment (e.g., an engineer has documented that there are no credible failure modes, and there is evidence that there are no communities in the vicinity that would be impacted and no ecosystems that would be irreparably harmed under the various credible failure scenarios). The level of effort required for the credible failure modes analysis should be commensurate with the level of risk, i.e., will be lower than what is required for hardrock mining operations. If the company is able to demonstrate through its evaluation that there is "no credible risk" of catastrophic failure that could result in significant impacts on human health, safety, the environment or communities, then further identification of physical risks in 4.1.3.3.a through j are not required, and various subsequent requirements identified later in this chapter that relate to “high consequence rated mine waste facilities” will not be relevant.

[9] Australian National Committee on Large Dams (ANCOLD). May 2012. Guidelines on Tailings Dams; Planning, Design, Construction, Operation, and Closure. Available at: https://www.ancold.org.au/?page_id=334
[10] Australian National Committee on Large Dams (ANCOLD). October 2012. Guidelines on the Consequence Categories for Dams. Available at: https://www.ancold.org.au/?page_id=334
[11] Canadian Dam Association. Dam Safety Guidelines. 2007. See also, Application of Dam Safety Guidelines to Mining Dams. 2014. Both publications available at: www.imis100ca1.ca/cda/Main/Publications/Dam_Safety/CDA/Publications_Pages/Dam_Safety.aspx?hkey=52124537-9256-4c4b-93b2-bd971ed7f425
[12] The International Commission on Large Dams (ICOLD). See www.icold-cigb.net for more information on over 200 technical publications.

applicable, an annual dam safety inspection report; i. Facility water balances (See also 4.1.3.2.d); and j. Dam breach inundation (if applicable) and waste rock dump runout analyses.		Re: 4.1.3.3.e, detailed engineering reports are the same as design reports in 4.1.3.3.a. (requirement duplicative, will be removed in next version). Re: 4.1.3.3.f, short-term means one to two years in the future and long-term means life-of-facility. Short-term plans should include quarterly placement schedule and long-term plans should include yearly schedule. Re: 4.1.3.4.g, master tailings placement plan is the same as a long-term plan as per 4.1.3.3.f. (requirement duplicative, will be removed in next version). Re: 4.1.3.3.h, all high-consequence facilities require regular (daily, weekly, monthly, quarterly) inspections by the operators consistent with their operations, maintenance and surveillance manuals, an annual dam safety inspection report by the Engineer of Record, and independent review/inspections every 3-5 years or similar as per ANCOLD, CDA, or similar. (See references in 4.1.3.3.c) Re: 4.1.3.3.i, facility water balances should indicate critical indicators such as allowable pool volume and level and take into account appropriate probable maximum flood criteria. Re: 4.1.3.3.j, all high-consequence facilities will include a breach inundation and/or runout analysis and it should be applied to an Emergency Preparedness Plan (EPP) or Emergency Response Plan (ERP), addressed in IRMA Chapter 2.5. For example, an operating tailings storage facility (TSF) should include a breach inundation analysis, and a closed TSF no longer containing water, or a waste rock pile considered to be high-consequence, should include a run-out analysis. A breach analysis should be performed consistent with applicable regulations or in the absence of regulations current best practice as identified by Bernedo (2013).[13]	

13 Bernedo, C. 2013. "Predictive Models and Available Software," Presentation at USSD Workshop on Dam Break Analysis Applied to Tailings Dams. https://docplayer.net/14116454-Ussd-workshop-on-dam-break-analysis-applied-to-tailings-dams.html

4.1.3.4. Facility characterizations shall be updated periodically to inform waste management and reclamation decisions throughout the mine life cycle.[14]	Yes	Explanatory Note for 4.1.3.4: Initial facility characterizations are based on qualitative and quantitative data that have been collected by the operating company. When new physical, hydrological or geochemical data are collected, or facility monitoring provides information that suggests that previous assumptions / characterizations are no longer valid, or there are changes in the mining project that affect mine waste facilities (e.g., there are changes in waste management practices, changes to materials being disposed, changes in site water management that may affect facility water balance, etc.) the operating company should update the facility's physical, hydrological or geochemical characterizations. Updates to facility characterization information should feed into updates to facility designs, operating plans and/or reclamation plans or reports. Updates to facility characterization information may also be used to update permits and/or financial assurance estimates, typically conducted every 3-5 years. See also IRMA Chapter 2.6—Planning and Financing Reclamation and Closure, 2.6.2.2.c, g, and l.	This is applicable to brine operations. Examples of when characterizations should be updated include if there are changes/expansions to location, size/shape, brine and/or process solution volume and chemistry, and operating characteristics of waste facilities, unintended discharges, residue build-up and removal, and concurrent reclamation.
4.1.3.5. Use of predictive tools and models for mine waste facility characterization shall be consistent with current industry best practice, and shall be continually revised and updated over the life of the mine as site characterization data and operational monitoring data are collected.	Yes	Explanatory Note for 4.1.3.5: Any tools and models used in providing the information in Sections 4.1.3.2 and 4.1.3.3 should be consistent with current industry best practice as described in the notes for those sections. Also, predictive tools and models should be updated if new data on physical, hydrological or geochemistry has been collected, or if monitoring suggests that the assumptions used in predictive tools and models are no longer valid. Models should also be updated if there are changes in the mining project that affect mine waste facilities (e.g., there are changes in waste management practices, changes to materials being disposed, changes in site water management that may affect facility water balance, etc.).	For brine and other process solution facilities, models will primarily consist of solution mass balance models that will show present and predicted or planned solution flows, pond and tank volumes, solution recycle, treatment and discharge. The models should address sensitivity both due to operational characteristics but also due to variation in climate including that resulting from anthropogenic caused climate change.

[14] See also IRMA Chapter 2.6—Planning and Financing Reclamation and Closure, 2.6.2.2.c, g, and l.

4.1.4. Waste Facility Assessment 4.1.4.1. (Critical Requirement) A risk-based approach to mine waste assessment and management shall be implemented that includes: a. Identification of potential chemical risks (see 4.1.3.2 f) and physical risks (see 4.1.3.3) during the project conception and planning phase of the mine life cycle; b. A rigorous risk assessment to evaluate the potential impacts of mine waste facilities on health, safety, environment and communities early in the life cycle; c. Updating of risk assessments at a frequency commensurate with each facility's risk profile, over the course of the facility's life cycle; and d. Documented risk assessment reports, updated when risks assessments are revised (as per 4.1.4.1.c).	Yes	Explanatory Note for 4.1.4.1.a: The "project conception and planning phase" begins at the outset of planning of a proposed mine, and is integrated with conception and planning for the overall site, including the mine plan and plans for ore processing. General steps include: Opportunity, Concept, Pre-Feasibility, Feasibility, and Detailed engineering. The remainder of the mine life cycle includes phases such as: Design; Initial Construction; Ramp-up, Operations and Ongoing Construction; Standby Care and Maintenance; Mine Closure; and Post-Closure.[15] Re: 4.1.4.1.b, risk assessment and management should take into account physical and chemicals risks posed by mine waste facilities; environmental risks such as earthquakes, landslides or avalanches, which could impact facilities; short- and long-term risks related to climate change; and other risks external to the operating company and the facility, including regulatory and permitting risks, e.g., not obtaining permits in a timely manner, or permits that are not aligned with the design intent of the facility.[16] During risk assessments consideration should be given to what might be the potential cumulative impacts from the identified risks, and how different proposed mitigation measures might decrease the cumulative impacts. When mine waste facilities are located near national borders or coastlines, the potential for causing transboundary impacts should also be considered. Re: 4.1.4.1.c, risk assessments should be completed as frequently as required to meet the tailings management objectives established for any given facility. The acceptable level of risk should be defined in the context of the facility and for its specific life phase, taking into account the likelihood and consequence of	As mentioned previously, "mine waste facility" should be interpreted to include ponds, tanks or other facilities containing brines, salts, residues or process solutions from which minerals are extracted. For the purpose of this section "mine" includes brine and process solution facilities. While we are still requiring a risk-based approach to managing these facilities, the level of effort should be commensurate with the level of risk, i.e., will be lower than what is required for hardrock mining operations.

[15] Mining Association of Canada. 2017. A Guide to the Management of Tailings Facilities (Third Ed). p. 37. http://mining.ca/documents/guide-management-tailings-facilities-third-edition
[16] Ibid. p. 18.

		catastrophic failure, and perspectives of the owner, regulators and communities of interest.[17]	
4.1.4.2. The operating company shall carry out and document an alternatives assessment to inform mine waste facility siting and selection of waste management practices. The assessment shall: a. Identify minimum specifications and performance objectives for facility performance throughout the mine life cycle, including mine closure objectives and post-closure land and water uses; b. Identify possible alternatives for siting and managing mine wastes, avoiding a priori judgements about the alternatives; c. Carry out a screening or "fatal flaw" analysis to eliminate alternatives that fail to meet minimum specifications; d. Assess remaining alternatives using a rigorous, transparent decision-making tool such as Multiple Accounts Analysis (MAA) or its equivalent, which takes into account environmental, technical, socio-economic and project economics considerations, inclusive of risk	Yes	Explanatory Note for 4.1.4.2: Re: 4.1.4.2.a, an alternatives assessment is a process to identify and objectively and rigorously assess the potential impacts and benefits (including environmental, technical and socio-economic aspects) of different options so that an informed decision can be made.[18] For the purposes of this chapter, the alternatives assessment evaluates different options for locating (siting and layout) tailings and other mine waste facilities, and informs the site-specific best available technologies (BAT) and best available/applicable practices (BAP) for designing facilities and managing wastes throughout the mine life cycle.[19] Re: 4.1.4.2.b, alternatives assessments should identify all possible (i.e., reasonable, conceivable, and realistic) mine waste facility locations, disposal technologies, waste storage options and disposal locations. As described by Environment Canada and the Mining Association of Canada, at this early stage it is imperative that no a priori judgments be made about any of the alternatives. (Environmental Canada, 2016; MAC, 2017, p. 46) The government of British Columbia, in the wake of the Mt. Polley tailings dam failure, developed the following guidance (Government of BC, 2016, pp. 12, 13), which IRMA strongly recommends companies utilize when assessing options for mine waste management in order to protect human health, safety and the environment: • Physical stability is of paramount importance, and options that require a compromise to physical stability should be discarded, • Facilities should be chemically and biologically stable, or be	This requirement is intended to address chemical and physical risks and the mitigation of those through waste facility siting and waste management practices. As the risks for brine and process solution facilities will generally be less significant than for most hardrock mining waste facilities, the alternatives assessment can also be less rigorous than described by this section. For example, a document describing the siting rationale, including why no alternatives were considered, may be considered adequate to meet this requirement, if facility and other operational risks are considered low.

[17] Ibid.
[18] Adapted from Environment Canada. 2016. Guidelines for the Assessment of Alternatives for Mine Waste Disposal. https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal/chapter-2.html and Mining Association of Canada. 2017. Guide to the Management of Tailings Facilities, p. 46. http://mining.ca/sites/default/files/documents/MAC-Guide-to-the-Management-of-Tailings-Facilities-2017.pdf.
[19] Mining Association of Canada (MAC). 2017. A Guide to the Management of Tailings Facilities (3rd Ed). http://mining.ca/documents/guide-management-tailings-facilities-third-edition

levels and hazard evaluations, associated with each alternative; e. Include a sensitivity analysis to reduce potential that biases will influence the selection of final site locations and waste management practices; and f. Be repeated, as necessary, throughout the mine life cycle (e.g., if there is a mine expansion or a lease extension that will affect mine waste management).		designed to mitigate transport of contaminants into the receiving environment, • Footprint areas of the facility should be minimized, • In-pit or underground backfill should be maximized, • Impacts to receiving environments should be minimized, • Post-closure land use objectives should be defined, including ecosystems support and productive uses for future generations where possible, • All available technologies should be considered, • Efforts to reduce and remove water from containment within tailings facilities should be made, • Alternatives to water covers should be considered in planning stages. Re: 4.1.4.2.c, the purpose of screening is to eliminate alternatives with "fatal flaws" from further consideration and develop a short list of alternatives for more detailed assessment. Re: 4.1.4.2.d, Multiple accounts analysis (MAA) is a tool that is used to support decision-making related to the tailings planning and design process. For more information on Multiple Accounts Analysis, see MAC Tailings Guide, 2017, Appendix 3.[20] Note that "project economics" must include not only capital and operating costs over life of mine but also closure and post-closure costs. Re: 4.1.4.2.e, any decision-making process is subject to bias and subjectivity. The goal of sensitivity analysis is to transparently manage bias and subjectivity to the point where an external reviewer would agree that the decision is justifiable and reasonable, irrespective of their own value system.[21]	
4.1.5. Mitigation of Risks and Management of Mine Waste	Yes	Explanatory Note for 4.1.5.1: Mining companies or organizations or governments across the world may have developed internal	Currently, we do not have Guidance developed on BAT/BAP for brine and process solution facility design and mitigation

[20] Mining Association of Canada (MAC). 2017. A Guide to the Management of Tailings Facilities (3rd Ed). http://mining.ca/documents/guide-management-tailings-facilities-third-edition
[21] Environment Canada. 2016. Guidelines for the Assessment of Alternatives for Mine Waste Disposal. https://www.canada.ca/en/environment-climate-change/services/managing-pollution/publications/guidelines-alternatives-mine-waste-disposal/chapter-2.html

Management Facilities 4.1.5.1. (Critical Requirement) Mine waste facility design and mitigation of identified risks shall be consistent with best available technologies (BAT) and best available/applicable practices (BAP).		standards or guidelines that are similar in nature, or aligned with BAP in this area, and adherence to these is acceptable as long as best practice is implemented. Re: BAT, there are several reference documents that contain useful information including, for example: European Commission (2009)[22] and MEND (2017).[23] Best industry design criteria have been used for tailings dams and other structures that may be subject to catastrophic failures, and that the criteria have been designed to prevent catastrophic events during operations and post-closure. Examples of industry accepted quality guidelines include ANCOLD,[24] CDA,[25] or equivalent.	measures. For the purposes of this requirement, to receive full marks companies will be expected to provide reasonable justification to auditors for why the design and mitigation approaches are considered to align with BAT/BAP. Auditors will be expected to reference the justification (or give specific examples of guidance or best practices implemented at the site in their narrative/basis for rating) so that stakeholders can understand what practices have been followed or implemented.
4.1.5.2. Mitigation of chemical risks related to mine waste facilities shall align with the mitigation hierarchy as follows: a. Priority shall be given to source control measures to prevent generation of contaminants; b. Where source control measures are not practicable or effective, migration control measures shall be implemented to prevent or minimize the movement of contaminants to where they can cause harm; and c. If necessary, MIW shall be captured and treated to remove	Yes	Explanatory Note for 4.1.5.2: The mitigation hierarchy prioritizes avoidance or prevention of impacts, and if that is not technically feasible or practicable then moves to minimization of impacts, then restoration/rehabilitation of impacted areas, and finally, if impacts remain, requires compensation, or offsetting, for ecological impacts. (See full definition of mitigation hierarchy for more information) Source control is given priority because it combines efforts to prevent the formation of contamination (e.g., measures to prevent sulfur oxidation and generation of acid rock drainage) and formation and migration of leachate. Source control typically involves the use of chemical mitigation such as neutralizing agents and more commonly geosynthetic liners and covers and/or store and release soil covers to prevent oxygen and and meteoric water infiltration.	There may be chemical risks related to brine and process solution facilities, so this requirement is relevant. Re: 4.1.5.2.a, source control measures are not generally applicable to brine and process facilities, so this does not need to be factored into the assessment. Re: 4.1.5.2.b, migration control measures for spills and leakage can be implemented, if necessary, such as pond liners, leak detection and mitigation, and double-containment. Re: 4.1.5.2.c, brine and process solutions are considered to be MIW (see Guidance for 4.1.3.2). If brine or process solutions escape containment they should be captured and treated if required before water is discharged or used for other purposes.

[22] European Commission. 2009. Reference Document on Best Available Techniques for the Management of Tailings and Waste-Rock in Mining activities. http://eippcb.jrc.ec.europa.eu/reference/BREF/mmr_adopted_0109.pdf
[23] MEND Secretariat. 2017. Study of Tailings Management Technologies. Mine Environment Neutral Drainage (MEND) Project Report 2.50.1. Prepared by Klohn Crippen Berger. http://mend-nedem.org/wp-content/uploads/2.50.1Tailings_Management_TechnologiesL.pdf
[24] Australian National Committee on Large Dams (ANCOLD). Visit www.ancold.org.au.
[25] Canadian Dam Association. Dam Safety Guidelines. 2007. See also, Application of Dam Safety Guidelines to Mining Dams. 2014. Both publications are available at: www.imis100ca1.ca/cda/Main/Publications/Dam_Safety/CDA/Publications_Pages/Dam_Safety.aspx?hkey=52124537-9256-4c4b-93b2-bd971ed7f425

contaminants before water is returned to the environment or used for other purposes.		Migration control does not stop contaminant generation, but aims to minimize the impacts on the environment by physically containing contaminants (e.g., using a pumpback system). Capture and treatment is also a method to minimize impacts on the environment by capturing and removing pollutants from contaminated waters. The lower tiers of the mitigation hierarchy, i.e., restoration or rehabilitation of impacted areas and compensation for residual impacts are not explicitly required here. Mines that have impacts requiring restoration/rehabilitation and/or compensation for residual impacts should refer to the requirements in other IRMA chapters (e.g,. Chapters 2.6, 4.2 and 4.6). Re: 4.1.5.2.c, it may not always be necessary to treat mining impacted waters (MIW) prior to re-use. For example, recycling of MIW for use in ore processing may not require any treatment.	
4.1.5.3. For high-consequence rated mine waste facilities, a critical controls framework shall be developed that aligns with a generally accepted industry framework, such as, for example, the process outlined in Mining Association of Canada's Tailings Management Guide.[26]	Maybe	Explanatory Note for 4.1.5.3: A critical controls framework should be developed for all mine waste facilities that have a high-consequence rating (see 4.1.3.3.c for a related requirement). These ratings should be based on the consequences of unwanted events or failures, as opposed to the risk (i.e., probability is ignored in the development of the consequence rating). Mine waste facilities with a high consequence rating would include those where the consequences of unwanted events or potential catastrophic failures could lead to unacceptable short or long-term impacts on human health, safety, environmental resources or cultural resources, or lead to economic losses for communities and financial and/or reputational damage to companies (e.g., a tailings facility where a breach could result in loss of life and property; a water treatment facility that could cause fish kills if unwanted releases of contaminated water were to occur, or that could affect the environment and water supplies in perpetuity If funding to operate the facility was to cease, etc.).	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[26] Mining Association of Canada. 2017. A Guide to the Management of Tailings Facilities (Third Ed). Section 4.4.3. http://mining.ca/documents/guide-management-tailings-facilities-third-edition

		The Mining Association of Canada's (MAC) Guide to the Management of Tailings Facilities says that processes for management of critical controls should be implemented, the key elements of which are as follows:[27] Identify risk controls associated with potential failure modes and causes; Identify those risk controls deemed to be critical on an owner or facility-specific basis; Appoint a "risk owner" and "critical control owner" for that risk; Define the critical controls and their performance criteria, measurable performance indicators, and surveillance requirements; Identify pre-defined actions to be executed if control is lost; Verify execution of critical controls by the critical control owner or designate, at a frequency commensurate with the frequency of control execution; Report deficiencies in critical controls to the Responsible Person(s) and, where appropriate, the Accountable Executive Officer, and identify actions to address those deficiencies; Track implementation of actions to address critical control deficiencies, and report to the Responsible Person(s) and, where appropriate, the Accountable Executive Officer; and Periodically review and update risk controls and critical controls, based on updated risk assessments, risk management plans, and past performance.	
4.1.5.4. Mine waste management strategies shall be developed in an interdisciplinary and interdepartmental manner and be informed by site-specific	Yes	Explanatory Note for 4.1.5.4: "Interdisciplinary" in this context means that mine waste management strategies may need the input and interaction of personnel with different expertise, such as geochemists, hydrogeologists, hydrologists, and geotechnical experts. For example, hydrogeological modeling can provide	This requirement is relevant, as management strategies, even for brine and process solution facilities, should always be developed in an interdisciplinary manner and be informed by site-specific characteristics and modeling (e.g., see 4.1.3.5).

[27] Mining Association of Canada. 2017. A Guide to the Management of Tailings Facilities (Third Ed). p. 24. http://mining.ca/documents/guide-management-tailings-facilities-third-edition

characteristics, modeling and other relevant information.		critical information on the necessity for different approaches to waste management (e.g., whether or not acid generation/metals leaching will occur). “Interdepartmental” in this context means that development of mine waste management strategies may need the input and interaction of several relevant business or operational departments or unit at the mine site (e.g., those responsible for ore processing will need to be involved, at least for some aspects of the risk management strategies. Also, if mine water is managed with tailings, then those responsible for ore extraction operations my also need to be involved). It is assumed that if operating company has carried out facility-specific source material characterization, developed facility-specific conceptual models and water and chemistry mass balances, evaluated physical risks posed by each facility, and carried out risk assessments for each relevant mine waste facility.	
4.1.5.5. The operating company shall develop an Operation, Maintenance and Surveillance (OMS) manual (or its equivalent) aligned with the performance objectives, risk management strategies, critical controls and closure plan for the facility, that includes: a. An operations plan that documents practices that will be used to transport and contain wastes, and, if applicable, effluents, residues, and process waters, including recycling of process waters;[28]	Yes	Explanatory Note for 4.1.5.5: Re: 4.1.5.5.a, some of the water-related issues may be covered in the adaptive management plan for water (or its equivalent) as per IRMA Chapter 4.2 (see requirement 4.2.4.4). The general requirements for an Operation, Maintenance and Surveillance (OMS) manual are provided by the Mining Association of Canada (MAC, 2011).[29] MAC is currently revising this guidance and the new guidance when published should be used.	An operations, maintenance and surveillance plan, or its equivalent, should be in place for any waste facility. The level of detail can be commensurate to the risks to health, safety or the environment.

[28] Some of the water-related issues may be covered in the Adaptive Management Plan for water (or its equivalent) as per IRMA Chapter 4.2 (see requirement 4.2.4.4).
[29] Mining Association of Canada (MAC). 2011. Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities. http://mining.ca/sites/default/files/documents/DevelopinganOMSManualforTailingsandWaterManagementFacilities2011.pdf

b. A documented maintenance program that includes routine, predictive and event-driven maintenance to ensure that all relevant parameters (e.g., all civil, mechanical, electrical and instrumentation components of a mine waste facility) are maintained in accordance with performance criteria, company standards, host country law and sound operating practices; c. A surveillance program that addresses surveillance needs associated with the risk management plan and critical controls management, and includes inspection and monitoring of the operation, physical and chemical integrity and stability, and safety of mine waste facilities, and a qualitative and quantitative comparison of actual to expected behavior of each facility; d. Documentation of facility-specific performance measures as indicators of effectiveness of mine waste management actions; and e. Documentation of risk controls and critical controls (see also 4.1.5.3), associated performance criteria and indicators, and descriptions of pre-defined actions to be taken if performance criteria are not met or control is lost.			
4.1.5.6. (Critical Requirement) On a regular basis, the operating company shall evaluate the	Yes	Explanatory Note for 4.1.5.6: Re: on a regular basis: "Performance evaluation occurs at various timescales, from hourly or daily, to annual or more, depending on the aspect of performance being	This requirement is relevant, as the performance of all facilities that have the potential to discharge contaminants to the

performance of mine waste facilities to: a. Assess whether performance objectives are being met (see 4.1.4.2.a and 4.1.4.5.c); b. Assess the effectiveness of risk management measures, including critical controls (see 4.1.4.5.e); c. Inform updates to the risk management process, (see 4.1.4.1.c) and the OMS (see 4.1.4.7); and d. Inform the management review to facilitate continual improvement (see 4.1.4.8).		evaluated."[30] Performance evaluations related to high-risk facilities should occur at least once per year, although for some performance objectives related to these facilities evaluations may need to be more frequent. Re 4.1.5.6.a, performance objectives and measurable indicators should be documented in the Operation, Maintenance and Surveillance (OMS) manual or an equivalent document that outlines mine waste management plans and actions. According the Mining Association of Canada, "The OMS manual documents facility-specific performance measures as indicators of progress on management actions and objectives. These measures include technical performance indicators as well as indicators tied to management actions, including maintenance activities."[31] Performance criteria, measurable indicators and surveillance requirements should be developed for all risk management measures (e.g., risk controls and critical controls).[32] Re: 4.1.5.6.b, typically the determination of whether or not mine waste facilities are being effectively operated or maintained is made as a result of internal surveillance (e.g., inspections and monitoring), or external input (e.g., regulatory inspections). According to the Mining Association of Canada, "Surveillance involves inspection and monitoring of the operation, structural integrity and safety of a facility. It consists of both qualitative and quantitative comparison of actual to expected behaviour. Regular review of surveillance information can provide an early indication of performance trends that, although within specification, warrant further evaluation or action."[33] Re 4.1.5.6.c, updates to the risk management process include updates to the risk assessments (as per 4.1.4.1.c) and the Operation, Maintenance and Surveillance manual (as per 4.1.5.7). If	environment or that may pose potential risks to human health or safety should be evaluated on a regular basis.

[30] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 34. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf
[31] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 25. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf
[32] Ibid. pp. 24, 25.

[33] Mining Association of Canada (MAC). 2011. Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities. Section 7-1. http://mining.ca/sites/default/files/documents/DevelopinganOMSManualforTailingsandWaterManagementFacilities2011.pdf

		current risk management measures and controls are not effectively minimizing risks associated with mine waste facilities (e.g., if physical or chemical risks such as instability, unanticipated seeps from wastes, overtopping of impoundments, etc. are present despite mitigation measures) then there may be the need to carry out additional risk assessment and/or revise management strategies in the OMS.	
4.1.5.7. The OMS manual shall be updated and new or revised risk and critical control strategies implemented if information reveals that mine waste facilities are not being effectively operated or maintained in a manner that protects human health and safety, and prevents or otherwise minimizes harm to the environment and communities.	Yes	Explanatory Note for 4.1.5.7: As mentioned in the notes for 4.1.5.6, typically the determination of whether or not mine waste facilities are being effectively operated or maintained is made as a result of internal surveillance (e.g., inspections and monitoring), or external input (e.g., regulatory inspections). According to the Mining Association of Canada (MAC): "Surveillance involves inspection and monitoring of the operation, structural integrity and safety of a facility. It consists of both qualitative and quantitative comparison of actual to expected behaviour. Regular review of surveillance information can provide an early indication of performance trends that, although within specification, warrant further evaluation or action."[34] For example, performance or stability of a waste facility may be affected if tailings characteristics begin to deviate from design specifications. In addition to looking for deviations from expected behavior, the operating company should have developed actual performance criteria or indicators for mine waste facilities. According to MAC: "The OMS manual documents facility-specific performance measures as indicators of progress on management actions and objectives. These measures include technical performance indicators as well as indicators tied to management actions, including maintenance activities."[35]	This requirement is relevant, as OMS manual or equivalent plans and mitigation strategies for all waste facilities should be reviewed for effectiveness, and updated, if necessary.

[34] Mining Association of Canada (MAC). 2011. Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities. Section 7-1. http://mining.ca/sites/default/files/documents/DevelopinganOMSManualforTailingsandWaterManagementFacilities2011.pdf

[35] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 25. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf

		If, through surveillance or some other means (e.g., input from government inspectors, grievances from workers or stakeholders) a company becomes aware that it is not meeting its performance criteria or objectives, the company would be expected to develop new or revised risk controls and critical control strategies. Mines that suggest no evidence of operational or maintenance issues would be considered exceptional. In most cases mines will have some history of these issues and should be able to demonstrate how changes were implemented to address them.	
4.1.5.8. The operating company shall implement an annual management review to facilitate continual improvement of tailings storage facilities and all other mine waste facilities where the potential exists for contamination or catastrophic failure that could impact human health, safety, the environment or communities. The review shall: a. Align with the steps outlined in the Mining Association of Canada's Tailings Management Protocol[36] or a similar framework; and b. Be documented, and the results reported to an accountable executive officer.	Maybe	Explanatory Note for 4.1.5.8: Re: 4.1.5.8.a, the review should align with the Mining Association of Canada's (MAC) Tailings Management Protocol (indicator 4) and Guide to the Management of Tailings Facilities, i.e., "Guide" (Section 7). See also the MAC Tailings Management Protocol Table of Conformance for more information on steps in the review process.[37] Although the MAC protocol and guidance are specific to tailings facilities, IRMA expects that a similar review would take place for any mine waste facility where the potential exists for contamination or catastrophic failure that could impact human health, safety or the environment. According to the MAC Guide: "the management review should identify and evaluate the potential significance of changes since the previous management review that are relevant to the tailings management system, including: • Changes to regulatory requirements, standards and guidance, industry best practice, and commitments to communities of interest; • Changes in mine operating conditions (e.g., production rate) or site environmental conditions; • Changes outside the mine property that may influence the nature and significance of potential impacts resulting from the tailings facility on the external environment or vice versa; and	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[36] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf
[37] In particular, see MAC Draft Tailings Management Table of Conformance (June 2017) or any final version, for the steps that should take place in the annual management review.

		• Changes in the risk profile of the tailings facility. The management review should also provide a summary of significant issues related to the overall performance of the tailings facility and tailings management system, updated since the previous management review."[38] Re: 4.1.5.8.b, according to the MAC Guide "the management review for continual improvement is reported to the Accountable Executive Officer to ensure that the Owner is satisfied that the tailings management system is effective and continues to meet the needs of the facility."[39] An accountable executive officer is someone designated by the company's Board of Directors or other governance body to be responsible for tailings management. According to the Mining Association of Canada, this person should:[40] Be aware of key outcomes of tailings facility risk assessments and how these risks are being managed; Have accountability and responsibility for putting in place an appropriate management structure; Assign responsibility and appropriate budgetary authority for tailings management and define the personnel duties, responsibilities and reporting relationships, supported by job descriptions and organizational charts, to implement the tailings management system through all phases in the facility life cycle; and Provide assurance to the operating company Board or governance body and communities of interest that tailings or other mine waste management facilities are managed responsibly.	

[38] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. Section 7. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf
[39] Ibid.
[40] Ibid. p. 20.

4.1.6. Independent Review of Mine Waste Management Facilities 4.1.6.1. The siting and design or re-design of tailings storage facilities and other relevant mine waste facilities,[41] and the selection and modification of strategies to manage chemical and physical risks associated with those facilities shall be informed by independent reviews throughout the mine life cycle.[42]	Maybe	Explanatory Note for 4.1.6.1: All tailings storage facilities must meet this requirement. Other "relevant facilities" would include mine waste facilities where the potential exists for contamination or catastrophic failure that would result in impacts on human health, safety, the environment, or the livelihoods of communities. Independent reviews should occur during all life-cycle stages of facility, from concept to post-closure. The frequency of reviews should be commensurate with the risks/consequences related to the facility. At minimum, independent technical review should happen when there are any changes to facility designs or operations, or modification to waste management practices that could affect the chemical or physical stability of the facility.	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.
4.1.6.2. Reviews shall be carried out by independent review bodies, which may be composed of a single reviewer or several individuals. At high-risk mine waste facilities, a panel of three or more subject matter experts shall comprise the independent review body.	Maybe	Explanatory Note for 4.1.6.2: For the purposes of this requirement, "high-risk facilities" are, at minimum, those where a breach could result in inundation of residence(s) and loss of life (on or off property).[43] According to the Mining Association of Canada, the particular expertise of the subject matter experts who make up the independent review bodies will vary based on the risks posed by the facility. For example: "At high-risk facilities, (where a breach could plausibly result in inundation of residence(s) and loss of life) a panel of three or four subject-matter experts with different but complementary areas of expertise and experience may be required to cover the various disciplines associated with management of the facility (e.g., geotechnology, hydrology, hydrogeology, and geochemistry). In other instances, temporary [independent review (IR)] involvement	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[41] Relevant facilities would be other mine waste facilities where the potential exists for catastrophic failure that would result in impacts on human health, safety, the environment, or the livelihoods of communities
[42] Independent reviewers should not be directly involved with the design or operations of the facility; but rather, should review all key documents and information, analyses, design values and conclusions related to the decisions made by others.
[43] Adapted from MAC, 2017, p. 58. Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf

		for niche disciplines (e.g., paleo seismology, seismic hazard assessment) outside the expertise of the core IR body may be required. Redundancy of technical disciplines within the IR body should be considered in accordance with a facility's risk profile."[44]	
4.1.6.3. Independent reviewers shall be objective, third-party, competent professionals.	Maybe	Explanatory Note for 4.1.6.3: Independent reviews should be carried out by competent professionals and/or internationally recognized subject matter experts who are not employed at the mining project, are not directly involved with the design or operations of the facility, and do not have any other relevant conflict of interest. The Mining Association of Canada includes the following description based on Robertson and Shaw (2003): "the reviewer generally reviews all key documents and does at least "reasonableness of results" checks on key analyses, design values, and conclusions. Design, construction and operational procedures are reviewed at a level sufficient to develop an independent opinion of the adequacy and efficiency of the designs, construction and operations. The reviewer generally relies on the representations made to the reviewer by key project personnel, provided the results and representations appear reasonable and consistent with what the reviewer would expect. A review report is produced which documents the reviewer's observations as to the adequacy of the design, construction and operations and indicates any recommendations that flow from these."[45]	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.
4.1.6.4. Independent review bodies shall report to the operation's general manager and an accountable executive officer of the operating company or its corporate owner.	Maybe	Explanatory Note for 4.1.6.4: There may be a process in place for the independent review body to report directly to a mining project representative who is not the general manager (e.g., the environmental manager who reports to the operation's general manager). If that is the case, it would be acceptable, as long as the results are also shared with the general manager and an accountable executive officer.	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[44] Ibid. p. 58.
[45] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 57. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf

		An accountable executive officer is someone designated by the company's Board of Directors or other governance body to be responsible for tailings management. According to the Mining Association of Canada, this person should:[46] Be aware of key outcomes of tailings facility risk assessments and how these risks are being managed; Have accountability and responsibility for putting in place an appropriate management structure; Assign responsibility and appropriate budgetary authority for tailings management and define the personnel duties, responsibilities and reporting relationships, supported by job descriptions and organizational charts, to implement the tailings management system through all phases in the facility life cycle; and Provide assurance to the operating company's Board or governance body and communities of interest that tailings or other mine waste management facilities are managed responsibly.	
4.1.6.5. The operating company shall develop and implement an action plan in response to commentary, advice or recommendations from an independent review, document a rationale for any advice or recommendations that will not be implemented, and track progress of the plan's implementation. All of this information shall be made available to IRMA auditors.[47]	Maybe	Explanatory Note for 4.1.6.5: This requirement is based on guidance from the Mining Association of Canada.[48] Non-disclosure agreements will be signed by IRMA auditors, but even so, confidential business information may be withheld as long as the company provides to auditors a description of the confidential information or materials that are being withheld and an explanation of the reasons for classifying the information as confidential; and if a part of a document is confidential, only that confidential part shall be redacted, allowing for the release of non-confidential information. (See IRMA Chapter 1.1, requirement 1.1.6.4)	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[46] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 20. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf
[47] See Explanatory Note for 4.1.6.3 for more information.
[48] Ibid. p. 59.

		In the interest of transparency and accountability, independent review findings and recommendations could also be shared publicly (e.g., summarized for public disclosure in a manner that protects confidential information).	
4.1.7. Stakeholder Engagement in Mine Waste Management 4.1.7.1. Stakeholders shall be consulted during the screening and assessment of mine waste facility siting and management alternatives (see 4.1.4.2), and prior to the finalization of the design of the facilities.	Maybe	Explanatory Note for 4.1.7.1: At existing mines, where waste facility screening, siting and assessment of facilities occurred without stakeholder engagement, mines will not be expected to have met this requirement. But given the attention and concern over the potential for catastrophic failure of mines waste facilities, mines will be expected to have informed stakeholders about the current design and management of mine waste facilities. And if there are any new waste management facilities proposed, mines will be expected to conform with this requirement. It is possible that screening and assessment of mine waste facility siting and management alternatives will take place as part of the Environmental and Social Impact Assessment (see Chapter 2.1). However, it is important that stakeholders be engaged specifically on mine waste facility siting and management alternatives, which may or may not always occur during an ESIA. If outreach occurred, but no stakeholders participated, mines should be able to demonstrate that they at least made good faith efforts to carry out stakeholder consultation on these issues. According to the Mining Association of Canada, "There are a number of aspects that are important for an effective alternatives assessment. . . External input is required through the steps described above. Input of [communities of interest (COI)], including regulators, informs the process, and Independent Reviewers should also be engaged."[49] Communities of interest should also be engaged during the screening of alternatives, detailed assessment of alternatives, and facility definition/final design of tailings facility.[50]	As in the Explanatory Note for 4.1.7.1, at existing lithium brine operations where brine or process solution facility screening, siting and assessment occurred without stakeholder engagement, operations can mark this as not relevant, unless there are any new brine or process solution facilities or other waste management facilities being proposed. In that case, operations will be expected to conform with this requirement.

[49] Ibid. p. 47.
[50] Ibid. p. 48.

		The Mining Association of Canada defines communities of interest as: ". . .all individuals and groups who have an interest in, or believe they may be affected by, decisions respecting the management of operations. They include, but are not restricted to: employees; Aboriginal or Indigenous peoples; mining community members; suppliers; neighbours; customers; contractors; environmental organizations and other non-governmental organizations; governments; the financial community; and shareholders.[51] This is similar to IRMA's definition of stakeholders, i.e., "Persons or groups who are directly or indirectly affected by a project, such as rights holders, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively." The appropriate stakeholders will vary from mine to mine, but should include host governments, rights holders such as indigenous peoples if present, representatives from potentially affected communities (e.g., local emergency response providers, local governments, public health agencies), and people living close to the mine. Other stakeholders might include NGOs, academics, investors, or other with an interest in responsible mine waste management.	
4.1.7.2. Emergency preparedness plans or emergency action plans related to catastrophic failure of mine waste facilities shall be discussed and prepared in consultation with potentially affected communities and workers and/or workers' representatives, and in collaboration with first responders and relevant	Yes	Explanatory Note for 4.1.7.2: As described by the Mining Association of Canada, "an emergency preparedness and response plan is an essential component of a tailings management system. This plan should be developed in collaboration with local first responders, [communities of interest], and relevant regulators, and is an important component of an effective communications strategy."[52] IRMA Chapter 2.5 is the primary chapter that addresses Emergency Preparedness and Response related to mining projects. However, fatalities in downstream communities from	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[51] Ibid. p. 4.
[52] Ibid. p. 28.

government agencies. (See also IRMA Chapter 2.5)		tailings facility failures underscore the critical need to include community representatives in emergency preparedness and response planning related to mine waste facilities. Consequently, emergency preparedness and response requirements have also been included in Chapter 4.1. Emergency preparedness plans may go by other names (e.g., emergency preparedness and response plans., emergency action plans, etc.). These plans should be developed and documented for each mine facility that may be associated with waste discharges or incidents, including catastrophic failures, that could lead to impacts on human safety or the environment. The facility-level plans may be separate documents but they should all be integrated with the overall site-level emergency response plan. The overall mine site emergency response plan, in turn, should be integrated into any Community Preparedness Plans developed to address all potential types of emergencies (i.e., not just mining) in a community. See Chapter 2.5 and resources mentioned in that chapter for examples of relevant government agencies to include in the planning process.	
4.1.7.3. Emergency and evacuation drills (desktop and live) related to catastrophic failure of mine waste facilities shall be held on a regular basis. (See also IRMA Chapter 2.5)	Yes	Explanatory Note for 4.1.7.3: One of the key elements of an emergency response plan is "alerting the public and coordinating evacuation using sirens or other warnings; well-rehearsed warnings, evacuation procedures and easily reached shelters."[53] The United Nations has developed an Awareness and Preparedness for Emergencies at the Local Level (APELL) for Mining, which is the basis for IRMA Chapter 2.5. The UN APELL states that: "Initial testing [of the emergency response plan] should take place without involving the public, to uncover deficiencies in coordination among groups and in the training that has taken place so far." They add, however, that "Nothing can	For brine and other process solution facilities, this requirement is not relevant unless a credible risk to human health, safety, the environment or communities has been identified as per 4.1.3.3, i.e., the facility is deemed a "high-consequence rated" waste facility.

[53] United Nations Environment Programme (UNEP). 2001. Awareness and Preparedness for Emergencies at the Local Level (APELL) for Mining. (Technical Report 41). p. 25. http://www.unep.fr/shared/publications/pdf/WEBx0055xPA-APELLminingEN.pdf

		replace a full scale emergency drill as a means of identifying further areas for improvement."[54] The UN APELL also provides guidance on emergency drills and informing communities about evacuation procedures.[55] There is no definition of "regular basis," as the frequency of drills should be commensurate with the risks posed by a catastrophic failure of a mine waste facility. As a rule of thumb, however, the Mining Association of Canada's Crisis Management and Communications Protocol requires that "table top" crisis simulations exercises be conducted annually, and that full crisis simulations are conducted every three years at mining facilities.[56] MAC provides guidance and examples of crisis simulations.[57]	
4.1.7.4. If requested by stakeholders, the operating company shall report to stakeholders on mine waste facility management actions, monitoring and surveillance results, independent reviews and the effectiveness of management strategies.	Yes	Explanatory Note for 4.1.7.4: Engagement with stakeholders or "communities of interest" (COI) plays an important role in the effective implementation of a mine waste management strategies. According to the Mining Association of Canada (MAC), "Such engagement is two-way, providing COI with opportunity to ask questions about tailings management, provide information, and express their concerns. It is also an opportunity for the Owner [or operating company] to respond to proactively provide information, and address concerns and questions as they arise."[58] As per IRMA Chapter 1.2, there may be limits to what is reported to stakeholders. That chapter says that any information that relates to the mine's performance against the IRMA Standard must be made available to relevant stakeholders upon request, unless the operating company deems the request to be unreasonable or the information requested is legitimate confidential business information. If part of a document is confidential only that confidential part can be redacted, allowing	This is relevant. If a stakeholder requests information about the management of a brine or process solution facility the company would be expected to provide the stakeholder with that information.

[54] United Nations Environment Programme (UNEP). 2001. Awareness and Preparedness for Emergencies at the Local Level (APELL) for Mining. (Technical Report 41). p. 29. http://www.unep.fr/shared/publications/pdf/WEBx0055xPA-APELLminingEN.pdf
[55] Ibid. pp. 29-31.
[56] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 7. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf
[57] Ibid. pp. 29, 30.
[58] Mining Association of Canada (MAC). 2017. Tailings Management Protocol. Towards Sustainable Mining. p. 4. http://mining.ca/sites/default/files/documents/TSM-Tailings-Management-Protocol-2017.pdf

		for the release of non-confidential information. Also, if original requests for information are deemed unreasonable, efforts must be made by the operating company to provide stakeholders with overviews or summaries of the information requested.	
4.1.8. Additional Considerations 4.1.8.1. (Critical Requirement) At the present time, mine sites using riverine, submarine and lake disposal of mine waste materials will not be certified by IRMA.	Yes	Explanatory Note for 4.1.8.1: The definition of rivers and streams includes watercourses that are perennial (flow year-round) and intermittent (flow for part of the year). It does not include water courses that are ephemeral (flow only in response to precipitation). Lake is defined as any permanent, non-flowing body of water surrounded by land. Submarine tailings disposal is also sometimes referred to as marine disposal of mine tailings or deep sea tailings placement. It refers to disposal of mine tailings into marine waters via a pipeline. According to a report prepared for the International Maritime Organization, "Marine disposal is no longer practiced along shorelines in shallow water."[59] At the present time neither shallow nor deep sea tailings placement is allowed by IRMA. IRMA's leadership believes that riverine tailings disposal is not consistent with IRMA's guiding principles. IRMA participants have divergent views on the issue of waste disposal into lakes and oceans. Further work is required to determine the specific requirements under which such disposal methods could be considered, and we welcome contributions from interested parties to help advance this debate. If lake or marine disposal is occurring at existing mines, those mines may still be scored against the IRMA Standard, but at the present time they will not be considered eligible for certification when IRMA certification begins in 2019. IRMA encourages feedback on this current position.	This applies to brine and process solution disposal into rivers, oceans/seas or lakes. If operations use such disposal practices, they will not meet this requirement.

[59] International Maritime Organization (IMO) and United Nations Environment Programme (UNEP). 2013. International Assessment of Marine and Riverine Disposal of Mine Tailings. p. 9. http://www.imo.org/en/OurWork/Environment/LCLP/newandemergingissues/Documents/Mine%20Tailings%20Marine%20and%20Riverine%20Disposal%20Final%20for%20Web.pdf